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Study of Improvement in Learning by Motivating Students in Aeronautical Engineering Subjects

Gabriel Fernando Martinez Alonso*, Juan Angel Garza Garza, Cesar Gerardo Dimas Acevedo

Faculty of Mechanical and Electrical Engineering (FIME), Autonomous University of Nuevo Leon (UANL), Nuevo Leon, Mexico

Abstract

Motivation is a complex aspect hard to accomplish for engineering students, mainly during the first semester of their career and in courses as Physics, not directly related to their specialty. This work shows a study oriented to increase the motivation of aeronautical-engineering students, based on the theory of expectancy-value, and specifically in the achievement of increasing the interest, by focusing the learning activities towards applications in the aeronautics field for a physics course. The study was performed in students of first semester consisting of two groups, one experimental, and the other of control. Measurements were made through three instruments: an interest and utility survey, of physics in engineering, applied at the beginning and at the end of the semester, a survey applied by an external agent, and the results of the evaluations of the students´ learning. Results showed a significant increase of the interest (from 2.45 to 3.08) and utility (from 2.44 to 4.17), of the physics of the students of the experimental group in comparison with the control group (interest: from 2.41 to 2.54; utility: from 2.30 to 2.91). Likewise, in the external survey, higher values of motivation for physics were obtained in the experimental group compared with all the groups (4.78 vs. 3.79) in the semester where the survey was applied. Grades obtained by the experimental group have higher values that in the control group in percent of students that succeed (73 % vs. 64 %) and in average grades (75 vs. 67), and though differences are not satisfactory, can be taken as a positive result of this work. The study has some limitations, as the number of students used in the group and the fact of being applied in a specialty of engineering, however, it can be considered as a step for future investigations in this field.

Keywords

Motivation, Utility Value, Interest, Engineering, Physics, Higher Education

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1. Introduction

One of the aspects university professors desire or appreciate the most is to achieve a high degree of motivation on the student´s side concerning the learning of the subject taught. According to some studies, motivation is a factor that weights the most when speaking of an appropriate learning of a given course.

Motivation may be defined as an internal state that arouses, directs, and maintains the behavior (Woolfolk, 2006). A unique theory of motivation does not exist, rather, a set of theories lapping one to the other; Among the most important, according with Urdan and Schoenfelder (Urdan & Schoenfelder, 2006) can be mentioned the one of the self-determination theory, the socio-cultural theory, and the expectancy-value theory.

The case of motivation for engineering students has been studied by several authors (Fernández Jiménez & Alonso Tapia, 2012) (Paoloni, 2009) (López Fernández, Alarcón Cavero, Rodríguez Sánchez, & Casado Fuente, 2014) who have carried out some contribution on this important issue from different points of view.

* Corresponding author
E-mail address: gabrilo2009@hotmail.com (G. F. M. Alonso)

The objective of this work is to analyze how the presentation of examples closely related to the students´ specialty influences the motivation of engineering students. In a Physics course for engineers, getting an adequate motivation is complicated due to several factors, so, giving the professor some orientation which allows him to improve students´ motivation is an important task. Herein, this paper points towards the work that the professor performs in the classroom when teaching a course of physics.

The course of Physics I is designed according to the competence model; being a subject of basic sciences for engineering students, has as objective the study of the mechanical motion; it is an algebra-based physics course, studying issues as kinematics, dynamics, and principles of energy conservation, as well as conservation of momentum. Students take this course during their first semester, and are offered as a common course for all the engineering specialties.

This work was carried out in engineering students having diverse specialties, nevertheless, was mainly focused for the Aeronautic Engineering career, at the Facultad de Ingeniería Mecánica y Eléctrica (FIME) of the Universidad Autónoma de Nuevo León (UANL), in México.

The article has a following structure: first an introduction shows the importance of the theme and the objective of the study; second is presented a background with the characteristics of the Physics courses for engineering students and the theoretical fundamentals of the work; third a methodology of the research is presented; a results and its discussion are presented in the fourth part and finally the conclusions of the work are shown.

2. Fundaments

University professors wish both, participating, and motivated students propelled to carry out activities and tasks proposed to achieve a good learning. The fact that student is motivated or not has strong influence on aspects such as the time devoted to perform the activities of the course, the courage, and tenacity shown during his performance; a motivated student is more likely to react positively in case of getting a low grade.

Motivation issue in engineering students has been studied by (López Fernández, Alarcón Cavero, Rodríguez Sánchez, & Casado Fuente, 2014) (Fernández Jiménez & Alonso Tapia, 2012) (Paoloni, 2009), where this problem is treated from different points of view based on psychological theories.

In most of these studies, some research has been done dealing with the relation between learning strategies and the motivation achieved; this is done by using questionnaires as the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, García, & McKeachie, 1991), or the Environment Motivational Quality Questionnaire EMQ-B (Alonso-Tapia, 1999), showing a high correlation between some types of strategies, such as using images or helping students. At the same time, non-motivating actions of the teacher are rejected, namely, applying only one exam, or shorten the time to solve an exam.

Whichever the case, studies state the importance of the issue to prepare high quality engineers nowadays demanded by modern society taking over key aspects of the formative process, such as desertion or the staying of excellent students (Casado, Carpeño, Castejón, Martínez, & Sebastián, 2012).

Generally speaking, professors tend to consider motivation as a personal characteristic of the students. Another point of view about motivation taken as a base in this work, is that motivation is strongly related to learning strategies used by the professor, in other words, motivation is a learning outcome after the student accomplishes the activities of the course (Biggs & Tang, 2011).

In general, the engineering career shows a high degree of difficulty for the students, consequently, this might produce a feeling of low self-efficacy, making more difficult for the student to achieve his motivation. Furthermore, when students go from high school to university, they show a negative pattern of motivation and self-efficacy, normally linked to a short perception of success and to his own capabilities to achieve it, being all of this generated by the increase in complexity of the educational level, besides the higher degree of independence and the complex challenge of the activities asked.

During first semester of engineering courses, these circumstances joint to some others, as: basic formation courses (mathematics, physics, chemistry) not directly related to engineering field, the high number of students to which the professor cannot assist personally, as well as the normal uncertainty felt by students when entering a new educational level, so students need to make some behavior changes. All of these characteristics make difficult to achieve an adequate motivation, and therefore, produces a deficient learning.

Historically, physics for engineers courses present a deficient learning, sometimes due to the normal complexity of the course, or because the professor misorients the course, in the sense that do not show the direct relation between physics and engineering; so, students do not understand the relevance the subject deserves, or take the course considering it as of general culture; therefore, the course does not stimulate, neither a good motivation, nor an important learning. A cause for this professors´ behavior is that they take motivation as something that resides totally inside the students, professors do not relate it with the course focus and the work performed in and out the classroom.

The main didactic interest of motivation is to watch what is what strikes in the students´ motivation. Literature (Pintrich P. R., 2003) about this shows many theories, but in general, all of them move toward three factors that determine the motivation of the students:

1. The value of what is learned.
2. The students´ interpretation of what makes the success or the failure.
3. Their success expectancies.

Particularly, for the purpose of this work, the first factor is of utmost importance, the one concerning the value of what is learned. If the student thinks that it is something important, motivation will be high, even if the item does not have a real value (videogames, for example); on the other hand, if the student believes that something is useless or he does not comprehend its value (calculus, for instance), then he will have to be motivated externally by something, as the grades.

These proposals are summarized into the so-called Expectancy-value Theory (Eccles, et al., 1983)**,** which states that if students think they can succeed in the task they are asked, their motivation to perform it is higher (expectancy), furthermore, it states that if students take it as a worthwhile task, interesting or pertinent, motivation to perform it is enhanced (value part). If any of this conditions is not achieved efficiently, the motivation of the student will decrease; as a matter of fact, it is said that motivation is as a product of these two factors, not the sum (expectancy x value), this is, if any of them is zero, motivation will also be zero.

More recent works applying this theory (Wigfield & Eccles, 2000), present different components of value, as the importance, the intrinsic value, and the utility. Utility is referred to as how the task is related to the future plans of the person; for students, this utility is seen as immediate, for instance, for simultaneous or linked courses. This applies also for the student´s life or his professional career that is the case of the presented work.

Hulleman (Hulleman, Godes, Hendricks, & Harackiewicz, 2010) carried out works on this same topic, emphasizing that utility may be of particular importance for motivation and performance of students, nevertheless, it is necessary to explore the causal effects of utility.

Taking as base the model of interest development in four stages (Hidi & Renninger, 2006) it is proposed that interest is achieved according to the stages during when the person first perceives the value of the activity (situational interest); next, if this situational interest is maintained, a more durable interest shows up, the individual interest; following this, the continuous work in the activity allow to increase the individual interest, and finally, it appears as completely developed, obtaining in this way the best learning and predisposition towards the activity.

Authors in this work applied the intervention model in students of sciences of high school level (Hulleman & Harackiewicz, 2009) demonstrating that making connections between science and everyday life of students interest is promoted, as well as the students´ performance, mainly in those showing low success expectancies.

Simply informing the students about the applicability of an activity might not be sufficient to promote interest, but rather, more elaborated methods or techniques must be used. The present work deals with this concept, in as much as it pursues to investigate how focusing a physics course for engineers, parting from situations closely related to the engineering specialty, exerts influence in students´ motivation.

Specifically, the work deals with the theory of Expectancy x Value and is specifically directed to increase the value of the learning activities developed in the courses, and above all, about the utility, by means of connecting them directly with proper activities for the engineering specialty, in this case, Aeronautical Engineering. In such a way, it is expected to increase the interest, and therefore, the intrinsic motivation of students, improving the learning quality, as well as the development of the course´s competence.

Using these types of activities along the course, makes possible that students follows the four stages of interest development, obtaining the development of individual interest, which, as it was stated, is the one that achieves a better learning and predisposition toward an activity

This work is different from the previously cited in the analyzed students, first semester for an engineering career, as well as the applied intervention, which consists of planning the course relating it with learning activities dealing specifically with aeronautical engineering, following recommendations given by Hulleman (Hulleman & Harackiewicz, 2009) about making the context more diverse, as well as the type of students.

3. Methodology

The study was developed during the August-December 2014 period, consisting of two groups of first semester in the Facultad de Ingeniería Mecánica y Eléctrica (FIME) of the Universidad Autónoma de Nuevo León (UANL), in México. It was designed as an exploratory study with a control group and an experimental group, imparting to them the subject of

Physics I, pertaining to the basic subjects for engineering, and deals with the mechanical motion. It is an algebra-based physics course, where students develop the competence of being able to solve problems of classical mechanics related to engineering, by using dynamics, the principles of mechanical-energy conservation and about the momentum. It is made up of three topics:

1. Kinematics of motion for one and two dimensions.
2. Dynamics of motion.
3. Principles of conservation (energy and momentum).

The two groups of under study were taught by the same professor, with a population of 78 and 55 students, the control and the experimental group, respectively. The difference between them is that the experimental group was composed by aeronautical engineering students only, while the control group was formed by students pertaining to different engineering careers as electronics, mechanics, communication and information and technology, mechatronics, among others.

In the Facultad de Ingeniería the students must do an entrance examination in order to be accepted in the college. Only the students with levels of knowledge approximately equal enter to the faculty. This guarantees that the control and the experimental groups have students in the first semester of the approximately equal preparation.

The course, based on competences, is taught through diverse learning activities which allow the students develop the different elements of the pursued competence, obtaining in this way the expected learning. The teacher of the course has more than 30 years of experiences in university teaching and the course is the same for the both groups, with the same program and the same criteria of evaluation. This guarantees that the teacher is unable to influence (deliberately or unintentionally) on the results of the research.

The didactic design for both courses is based on courses where the theoretical concepts are shown, and then, students perform some learning activities which are ordered in didactic sequences, whose objective is that students develop the planned competence. Activities may be inside or outside the classroom, as tasks to perform, for instance: elaborate motion graphics, using simulations programs to corroborate motion situations; elaboration of a mini-project about calculation of mechanical parameters or solving a specific problem about motion mechanics.

The intervention, carried out with the objective of analyzing its effect on the students´ interest about physics, consisted of using learning activities and examples that always reflected a situation closely related to aeronautical engineering. On the other hand, control groups were taught using more general situations, though they did reflect a practical problem, they were not related to a specific engineering field. Physical principles to be applied and mathematical difficulties of the situations shown to both groups were similar, in order to exclude the influence of these variables of the study.

For example, for the experimental group, an activity developed by students is to solve the next problem:

A Bell UH-1 helicopter is performing some tests to its motor. The UH-1 must reach normally a vertical speed of 8.9 m/s. During the test, the helicopter takes off vertically upwards obviously, from land with an acceleration of 2 m/s^2; when reaching 10 m from land, a failure in the motor occurs and the rotor stops, provoking the helicopter to drop suddenly. What´s the maximum height the helicopter reached? What´s the velocity the helicopter has when hits the land?

At the same time, an activity for the control group was to solve the next problem:

A crane lifts a brick load from the floor vertically, upwards, with an acceleration of 1 m/s^2. At 5 m from the floor a brick falls down. What´s the maximum height the brick reached? What´s the velocity of the brick when hitting the floor?

As can be seen, the physic concepts to be applied to solve both situations are the same, as well as the mathematical difficulty; however, the first one shows a situation fully related to an actual fact in aeronautical engineering, allowing the student realizing by himself the physic concepts -applied to his specific career- to solve the problem.

As part of the learning activities, a mini project was proposed; for the experimental group, the project dealt with a very important problem for the design and exploitation of airplanes, consisting in finding the center of gravity of an airplane, by using real data of a F/A 18 Hornet and of a Boeing 757-300, parting from an example taken from a material of the NASA (NASA, 2007), whereas for the control group, it was calculated the center of gravity of any given object.

The most challenging part was to find examples of aeronautical situations appropriate to be used as learning activities. To overcome this, an exhaustive search of INTERNET sites was developed; the information obtained was adapted to the course goals. Among the sites selected was the National Transportation Safety Board (NTSB, 2005), as well as other aerial security agencies; NASA (National Aeronautics and Spaces Administration (NASA), 2015), and sites of INTERNET devoted to aeronautical topics adapted to the course, obviously. For the students´ support, a WEB site for the Physics course –devoted to aeronautics- was created. The site includes the course materials, as well as links to other WEB sites about the topic (Martinez Alonso, 2010).

This work hypothesis is that if the course of physics for engineers is taught by using learning activities showing directly the application of this science in engineering students will perceive in a higher degree the utility of the course, and along with this, a higher motivation towards the learning. In addition, it is stated that as consequence of this higher motivation, a better predisposition to perform the learning activities, and a better learning are achieved.

The evaluation of this study was made by using several indicators:

1. A survey about interest and utility are applied at the beginning and at the end of the course.
2. A survey applied for an external agent (a college) about different aspects of the course.
3. The grades of students of all the courses under study, as an indicator of the learning achieved, as a result of the intervention.

The interest and utility survey consisted of eight questions of every aspect to be evaluated, as a result of an adaptation of the survey used by Hulleman (Hulleman, Godes, Hendricks, & Harackiewicz, 2010), being:

Utility:

1. Physics may be useful for my engineering career.
2. I don´t think that Physics be useful for me in the future.
3. I don´t think Physics be necessary for my engineering career.
4. For being a good engineer I need to comprehend Physics very well.

Questions were mixed (interest and motivation), one following the other; the same for negative and positive statements. All the statements were evaluated using a Likert scale of agree-disagree, with five possible answers (1-complete disagree, 2-disagree, 3-indifferent, 4-agree, and 5-complete agree).

Interest and utility survey were applied in paper, directly by the professor of the course during a class session. The validity and consistency of this instrument were studied by its author and they are not an object of this study.

External agent survey was applied on line, at the end of the semester to a random sample of each group. This survey consisted of questions in which students were asked to evaluate, in a scale of excellent (5) to bad (1), some aspects of the course, as:

1. Learning achieved during the course.
2. Motivation toward studying, reached at the end of the course.
3. Competence developed in the course for solving physic problems.
4. General evaluation of the course.

This survey is not under the control of the researchers and the questions cannot be modified.

4. Results and Discussion

The data of the survey (initial and final) were performed using the statistical functions of the EXCEL 2013, that is simple to use and very completed for the necessary operations in this study.

4.1. Survey of Interest and Utility

The survey (initial and final) about interest and utility of physics, was completed by 60 students of the control group (77% of population) and 52 students of the experimental group (population of 94%), counting only those students participating in both surveys, for some students were absent in any of the two surveys.

In order to evaluate the reliability of the survey the Cronbach's alpha (Snedecar & Cochran, 1989) was used. This coefficient measures how well a set of items (or variables) measures a single unidimensional latent construct. It is a coefficient of reliability of the used survey. In this study the Cronbach-alpha coefficient was calculated for the initial survey and have the value of 0.85 (interest survey) and 0.88 (utility survey). That means that the used survey has a good reliability because the coefficient bigger than 0.7 is acceptable for social studies. The conclusion of this data is that items measure a single unidimensional latent construct in one case the interest and in other the utility of Physics.

Average values of interest for the control and experimental groups are shown in Table 1.

Table 1. Results from the initial survey of interest about Physics.

	Control group	Experimental group
Average	2.41	2.45
Standard deviation	0.91	0.80

As can be seen, there is not statistically significant differences between average values for both groups. The absolute value of the t - statistic test for the initial interest survey, 0.244, is smaller than the critical value of 1.981, so, we accept the null hypothesis and conclude that the two population means are equal for a significance level of 0.05. This means that the interest towards physics subject in the control and experimental groups has the same level at the beginning of the semester. The same conclusion can be made from the probability of the statistic t that has the value of 0.807, which is greater that the significance level of 0.05.

The results of the initial survey about utility is shown in Table 2

Table 2. Results of the initial survey of utility about physics.

	Control group	Experimental group
Average	2.30	2.44
Standard deviation	0.83	0.80

In spite of having a higher difference between the control and experimental groups, in which for the interest case it is not statistically significant. In this case, the absolute value of the t - statistic test for the initial utility survey, 0.899 is smaller than the critical value of 1.981, so, we accept the null hypothesis and conclude that the two population means are equal for a significance level of 0.05. This means that the utility of physics for the control and experimental groups has the same level at the beginning of the semester. The probability of the statistics t is 0.37, which is greater than the significance level of 0.05, arriving to the same conclusion.

These results of the initial survey prove that the control and experimental groups had a similar state concerning their interest about physics and its perception of utility for engineering. Mainly, this is due to the previous formation of students, for most of them come from schools where actually, it is not common to show the application of physics in everyday life or in the engineering field.

The final survey of the course about interest and utility was applied during the last week of the semester, once all the learning activities were finished, with the intervention characteristics previously stated. For both groups, only were taken the students that participated in initial survey, in order for the outcomes to be compared.

The obtained values are shown in Table 3.

Table 3. Results of the final survey, interest and utility of physics.

	Control group		Experimental group	
	Interest	Utilty	Interest	Utility
Average	2.54	2.91	3.08	4.17
Standard deviation	0.79	0.82	0.65	0.36

From these results, it is observed a clear difference between the values of the experimental group for the values of the initial survey, in as much as the interest increased from 2.45 to 3.08, whereas utility increased from 2.44 to 4.17. For the control group, even though there was an increment, it was no significant (interest from 2.41 to 2.54 and utility from 2.3 to 2.91). Comparing the control and experimental group values, significant differences between interest and utility can be observed.

The absolute value of the t - statistic test for the interest survey is 3.94, which is greater than the critical value of 1.981, so we reject the null hypothesis and conclude that the two population means (control and experimental) are different for a significance level of 0.05. The interest towards physics at the end of the semester is higher in the experimental group than in the control group, due to the intervention performed. The same conclusion can be made from the probability of the statistic t that has a value of 0.00013, smaller than the significance level of 0.05.

For the utility survey, the value of the statistic t is 10.77, which is greater than the critical value of 1.981, so we reject the null hypothesis and conclude that the two population means are different for a significance level of 0.05. This means that the utility towards physics at the end of the semester is much higher in the experimental group that in the control group, due to the intervention performed during the semester. The same conclusion can be made from the probability of the statistics t that has the value of $1.90x10^{-17}$, which is smaller than the significance level of 0.05.

It is interesting to note the reduction of the standard deviation in the experimental group (from 0.80 initial, to 0.65 or 0.36 final) indicating a higher concentration of the answers of the students towards the most higher values, whereas in the control group the dispersion of the answers keeps alike, according to the similar values of the standard deviation (around 0.80)

The results presented, are of great importance, for they demonstrate the fundamental hypothesis of this work: interest and utility perception can be increased for engineering students of physics, focusing the course with activities that show how this science is applied to solve engineering problems of a specialty.

4.2. Survey of an External Agent About Different Aspects of the Course

As it has been mentioned, this survey is applied for the headship of the school, at the end of the semester to all the groups; its objective is to obtain the perception of students about different aspects of the courses. The evaluated aspects are: achieved learning, accomplished motivation, competence development, as well as a general evaluation of the course. They are applied on line, by using a scale of 1: bad, 2: regular, 3: good, 4: very good y 5: Excellent.

The samples in this case were selected randomly, by the applicator, among the students of the course. The control group consisted of 63 students (80% of the population) and 39 for the experimental group (70% of the population).

The results for the groups under study are presented in Figure 1, where bars are shown corresponding to the standard deviation of every average value (control group =0.4, and experimental group =0.3)

From the results shown, can be concluded that the experimental group obtains values of perceptions above the ones for the control group, though they are close to the intervals with a standard deviation. It should be emphasized that the value of motivation of the experimental group (4.78) -which is the objective of this study- reflects the high level of motivation achieved, as consequence of the style the course was taught.

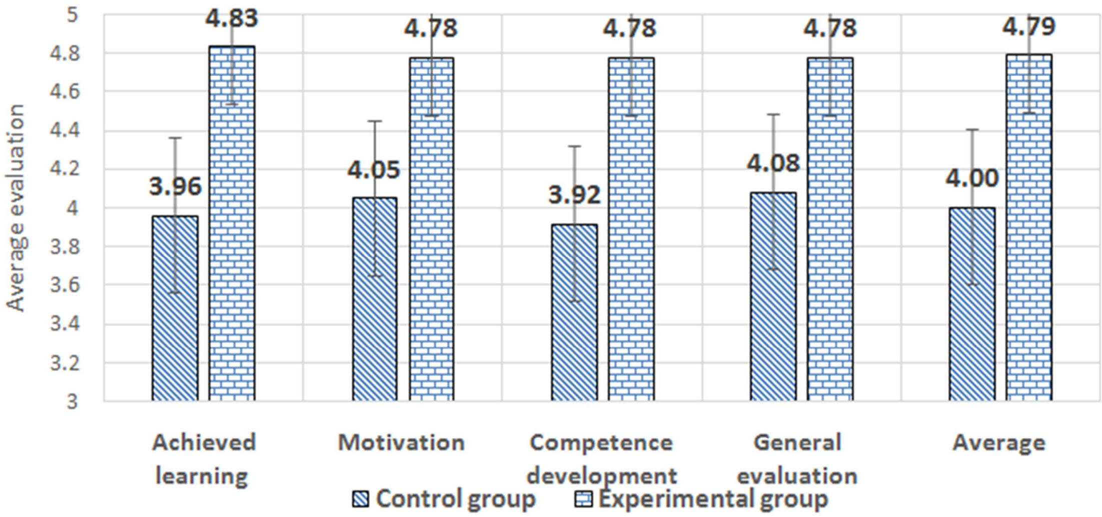

Figure 1. Average evaluation about aspects of the course. Source: survey applied to students by an external evaluator.

Along with this, the aspects achieved learning and competence development of the course, can be considered as an self-evaluation of the student about what he got to assimilate, as result of the learning activities, and as can be shown in figure 1, both aspects are evaluated better in the experimental group, which can be considered as a confirmation of results from other studies (Hulleman & Harackiewicz, 2009), where is stated that a major interest and therefore, a major intrinsic motivation in students, improve the learning quality, as well as the development of the competence of the course.

As another comparison, Table 4 shows the values of these same aspects but extracted from all the groups (a total of 48 groups with sample of 725 students), belonging to first semester of physics, compared with the values of the experimental group.

Table 4. Average values of evaluation of aspects of the course. Source, survey to students by an external agent.

	Achieved learning	Motivation	Competence development of the course	General evaluation	Average
All the groups in the semester	3.70	3.79	3.65	3.69	3.71
Experimental Group	4.83	4.78	4.78	4.78	4.79

From the data shown, can be concluded that the experimental group was the one with the biggest evaluation in the survey that was applied to a sample of the all students in the semester, in aspects as learning and motivation, and can be considered as an important outcome of this study.

4.3. Grades of Students of All the Groups of Study

Grades of the course are granted according with the score that every student gets from the learning activities, as well as in two exams: one at the middle of the semester, the other at the end. The weight of both exams in the final grade is of 50 %, for it is considered that the evaluation of the competence developed in the course is not only given by one exam, but with a series of activities of different types, as simulations, mini projects, elaboration of graphics with a software, among others. The final exam consists of solving 5 exercises from all the topics of the course. If the student does not succeed in the first final exam, he has another opportunity to take the exam. An example problem for the experimental group was:

A passenger aircraft Boeing 747-8 has to make a forced landing along a short track of 250 m. The airplane hits the track with a velocity of 136 knots (70 m/s), having a total mass of 343400 kg. The total friction coefficient (with the air and the track) during the brake time is 0.9; eventually, the airplane leaves the track and crashes with a building, stopping after the airplane sinks into the building a distance of 10 m, measured by the airplane deformation.

A) What´s the force the building exerted upon the airplane during the crash?

B) A 65 kg passenger is seated with the security belt fasten. It is supposed that if the force the belt exerts on the passenger doubles his weight, injuries may occur. Will the passenger suffer injuries in this crash?

A similar problem for the control group was:

An 800 kg automobile, goes along a horizontal foggy road at 20 m/s. The driver watch a tree lying on the road, so he starts braking (μ=0.8). The car slides during 10 m till it hits the tree, still fixed to the ground. The car goes into the tree a distance of 0.8 m until it stops. Calculate:

a) The force the tree exerted upon the car

b) If a 70 kg passenger is inside the car, what´s the force he himself must exert to stay in his seat during the crash?

As it had be established, both problems implies the same physics (Energy conservation, momentum, and impulse) as well as the same mathematical difficulty, nonetheless, the problem for the experimental group is related directly with aeronautics specialty.

Table 5 shows data about the total students that succeed (70 points minimum) for the two groups, as well as the average grades, having 100 points as a base.

Table 5. Course outcomes for the two groups; 100 as base.

	% succeed	Average grades	Standard deviation for average
Control group	64	67	28
Experimental group	73	75	26

As can be seen, the experimental group has higher values for both indicators, though there is no significant differences between the average values of grades for both groups. The probability of the t statistic is 0.95, greater than the significance level of 0.05, which means that there is not a statistic differences in the average grades for the groups. Anyway, it can be established that increasing the average grades and the percent of succeed students by 8 points, represents an interesting result of this study.

These outcomes can be considered as a partial confirmation that a better motivation, related to the utility of the activities, renders a better learning.

It can be stated that this superior outcome, although still insufficient, is due to the intervention carried out by the professor by focusing the course with aeronautics.

An additional measure of motivation achieved in the experimental group is the percent of students that carried out the learning activities of the course, which can be taken as a measure of motivation, for it is an indicator of persistence in doing the tasks during the course. In the case of the experimental group, a 95% of performance (Per cent of the number of activities fulfilled by the students multiplied by the number of them divided by the total number of activities multiplied by all the students) is obtained, whereas in the control group the performance was of 88%; the hundred percent of performance is given by the number of activities times the number of students. We consider it is an important indicator, since it means that the focus given to the experimental course caused that a major quantity of students devoted time and effort to perform the course activities.

5. Conclusions

In this work it has been shown the findings of an exploratory study for a physics course for engineers; it is oriented to evaluate the effect of focusing the learning activities towards situations that can be related directly by students, as the application of physics in the aeronautical engineering, in the motivation of the students for physics, and its utility in engineering studies.

This study is based on the theory of expectancy-value of Eccles (Eccles, et al., 1983) and also, in more recent works of Hulleman dealing with the utility of the tasks and its influence in the learning, supported by the development model of interest of Hidi and Renninger (Hidi & Renninger, 2006)

As conclusions of this study can be mentioned that:

1. It has been achieved an increase in interest towards physics in the experimental group, compared with the control group, as well as the perception of students about the utility of the course; all of this is clearly seen in the comparison of the final and initial surveys
2. For the experimental group, an increase of the students´ motivation has been detected, according to the survey carried out by an external agent. It is necessary to emphasize that the experimental group, in this survey, obtained the higher value of motivation of all the groups in the semester August-December 2014.
3. The results of the learning evaluation are superior, referring to the succeeded students and in the average grades for the experimental group; though this difference is not significant it is an important result having in mind that first semester groups are characterized by having low grades in physics. That´s why having an increment in 8 points seems to be a good result, though partial.

The hypothesis of this work, that if the course of physics for engineers is taught by using learning activities showing directly the application of this science in engineering students will perceive in a higher degree the utility of the course, and along with this, a higher motivation towards the learning, was demonstrated.

The outcomes of this study can be considered in accordance to the stated by Hulleman (Hulleman, Godes, Hendricks, & Harackiewicz, 2010) who says “For example, finding an application for an activity (e.g., math and engineering) may create the possibility of making connections to goals or aspirations that are personally important to the individual (e.g., a career as an engineer)”.

Among the limitations of this research are: it was developed for a subject of basic sciences, physics, for the career of aeronautical engineering, for which it is necessary replicate it for other specialties and other subjects, in order to generalize the outcomes. This is the reason why this sample is somewhat short (60 students for the control group and 52 for the experimental group completing the survey); a further step is to enhance the samples.

The study presented here is only exploratory, and was made to understand much better some aspects of the students´ motivation problem.

Future research on this topic is very important, in order to improve motivation of engineering students towards physics. It will be necessary to broaden the study to other engineering careers, as mechanics, electronics or electrical; test on wider samples is necessary to obtain more general results. The use of better methods to evaluate motivation is also needed to improve the validity of the research.

It is indispensable for this to implement groups whose students be part of only one specialty, this is, all of them taking the same engineering career (Mechanics, Electronics, for instance).

The findings of this study, once generalized, allow the professor interested in enhance the engineering-students interest, apply an intervention in a relatively easy and inexpensive way, having positive outcomes in areas somewhat complex as physics or mathematics teaching for future engineers. In this fact its principal value lies, considering that this course presents always difficulties for engineering students.

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