Enhancing motivation and satisfaction of students: analysis of quantitative data in three subjects of Industrial Engineering

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Abstract: - Many lecturers question the necessity to incorporate changes in the methodology of their subjects and the lack of instruments to verify if the changes that these active methodologies have a desirable effect. In this sense, the validation of the JDS adapted to university teaching, allow to fill up this deficiency. Any lecturer that want to know the satisfaction of students with his teaching, have with this tool a robust procedure that can complement or clarify the information that arrives by the student's surveys or other sources. The model consists of seven scales that measure the characteristics of the job as well as an indicator of the motivate profile of the work (MPS) and six scales of satisfaction with diverse aspects of the job. The scales vary significantly when we compared the data obtained from an experimental group with active methodologies teaching with respect to two control groups with traditional teaching. The adapted version of JDS scales has suitable values of internal consistency. Only the models hypothesized with correlated factors, display accepted values respect to the reliability of construct and the variance extracted and also the best values of goodness-of-fit indicators.

Key-Words: - Teamwork methodologies, student perceptions, engineering students.

1 Introduction

Different studies suggest that students' motivation for learning and academic performance can be analyzed in a similar way to the enterprise world, due to analogy between the world of the company and the academic world. In identifying the major structural characteristics of course design and understanding their relationships to motivation, performance and satisfaction between the classroom environment and teaching strategies can be evaluated with the JDS adapted to university teaching.

The Job Diagnostic Survey (JDS) is one of the instruments of diagnosis used in the enterprise world to guide the transition from a traditional job to an enriched one. Many researches have been conducted to evaluate the effect of job changes, to understanding job design-employee response relationships, in order to improve employee productivity and satisfaction. Hackman and Oldhams's [1] is currently the most widely used measure of job design, which was develop to asses job characteristics across different levels and organizations. But, recently different studies have questioned about design measurement of JDS, its dimensionality and construct validity.

The objective in this investigation is to construct an adapted version of the JDS to the context of teaching, to verify if this adaptation has suitable psychometrics properties and if we can use it to guide the process of transition of traditional teaching towards a more active educational methodology.

The rest of the paper is structured as follows. Section 2 analyzes the theoretical framework. The methodology used in our research is explained in section 3. Section 4 shows the discussion of our results. Finally, section 5 gives our conclusions.

2 Theoretical Framework

2.1 Active methodologies

Various sources have propounded the advantages offered by considering a teamwork-based methodology with university students. On the one hand, it enables students to experiment and acquire the skills that they will need in their future jobs. Some of these skills are: interpersonal communication, teamwork, group problem-solving, leadership, negotiation and time management [2-13]. On the other, teamwork used in a context of active methodologies provides profounder and more significant learning. In addition, positive effects have been shown on the academic performance of students, motivation and their attitudes towards learning [6; 9; 13-18]. Nevertheless, university lecturers perceive certain deficiencies and the lack of information about the true advantages and disadvantages of this type of methodologies, especially when comparing them with the traditional methodologies, based on classes mostly lectures [19].

Everyday is more frequent to find opinions about the necessity to increase to the level of participation of the students in the process of learning [7; 18; 20]. A way to obtain it is redesigning it the way in which the students make their tasks in class [21; 22].

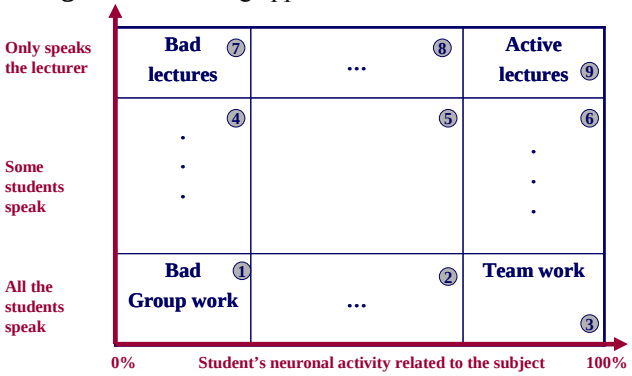
Active learning shifts the focus of content structuring from the teacher to the learner. By being actively involved in the shaping of the content, the learners gain a far better understanding of the information than they would otherwise have.

The opposite of active learning (i.e. passive learning) occurs when the teacher shapes the content for the students completely and provides that information to the student, usually in a lecture format. This information use to be given in logic, structured a lineal manner, with examples, solving problems on the blackboard, proposing tests and problems for homework and correcting this tasks given for homework. The student takes notes, memorizes the content, and feeds it back to the teacher for the test [14; 18; 23-25] Students only take and accept the information and the knowledge provided by the lecturer [18; 23]. Because of it, many people consider that passive learning encourages superficial learning to the students (memorizing and replying contents) [5; 24; 26]. However, complex learning that require comprehension, application, analysis, synthesis and critics to the content, needs an active participation of the student in the learning process. So he/she passes from receiving information to the knowledge evaluation and organization [27]. This manner of learning provides higher lasting knowledge retention [24].

In figure 1 we represent several teaching approaches. Between the propose alternatives to traditional teaching (cells 1, 4, and 7), we can find the active methodologies (cells 3, 6 and 9) [5; 18].

Cell 4 represents direct questions of the lecturer without engaging in student activity or forced participation in class (such as solving a problem in the dashboard). The active learning usually uses guided discussions by the professor (cell 9), participation of the students raising questions that are responded in the classroom or some kind of peer teaching or workshops (cell 6), work in group (cell 3) [4; 25; 28]. Cells 2, 5, and 8 represent a point between the extremes of the active methodologies continuum. The active participation of the student in the learning process, change the reception of information to the evaluation and organization of the knowledge [23].

Figure 1. Teaching approaches



2.2 JDS adapted to university teaching

In the last years many reflections about the analogy between the world of the company and the academic world are turned up. From diverse branches of the management of companies it is thinking about of applying their theories to manage a group as the university classes [28-33]. Even, from the pedagogic area are considering the possibility of understanding to the lecturer like a leader that manages a group of people [34].

This allows lecturers to be able to undertake actions of improvement its subjects, using models contrasted in other fields. If we consider that a company is a set of people with shared objectives and norms that regulate the behaviours [35; 36]. These three definite characteristics of which is considered a company are present in university teaching. For that reason we propose to consider our subjects like companies and use in them the human resources management tools.

One of these tools is the questionnaire JDS, that has been used to guide the process of redesign of jobs [37-39]. This process of redesign of jobs consists of providing the workers positions where they can feel active, participate in the decisions, imply themselves in the results and have a greater autonomy. Indeed, these are the behaviours wished in the students when active methodologies are implanted [7; 20; 40].

According to the terminology of this study, a "job" consists in one or more functions carried out by a person [41]. In a company there are so many jobs as contracted workers. We considered that this definition can be applied to the educational context if we consider "registered student in a subject" as "workers contracted in a company".

The job has a fixed requirements and characteristics (capacity of the job to motivate). So it is necessary for any person that would render in his position that he acquires the knowledge, abilities and attitudes necessary to fulfil the requirements of the position.

Table 1. Variables definition of the adapted model

Job characteristics	Adapted definition to educational context
Skill Variety (VAR)	The degree to which a job requires a variety of different activities in carrying out the work, which involve the use of a number of different skills and talents of the employee.
Task identity (ID)	The degree to which the job requires completion of a "whole" and identifiable piece of work.
Task significance (SIG)	The job has a substantial impact on the lives or work or affect their professional future..
Autonomy (AUT)	The degree to which the job provides substantial freedom, independence, and discretion to the student in scheduling the work and in determining the procedures to be used in carrying it out.
Feedback from the job itself (FJ)	The degree to which carrying out the work activities required by a subject results in the student's obtaining direct and clear information about the effectiveness of his or her performance.
Feedback from agents (FA)	The degree to which the student receives clear information about his or her performance from supervisors or from other students.
Dealing with others (DO)	The degree to which the job requires the student to work closely with others, inside and outside the subject, in the execution of subject activities.
Motivating Potential Score (MPS)	Provides a single indicator of the extent to which the first five job characteristics are present in a job.
Satisfaction	Adapted definition to educational context
General Satisfaction (GS)	An overall measure of the degree to which the student is satisfied and happy with the job.
Internal Work Motivation (IM)	The degree to which the student is self-motivated to perform effectively on the job-that is, the student experiences positive interna1 feelings when working effectively on the subject, and negative internal feelings when doing poorly.
Pay satisfaction (PS)	Refers to the degree of satisfaction with basic compensation and benefits (course marks) as well as satisfaction with the extent to which the marks relates to the individual's contribution to the organization.
Job security (JS)	Degree of satisfaction with the amount of general security experienced to pass the course.
Social satisfaction (SS)	The degree of satisfaction with other students with whom contact is made in the subject, as well as satisfaction with opportunities to get to know and to help people.
Supervisory (SUP)	The degree of satisfaction with the treatment, support and guidance received from supervisors (professors), as well as the degree to which the general quality of supervision is considered satisfactory.
Growth (GRW)	Growth-need strength refers to workers' needs for personal accomplishment, for learning, and for developing themselves beyond where they are at present.

But also it is necessary that his personality, interest and desires fit with the characteristics of the job for motivating the worker [27]. That is to say, the performance would come determined by the multiplication from a set of factors like attitudes, skills, understanding of the task, decision to use effort in the task, decision on the effort degree to use, decision to persist in the effort and other inhibiting conditions that is not under the control of oneself [42].

The redesign of jobs has the intention specify how the work would be made to optimize the achievement of the objectives for the company and to drive that the workers can feel satisfied making their work [41]. In our analogy, the redesign of the work is equivalent to design an active educational methodology.

In the enterprise world there is a traditional approach for the design of jobs that are based on obtaining the maximum simplification and possible functional specialization in each position [41]. In parallel, in the university educational world, there is a traditional approach that is based on the use of the expositive class like main educational instrument [11; 18], with the objective to maximize the capacity of transmission of knowledge from the lecturer to the students but it leaves of side some necessary personal and social aspects of learning.

3 Methodology

We have adapted the JDS questionnaire based on Spanish version [40; 43] of the original model [44] that continues being considered valid [39; 45; 46]. The model consists of seven scales that measure the characteristics of the job as well as an indicator of the motivate profile of the work (MPS) and six scales of satisfaction with diverse aspects of the job (table 1). The scales of the characteristics of the job are measured with three items valued in a Likert scale from 1 to 7. In each scale, one of items appears with anchorage phrases (i.e: To what extent does your job require you to work closely with other people, either students, professors or people out of the university)?

1. Very little; dealing with other people is not at all necessary in doing the job; ...;; 4. Moderately; some dealing with others is necessary; ...; 7. Very much; dealing with other people is an absolutely essential and crucial part of doing the job). The other two are a phrase to which the students must respond to the degree in agreement or disagreement. One of those phrases is written up positively (i.e.: The job

requires a lot of cooperative work with other people) and the other negatively (i.e: The job can be done adequately by a person working alone-without talking or checking with other people).

For developing items adapted to the educational surroundings, we have worked as follows: a lecturer and 2 students of last year of industrial engineering career made independently a translation of items to the Spanish version of the JDS [40; 43] to which they considered equivalent in the context of activities of university students. Later, for each item of the model, we compared the three proposals, we chose the formulation that was more intuitive for the students and we verified that the resulting item agreed with the meaning of the original model.

In order to evaluate if the measurement scales continue being suitable in this case, it is necessary to evaluate the reliability and validity of them. The reliability is defined as the degree of consistency between different measures of the same variable and is estimated measuring the internal consistency of a variable. For the reliability of the scales we will use α Cronbach as measure of goodness of fit [40; 43; 46], although this measurement of reliability presents the disadvantage of assuming that each construct present unidimensionality instead of supposing it [47]. Other measures used in this work (Table 5) are the compound reliability and the extracted variance, being appropriate values for each case those that exceed respectively to 0,7 and 0,5.

Finally, in order to analyze the underlying structure of the questionnaire, a confirmatory methodology will be applied to verify different hypotheses or models, in front of the model originally proposed of 5 orthogonal factors. Models with other factorial structures were hypothesized: model of a factor, model of three factors (identity, feedback and others), model with 5 factors and one that collect all inverse items and, finally, models 7 factors. All these factorial structures will be hypothesized as much as orthogonal and correlated factors and as much as including all items of the questionnaire and without including inverted items [48; 49].

In order to evaluate model fit measures we used d different indices [50-53]. The statistical $\chi 2$ is very sensible to deviations of normality and the size of sample [39], other indices have been considered: the Goodness of Fit Index (GFI) and varies from 0 to 1 and it should by equal to or greater than .90 to accept the model, the Adjusted Goodness of Fit Index (AGFI) and should also be at least .90. The Parsimony Goodness of Fit Index (PGFI), is a variant of GFI which penalizes GFI by multiplying it times the ratio formed by the degrees of freedom in your model and degrees of freedom in the independence model. It must be next to 0,6. Normed fit index (NFI) of Bentler and Bonnet, which varies from 0 to 1, and values below .90 indicate a need to respecify the model. The index of not-normed adjustment (NNFI) of Bentler and Bonnet considers the degrees of freedom when dividing the value of the chi-square by the degrees of freedom of the model and must be near to 0.9 for a good adjustment. Also the root mean square of approximation (RMSEA)was analyzed, that measures the amount by which the sample variances and covariances differ from the corresponding estimated variances and covariances, estimated on the assumption that your model is correct. Finally, also other indices have been evaluated like Hoelter with values superior to 200 indicates that the differences between the raised model and the data are not excellent and the ECVI or index of crossed validation, that allows to confirm if they are going away to obtain similar results in other samples. Inferior values next to zero are accepted.

In our case, the measurement variables are items of the questionnaire, correlated in the different models with the corresponding latent variables. We tried that all necessary indicators were including each one of the models, so that was avoided to commit specification errors.

To identify whether changes in methodology are perceived by students, we did an experimental intervention in a subject of the third course of Industrial Engineering degree. This intervention gives characteristics of active methodology to the experimental subject (Sbj01). The data will be compared with two control subjects (Sbj02 and Sbj03) attended the same students who Sbj01 and which maintains a traditional teaching methodology [54]. The characteristics of teaching in each of these subjects are described in Table 2.

The data were collected in the course 2005-06. The adapted JDS questionnaires were administered to 103 students of 4º course of the degree of organization engineering. Each one of the students filled up two questionnaires, one for the subject with active methodologies (Sbj01 N1=103) and another one for one of the subjects with traditional methodology (Sbj02 N2=30 and Sbj 03 N3=68).

Table 2. Teaching methodology in the subjects of the experiment

Treatment (Sbj01)	**Control (Subj02)**	**Control (Subj03)**
One weekly 150 minutes session. It begins the sessions with activities to collect or resolve doubts on the topic of the previous week (direct question from students, brainstorming of doubts or group activity to express or resolve the doubts). These activities last about 10-30 minutes, depending on the week. Then, one or more group dynamics related to knowledge and skills of the topic to be explained in this week (30-60 minutes). Then a short lecturer (30-40 minutes) on the contents of the topic of the week, summarizing the concepts that are developed in detail in the basic literature of the subject. Finally, it is entrusted students with the read the basic literature as home work in order to record doubts or questions to be answered in next session.	One weekly 180-minutes session. The lecturer writes on the blackboard or shows slides and reads the content of the topic. In some cases shows examples how to use the content in real life. The students use to have a passive behaviour. They are seated writing routinely what the lecturer is writing on the blackboard, or showing in the slices. Or they are reading the contents in the textbook. When the lecturer asks a question to the students, usually they avoid looking to the lecturer at that moment. In some of the classes (not so many), when the class finishes, students are encouraged to solve some problems as homework. But the teacher doesn't collect the proposed homework, neither solve it in the blackboard, nor provide any kind of feedback to the few students that fulfilled the homework	Two weekly sessions (120' and 90' each). The lecturer writes on the blackboard or shows slides and reads the content of the topic. Usually this content could be found in a textbook. The students use to have a passive behaviour. They are seated writing routinely what the lecturer is writing on the blackboard, or showing in the slices. Or they are reading the contents in the textbook, or just dreaming awake. The lecturer doesn't ask questions to the students, Nor ask for students interventions. When the class finishes the teacher doesn't propose homework to the students.

4 Analysis and discussion of results

Table 3 and 4 summarize the analyses and allowed us to verify the reliability of the adapted scales and compare it with data of original model. We can appreciate that the psychometrics properties of the adapted model are rather average. Three of the characteristics of the job (variety, identity and autonomy), have a low α-Cronbach, below to the indices commented in the investigation with the original questionnaire for companies [46]. Also they are smaller to the data provided by González [43] in his Spanish version of questionnaire. Nevertheless, the values of the scales of the educational questionnaire are, in general, quite superior to which was reached in the investigation of Fuertes Martinez with the Spanish version of the JDS for jobs [40]. The results of the confirming factorial analyses made to evaluate the different hypothesized models, as well as path diagram of the more significant ones, appears in the table 9. The indices of goodness of adjustment of the different hypothesized models are show in table 9. The autonomy scale is the one of greater methodology problems and it is recommended to review.

Analyzing the different indices we can conclude that the hypothesis that the best representation of the factorial structure of the JDS adapted like tool of diagnosis of educational methodologies in the university classrooms, obtains with only one dimension, seems quite inadequate, as happened in the study of the original JDS, carried out by González.

Considering that the underlying structure of the JDS is multidimensional it is necessary to verify the number of dimensions that better represents it. From all hypothesized models, the model of 5 orthogonal factors (3a), presents again fits quite inadequate, denoting divergences between the matrix of variances and covariances of the sample and the matrix generated from the model. Although these divergences are not reduced either when we spoke of an oblique solution of 5 factors (3 b) considering all items [χ^2= 144.099, gdl=182 and p-value=0,000], but the indices goodness fit, improve enough, being next to the values recommended for each one of them. On the other hand, the structure of 5 negative oblique factors without items developed in the model 3e, displays a moderate adjustment, [χ^2= 24.2344 p-value = 0.284], and the rest of indices is within the limits recommended for a good adjustment: NFI and CFI are next to 0.9 (0.958 and 0,994) although the model does not denote much parsimony, because indices PNFI and PGFI (Parsimonious goodness fit index, GFI/gdl) get worse, not being very next to 0.6 (0.453 and 0,471), and that are those that we must consider when comparing alternative models [50].

Nevertheless, statistical χ^2 /gdl, demonstrates a good fit in both models. Also the RMSEA is quite next to zero, which denotes that the discrepancy between awaited and observed matrix of covariances is minimum. Hoelter takes values superior to 200, concretely 279, indicating that the differences

between the raised model and the data are not relevant. Finally, the index ECVI or index of crossed validation, takes values next to zero. Again the variances matrix of and covariance of the sample are not reduced to the divergences between and the matrix generated from the model either when we spoke of an oblique solution of 5 factors and construct denominated "Method" (3d) defined from items formulated in inverse sense (χ^2= 178.118, p-value=0,000), but also the indices of adjustment kindness are acceptable.

Both models of 7 factors correlated proposed (4a and 4b) with all items and without considering items formulated in negative sense (4c and 4d), continue denoting divergences between the matrix of variances and covariances of the sample and the matrix generated from the model, although the indices of fit improve in the case of not considering items in negative formulation.

In agreement with the results of the analysis if we choose the 7 factors model without reverse scored items, the other four characteristics scales and the Motivating Potential Score have high construct reliability and variance extracted and although this model denotes divergences between the matrix of variances and covariances of the sample and the matrix generated from the model, presents good values of the indices of fit, as shown in table 6. Therefore, according with previous JDS literature, the validity of most of the scales in this model are well established.

The satisfaction scales, except the satisfaction with the note, have suitable values of internal consistency and superior to the only investigation that we have been able to contrast [40; 55].

Table 3. Reliability and extracted variance for JDS dimensions (N=206)

JDS Dimension	α Cronbach	7 Factors		7 Factors without reversed items	
		Construct reliability	Extracted Variance	Construct reliability	Extracted Variance
Skill Variety (VAR)	0.46	0,470	0,278	0,570	0,403
Task identity (ID)	0.47	0,523	0,360	0,568	0,510
Task significance (SIG)	0.76	0,783	0,562	0,847	0,735
Autonomy (AUT)	0.40	0,544	0,375	0,383	0,237
Feedback from the job itself (FJ)	0.79	0,662	0,423	0,729	0,582
Feedback from agents (FA)	0.79	0,737	0,488	0,787	0,665
Dealing with others (DO)	0.74	0,802	0,613	0,932	0,873
Motivating Potential Score (MPS) (7 items)	0.86	-	-	-	-

Appropriate values for reliability and extracted variance, are over to 0,7 and 0,5 respectively.3

Table 4. Reliability for satisfaction dimensions (N=206)

Satisfaction dimension	Number of items	α Cronbach
General Satisfaction (GS)	5	0.82
Internal Work Motivation (IM)	6	0.65
Pay satisfaction (PS)	2	0.36
Job security (JS)	2	0.64
Social satisfaction (SS)	3	0.80
Supervisory (SUP)	3	0.76
Growth (GRW)	4	0.78

Table 5. Goodness of fit indices for hypothetized models

	χ^2	gdl	p-values	NFI	CFI	PNFI	PCFI	RMSEA	ECVI	HOELTE
1.a	1023,155	74	0,000	0,000	0,000	0,000	0,000	0,207	5,586	27
1.b	782,2	24	0,000	0,000	0,000	0,000	0,000	0,283	4,216	17
1.c	404,637	137	0,000	0,820	0,873	0,621	0,662	0,094	2,676	88
1.d	474,94	80	0,000	0,795	0,850	0,598	0,639	0,099	3,097	82
1.e	445,975	80	0,000	0,812	0,874	0,618	0,666	0,087	2,956	96
2.a	524,937	158	0,000	0,845	0,841	0,627	0,677	0,094	3,478	86
2.b	187,31	66	0,000	0,896	0,933	0,631	0,658	0,086	1,558	105
3.a	162,9374	75	0,000	0,807	0,867	0,871	0,885	0,089	12,229	22
3.b	144,099	65	0,000	0,849	0,912	0,558	0,599	0,073	1,230	128
3.c	675.399	45	0,039	0,958	0,982	0,536	0,578	0,058	1,565	105
3.d	24,2344	25	0,2843	0,958	0,994	0,453	0,471	0,026	0,569	279
3.e	28,6	26	0,330	0,958	0,996	0,453	0,471	0,022	0,569	279
3.f	178,11	76	0,000	0,826	0,887	0,633	0,562	0,081	1,493	113
4.a	918,45	210	0,000	0,573	0,616	0,604	0,648	0,150	3,111	102
4.b	401,745	133	0,000	0,830	0,891	0,604	0,648	0,082	3,260	109
4.c	588,841	71	0,000	0,682	0,623	0,525	0,542	0,189	1,360	178
4.d	88,899	30	0,006	0,951	0,982	0,525	0,542	0,0051	1,370	178

- 1a,.e.1 three factors, 4 factors that are the obtained ones to apply the analysis of main components with the criterion of eigenvalues greater than one without considering Rp and Contact, and 5 factors, that are the obtained ones to apply the analysis of main components with the criterion of eigenvalues greater than one considering Rp and Contact. I
- 2a and 2b, are to the models of three factors established like identity-feedback and others, correlated, without items as much negative as with them. 2
- 3a, 3b, 3c, 3d and 3e, are all the models proposed for 5 as much orthogonal fixed factors as correlated and as much considering all items as without considering the formulated ones in inverse sense.
- 4a, 4b, 4c and 4d, are the models for 7 as much orthogonal fixed factors as correlated and as much considering all items as without considering the formulated ones in inverse sense.

The only constructs with suitable values of the reliability and variance extracted are the meaning, the feedback of the position and social, and the social contact, according with previously commented about the validity of some of the scales is not this established with forcefulness.

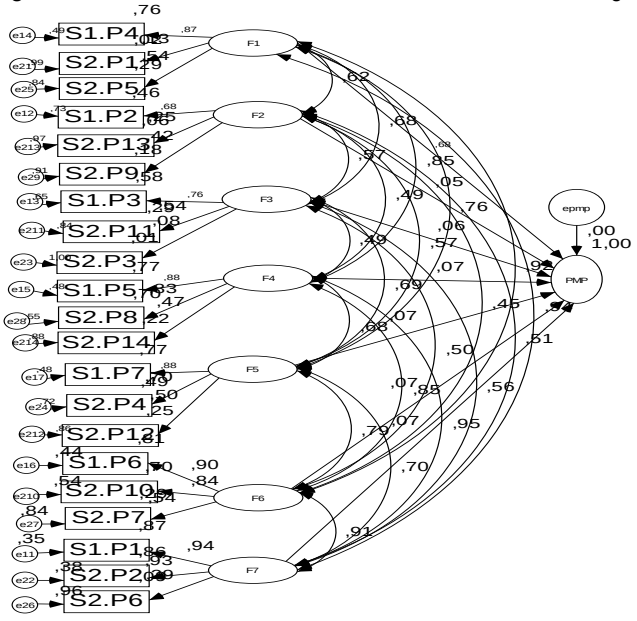
The results of the confirming factorial analyses made to evaluate the different hypothesized models, as well as path diagram of the more significant, appears in the table 5 and figure 2. The indices of goodness of adjustment of the different hypothesized models are show in table 5. The autonomy scale is the one of greater methodology problems and it is recommended to review [56].

Considering that the underlying structure of the JDS is multidimensional we hypothesized 4 models. Models 7.a and 7.b represent 7 factors with all items but 7.a is orthogonal fixed factors and 7.b correlated factors. 7.c and 7.d represent 7 factors without considering items formulated in negative sense. The first with orthogonal factors and the second with correlated factors. All the models denoting divergences between the matrix of variances and covariances of the sample and the matrix generated from the model, although the indices of fit improve in the case of not considering items in negative formulation.

Consequently, there are enough variability in the number of underlying factors of structure of the adapted JDS to educational methodologies, so as happened to the original version of the JDS [57]. The main disadvantage detected by these authors [57], is that each factor is only represented by three items. Finally to establish, that the models that better fit present are those that does not consider items formulated in inverse sense, since these items can lead to other problems when we considered factors with very few items, as it is our case [57].

Table 6, show the unilateral correlations between the dimensions of the JDS and the satisfaction appear. In general, the data of our investigation agree with previous investigations [56] with moderate and significant correlations, around the 0,5, between the general satisfaction with almost all the dimensions of the JDS. We may also note that the Motivating Potential Score (MPS) has strong correlation with social satisfaction or growth satisfaction than with extrinsic satisfaction as the note or security to pass.

Figure 2. Model with seven correlated factors without considering the items formulated in inverse sense (4d).



Note:
- R_i: item or observable variable.
- e_i: Error term of each item.
- Latent variables are enclosed in ellipses.
- Double-ended arrows: relationships between latent variables.
- We fixed to one the initial saturation coefficients corresponding to a single variable for each of the factors to avoid identification problems.
- F1: VAR, F2:AUTONOM, F3: IDENT , F4: SIG, F 5: RP, F6: RS and F7: CONTACT.

Table 6. Relation among JDS dimensions and satisfaction of students

	GS	IM	PS	JS	SS	SUP	GRW
VAR	,414(**)	,264(**)	,138(*)	-,145(*)	,586(**)	,461(**)	,501(**)
ID	,375(**)	,343 (**)	,181(**)	,183(**)	,306(**)	,396(**)	,429(**)
SIG	,506(**)	,331 (**)	,135(*)	,003	,689(**)	,528(**)	,580(**)
AUT	,383(**)	,207 (**)	,081	,126(*)	,345(**)	,240(**)	,401(**)
FJ	,525(**)	,268(**)	,225(**)	,247(**)	,512(**)	,565(**)	,595(**)
FA	,512(**)	,234(**)	,115(*)	,024	,682(**)	,651(**)	,669(**)
DO	,440(**)	,289(**)	,087	-,162(*)	,644(**)	,464(**)	,558(**)
MPS	,612(**)	,369(**)	,181(**)	,039	,747(**)	,650(**)	,729(**)

* Unilateral correlations between the dimensions of the JDS and the satisfaction
* Pearson correlation significance: * α<5% ** α<1%

Finally, Table 7 presents the ANOVA statistical analyses performed. Here we can see that differences with the experimental and control subjects are significant in almost all dimensions. Only the task identity in subject 01 is not significantly different from the subject 03. Being this the dimension with minor differences with the subjects with traditional teaching may indicate an area to improve in successive years. It should also pay attention to the dimension of autonomy, which, although it is higher in experimental subject than in control subjects, is receiving the lower scores for Subj01. On the other hand we can see that the dimensions that reflect social contact are the most different from traditional teaching. This is a logical outcome given the intensive use of the teamwork that was encouraged in the course Subj01.

Table 7. JDS dimensions comparison between the experimental and control subjects

	Media Sbj01	**Media Sbj02**	**Media Sbj03**	**F**	**Sig.**
General Satisfaction (GS)	4.96	3.90**	3.82**	17.209	,000
Internal Work Motivation (IM)	5.87	5.56*	5.56**	4.045	,008
Pay satisfaction (PS)	4.06	4.03	4.00	0.086	,968
Job security (JS)	4.14	3.90	4.48*	3.581	,015
Social satisfaction (SS)	5.89	4.32**	4.20**	53.350	,000
Supervisory (SUP)	5.64	3.68**	4.32**	44.858	,000
Growth (GRW)	5.20	3.67**	3.91**	45.706	,000
N	103	30	68		

Values from 1 to 7. * 5% significant differences against Sbj01; ** 1% significant differences against Sbj01

5 Conclusion

The new proposals of change of educational methodologies in the university tend to the incorporation of the participation of the student and the work in group through active methodologies. The JDS provides a guideline to change the teaching methodology. If lecturers want to change to a more active methodology, they have to provide tasks where the students have to perceive variety of skills, significance, autonomy, feedback, and social interaction. In addition, any teacher can use this tool to determine the degree of satisfaction of their students with the teaching methodology.

We have adapted the Spanish version of the questionnaire Job Diagnostic Survey. The first conclusion that can be drawn from our factor analysis of the questionnaire is that all the tests we performed showed that the data matrix was sufficiently relevant, reliable, and valid.

Our use of confirmatory factor analysis allowed us to define the dimensionality of the questionnaire, determine the structure of these dimensions and verify the reliability of each construct. It should be highlighted that confirmatory factor analysis based on structural equation modelling has proven to play an essential role in determining the validity, reliability

and dimensionality of questionnaires as it helps to identify those models which are most representative of the structure of it with a sample of engineering students. The scales of the characteristics of the job are measured with three items valued in a Likert scale from 1 to 7. On the other hand, we verify the capacity of JDS to discriminate different educational methodologies. For this, we compared the data obtained from an experimental group with active methodologies teaching with respect to two control groups with traditional teaching. The results throw that the adapted JDS tool is a robust procedure that can complement or clarify the information that arrives by the student's surveys or other sources

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