ATTITUDES AND LEARNING: AN IMPORTANT RELATIONSHIP FOR ENGINEERING STUDENTS

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Abstract

Students who enter engineering programs must demonstrate disciplinary competences in mathematics and physics, as well as generic skills-oral and written communication and teamwork-that allow them to progress successfully in their school career. To design a strategy that improves the efficiency indicators of the engineering programs, analysis of the results of the candidates to enter the technological institute is made. In this case, the results of the admission and diagnostic tests and a series of questions related to the students' attitudes towards the study and their school success were analyzed with the hypothesis of finding a positive relationship between them. The results showed that the qualifications in the skills and knowledge exams are related to the attitudes of the students towards the study. These attitudes are associated with the gender of the students, women tend to have more positive attitudes and men towards negative ones; these attitudes do not vary from one high school of origin to another. The applicants to Chemical Engineering have results far above the rest of the candidates, although in some areas the candidates to Electronic Engineering and Computer Systems Engineering also have results above others. Therefore, it is feasible to apply a differentiated strategy of income to the institution where not only elements of reinforcement in the basic areas for engineering are included, but also the attitudinal improvement towards the study of the students and with that of the results in their school trajectory.

Key words: attitude, will to achieve, engineer training, higher education

Introduction

The National Technological Institute of Mexico has been conducting various investigations to focus its efforts on improving the approval rates of the first year subjects, based on the interpretation of the reality that students who enter their undergraduate programs live. Particularly, in the case of engineering programs, the demand for a minimum level of mastery of the required mathematical bases and the competencies associated with their reading skills and abilities are basic elements without which the first-year engineering student has complications in their performance academic and his school career is disrupted to extremes such as desertion, or the delay that generates problems of all kinds, including indicators of terminal efficiency.

Before the entry process in 2016, the previous information was analyzed, a comparison was made with what other campus were doing in the National Technological Institute of Mexico, and it was decided to rethink the entry strategy to one of them: the ITCM. Although the teachers' perception of the first courses of mathematics and physics is that there have been no significant differences, an evaluation of this new attempt is being made to improve the school trajectory of the newly admitted. This differentiated income strategy is in the process of evaluation and one of the stages is reported in this document.

The principle behind this strategy is that all students have an entry option as long as they demonstrate the minimum competency in mathematics, but also in physics or written language of the EXANI-II exam of the National

Center for Higher Education Evaluation (CENEVAL), according to the engineering program they chose; the time of admission was conditioned to the scope of the mentioned results. However, according to verbal reports from the teachers of these subjects, the students' results are related to their attitudes towards the study, in the context that is presented to them in higher education.

This paper presents elements of the exploratory research carried out to find answers to the questions: are the results in the skills and knowledge exams related to the attitudes of the students? Do students' attitudes depend on their gender? Do students' attitudes change when they study one career or another? Do the attitudes of the students change according to the regime or the type of high school they come from? These results allowed to guide some specific actions in the strategy of entry to the campus.

Review of the Literature

Students recently enrolled in a higher education program present diverse experiences in the transition process; some adapt more easily than others to changing educational levels, but all have diverse experiences with peers, friends, teachers, cultural norms, new content and teaching-learning styles, which are sometimes full of "shocks, ambiguity and uncertainty in various plans of action" (Ramírez-García, 2013, p. 29). During this journey, students assume a position in the face of new knowledge and the challenges involved in successfully completing the subjects of their curriculum, which implies the assumption that everything presented by the teacher or the book is the truth, to which Perry, cited by Pozo & Mateos, denominates as "fundamentally dualistic" (2009, p. 76). While, in the following two years, the awareness of the diversity of opinions and uncertainty, regarding the validity of knowledge in all cases, leads students to pluralism, continuing with Perry himself. And only some, in recent years, will reach a radical change where the truth is replaced by relative truths according to the context, "so that the advance in knowledge would make students to acquire increasingly complex, autonomous concepts on knowledge and its validation criteria" (Idem, p.79).

In this context, the attitudes and habits of each and every one of these students inevitably arise before their own learning and the educational process as a whole as variables to be considered. Because "there are emotions that move us towards a harmony and "fluidity", in relationships and in what to do educational, instead there are emotions that limit and cut the links and possibilities of actions of students" (Faúndez-Pinto, 2014, p. 164). In this sense, students can cling to tools, specific and concrete techniques that allow them to face the challenges presented to them emotionally, it seems to offer a way for young people to increase their probability in their continuous and systematic application. of success in school performance; and beyond, recognizing the "importance of learning the emotional and social aspects to facilitate the global adaptation of citizens in a changing world, with constant and dangerous challenges" (Fernández-Berrocal & Extremera-Pacheco, 2005, p. 65) .

About the Neurosciences

The Neurosciences are dedicated to trying to explain how the nervous system acts in the brain to produce a behavior, "they are contributing to a greater understanding, and sometimes to answer questions of great interest to educators" (De la Barrera & Donolo, 2009, p. 4), to give a greater understanding about the learning process (Campos, 2010). Therefore, the most important thing for a teacher is "to understand Neurosciences as a way of knowing the brain more widely - how it is, how it learns, how it processes, records, preserves and evokes information, among other things- so that based on this knowledge, it can improve the proposals and learning experiences that occur in the classroom" (Ibidem, p. 5).

The entire body and brain are involved in the learning process, "who acts as a stimulus receiving station and is in charge of selecting, prioritizing, processing information, recording, evoke, emitting motor responses, consolidating capacities, among thousands of other functions" (Campos, 2010, p. 6). The brain learns through patterns that it detects, learns and finds a sense of usefulness when necessary; uses conscious and non-conscious mechanisms. Which implies that the attitude of the teacher in front of proposals of learning and in front of the students is extremely important. The example has a fundamental role in learning by patterns and non-consciously.

Campos (2010) mentions that emotional stimuli interact with cognitive abilities, that "states of mind, feelings and emotions can affect the ability to reason, decision making, memory, attitude and willingness to learn" (p. 6), besides that a high level of stress negatively affects learning. Therefore, pleasant conditions in the classroom and an emotionally intelligent teacher are essential factors for learning. The brain and the body learn in an integral way,

the movements, the perceptions through the sensory organs, the corporal communication, the direct and concrete experiences "stimulate the development of the sensory systems, of the motor systems and of different regions in the brain" (Ibid, p. 7). According to the author, the physical exercises, the corporal movement, "allow greater oxygenation of the brain, improve cognitive abilities, stimulate mental, social and emotional capacities" (Idem).

It has also been reported that in teachers their social-emotional skills allow to create more positive educational environments with students and they themselves improve their health and well-being indexes (Palomera, Briones & Gómez-Linares, 2017). These socio-emotional skills include self-knowledge, emotional self-management, social awareness, skills to relate and responsible decision-making, according to Casel's quotation (Idem), which, it is recognized, are feasible to develop. However, it is also emphasized that "innovative projects require commitment, ongoing training and teacher coordination, as well as the flexibility of institutions to host these innovations" (Idem, p.181).

Low self-efficacy beliefs, along with low interest for learning and for achieving good academic results, define this group with the most motivational profile negative (Valle, et al, 2015, p. 6) then, in those cases, both for teachers and students, it would be important to pay attention to the emotional aspect present in the teaching-learning process, and to reinforce it, especially since the holders of the mathematics and physics courses have, in a natural, a detached profile of humane treatment with the student.

The professors of the first year of engineering

In particular, the professors of the first semester of engineering account for the lack of awareness of the students, in their great majority, regarding the importance of reaching, above all, the desired knowledge; Those teachers who meet with a group whose level of performance is more in line with the established in the profile of entry to the race seemed lucky.

The above is circumscribed within the scope of the subjects of the so-called "hard" sciences, where teachers of mathematics, physics and chemistry establish evaluations based on evidence of the learning of the concepts and procedures, in order to account for disciplinary knowledge. However

The challenge for teaching is to prevent the deficit of higher level cognitive activities. The teaching has, therefore, two facets: identify and eliminate the characteristics of our teaching that encourage the use of low-level substitute verbs and support what may stimulate students to use, instead, the high-level verbs . Much of the problem of the first type lies in the affective area: class and institutional motivation and climate "(Biggs, 2005, p. 96).

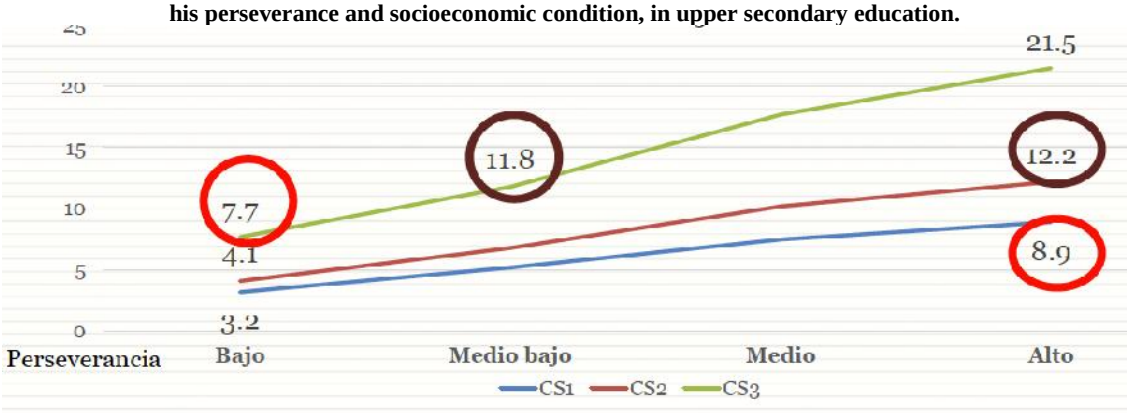
It has been such the search of alternative strategies of leveling for the students of new entrance to the engineering and with results of little significance, that the professors seem to have lost the hope of normalizing the work to the must be and they have been satisfied with doing what is can with what you have. The deficit of cognitive activities in teaching and learning strategies has led to the strengthening of a quality of teachers: resilience, their ability to adapt to the environment, the new circumstances.

The students graduated from high school

The Secretariat of Public Education (SEP) in Mexico has focused in recent years on seeking strategies to minimize indicators such as exclusion at the high school level, antecedent of the degree; such is the case of the Construye-T program established for all public schools of that educational level. This Construye-T program supports its work in six dimensions are: "a) Self-knowledge, b) Healthy living, c) School and family, d) Culture of peace and non-violence, e) Life project (UNESCO, 2011), associated with the Comprehensive Reform of Higher Secondary Education, started in 2008, and which is focused on the development of a life project and the prevention of risk situations, as an intervention strategy in the psychosocial field.

The National Institute for the Evaluation of Education (INEE), based on a study over the impact that Construye-T program has had on upper secondary education, affirms that students with greater socio-emotional skills obtain higher levels of school achievement and the gaps associated with socioeconomic status are reduced -see figure 1.

Figure 1. Relationship between the maximum level of achievement in Mathematics of a student and his perseverance and socioeconomic condition, in upper secondary education.



Source: SEP (2015).

Therefore, the SEP and INEE have worked on a strategy to strengthen teachers with practices and exercises, applicable to students, on 18 socio-emotional skills: self-perception, self-efficacy, recognition of emotions, management of emotions, postponement of gratification, tolerance to frustration, achievement motivation, perseverance, stress management, empathy, active listening, perspective taking, assertiveness, interpersonal conflict management, pro social behavior, generation of options, critical thinking, and analysis of consequences (SEP, 2015). The large subsystems of upper secondary education, such as those that include the technological baccalaureate, have already implemented it. This implies that the majority of students who join the ITCM have certain bases for their emotional management.

With the intention of making diagnoses of the results of the educational process in higher education, in Mexico, standardized tests are used to identify the level of mastery of basic skills in students through admission tests on Mathematical Thought (MT), Analytical Thought (AT), Structure of the Language (SL), and Reading Comprehension (RC). The results are issued in two types of scale -ICNE and percentage- for the knowledge of the educational authorities and the supporters. The ICNE scale of the CENEVAL EXANI-II varies from 700 to 1300 points. This also applies a diagnostic test of basic knowledge, specific to engineering programs, of: Mathematics (Math), Physics (Phy), Written Language (WL) and English as a Foreign Language (EFL). In this case the results are delivered in a binary format: Satisfactory or Unsatisfactory. In addition, the applicants must answer a questionnaire about the characteristics of the context in which they live and study, which includes questions related to their perceptions on various matters such as: if they fulfill their school duties, if they have a person they can trust, his position on problems or bullying, his level of competence in various jobs related to school activities, among others.

The exams provide information about the learning outcomes of the applicants that are predictive of the academic performance they will have during their subsequent career. In particular, the detection of skills and competences in relation to mathematical and analytical thinking and reading comprehension and structure of the language, allow detecting the potential of candidates to successfully complete the first year of undergraduate level (CENEVAL, s.f.).

Students admitted to an engineering program are subject to support strategies such as tutoring, which have the objective of "supporting the student in the decision-making process related to the construction of their training trajectory ... aimed at improving students' Continuously based on the reflection on its performance" (DGEST, 2013, p. 18), that is, the integral formation of the professional in engineering is contemplated with different strategies, some of them focused on the development of the person, of being.

However, the majority of students recently admitted to the engineering programs of the technological institute where the research is conducted present weaknesses in their disciplinary competences in Mathematics, and in those related to their oral and written communication in Spanish.

That is an strategy like "mentoring has long been considered a developmental and retention strategy for undergraduate students, and research suggests mentoring efforts are positively related to a variety of developmental and academic outcomes" (Crisp, Baker, Griffin, Lunsford, & Pifer, 2017, p. 7), or the aims like SUG program in the USA: reduce pressure associated with traditional grades during the first semester and help sutdents transition successfully from high school to postsecondary education (Novak, Paguyo, & Siller, 2016); or the use of remedial courses for attendig weaknesses in basic math knowledge (Ulmer, Means, Cawthon, & Kristensen, 2016). All of them have been developed at ITCM but it is necessary to try other strategies.

In particular, the professors of the first semester of engineering realize the complexity involved in attending and guiding groups of students with socio-economic and cultural differences that stand out as reflected in the skills and knowledge necessary to continue their academic career. If the attitudes of these new students who show communication problems with the teachers and tutors, and sometimes even with the peers, are added to the above, it is also presented as an obstacle both for the academic formation and for the integration to the institutional community (Guzman-Gomez, 2013).

Although the ITCM has an educational offer focused on engineering programs, the student community is very heterogeneous, not only for its socio-economic and cultural reasons, but also for the educational models of the upper secondary level from which they come, due to the transformation of the context social of the southern zone of Tamaulipas. In addition, the distinctive profile of each engineering career induces students to follow a series of behaviors, codes and rituals for survival purposes with their peers and their teachers; some manage to adapt, but others end up emigrating to another career or to another institution or to the productive sector.

It is also recognized that the teacher's task has its effect on the student's performance in the emotional and cognitive aspect, for this reason the continuous formative evaluation is so important to generate confidence (Silva-Laya & Rodríguez, 2012). In the upper middle level, it has been identified that the percentage of students who reach the excellent level in Mathematics is directly related to the frequency of collegiate work on the campus, with the collaborative work of their teachers (INEE/SEP, 2015). Some of the aspects related to the development of the person in their psychosocial environment are linked to food, self-esteem, exercise and breathing, physical and mental balance that allows better conditions for learning (Soto-Hernandez & Orta-Kenning, 2017).

Method

This work forms part of a longitudinal investigation with candidates to study at one of the institutions of the National Technological Institute of Mexico and was carried out during the second semester of 2016. The results of the 1581 applicants of the EXANI-II examination were analyzed, both the areas of admission - Mathematical Thought, Analytical Thought, Structure of the Language, and Reading Comprehension - as diagnostic - Mathematics, Physics, Written Language and English as a Foreign Language - and the answers given to seven questions of the context questionnaire related to their attitudes towards the study.

These context questions referred to the identification of students with the following statements: *If I try hard enough I will succeed in school; Whether I do well or badly depends entirely on me; If I propose, I do better in school; With other teachers I would do better in school; If my family supported me more, I would do better; My grades in school are due to my luck; My grades at school are due to things I can not change*. The eligible answers were: 1) *I do not identify myself*, 2) *I identify myself little*, 3) *I identify myself,* or 4) *I identify completely*. These seven questions were classified as positive - the first three - and negative - the other four - according to the personal decision to work to achieve the competencies established in the study programs.

The results of the skills tests -admission- and of knowledge -diagnostics- and the answers to the seven questions of the questionnaire of the entire population were analyzed through the IBM SPSS program to identify correlations between different variables and, then, possible dependencies. that will make a diagnosis; which was used to guide some actions of the strategy of attention of the students during the first year of their school trajectory in higher education. The reliability of the data using Cronbach's alpha was very high for student averages with 0.863, and 0.744 for answers to questions about both positive and negative attitudes and results in diagnostic tests.

Results

The applicant population at the ITCM was constituted by 65% of men and 35% of women, of which 76.3% came from a baccalaureate with a public support system and 23.7% from a private school. Among all the baccalaureate modalities of the educational system of Mexico, the technological baccalaureate contributed 58.6% of the applicants, the general baccalaureate 35% and the technical professional modality of the National College of Technical Professional Education (CONALEP) 5%, the rest between baccalaureate by TV -14 applicants-, international baccalaureate -four applicants- and intercultural baccalaureate with an applicant (bilingual indigenous).

Table 1 shows the distribution of applicants frequencies by program: Environmental Engineering (EvE), Electrical Engineering (EiE), Electronic Engineering (EoE), Geosciences Engineering (GE), Business Management Engineering (BME), Industrial Engineering (IE), Mechanical Engineering (ME), Petroleum Engineering (PE), Chemical Engineering (ChE) and Computer Systems Engineering (CSE).

Table 1. Frequency distribution of the population examined by engineering program.

Engineering	EE	EiE	EoE	GE	BME	IE	ME	PE	ChE	CSE
Applicants	64	129	84	137	184	278	219	96	262	128
Percentage	4%	8.2%	5.3%	8.7%	11.6%	17.6%	13.9%	6.1%	16.6%	8.1%

Source: Own elaboration with data from CENEVAL (2016).

About the admission exam

On the results of the admission exam, according to the modality of the baccalaureate of origin, the comparisons between the overall result obtained by the applicants in the institute, in the state of Tamaulipas, and the obtained at the national level, are better results the applicants of the institute in the cases of the general baccalaureate, technological baccalaureate and technical professional -see table 2. Of the three baccalaureate modalities preponderant for the institute, the one that is always better evaluated is the one corresponding to the technological baccalaureate, which contributes 59% of the enrollment.

On average, the results of the candidates in the admission exam were: Mathematical Thought 55.3%, Analytical Thought 55.3%, Language Structure 52.8%, and Reading Comprehension 54.3%. The results per engineering program for each of those skills are shown in graph 2. The averages of grades shown on it were analyzed to verify if there were significant differences between the applicants for the different engineering, through the tests of hypotheses of equality of population variances. See the table 3.

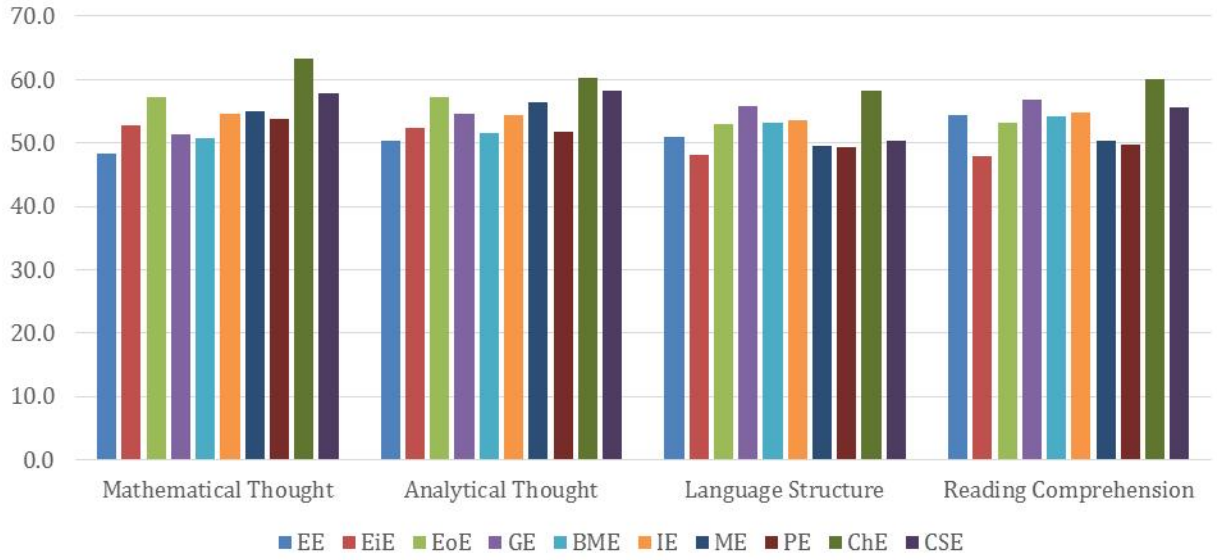
Table 2. Comparative global results of the EXANI-II Admission by modality of the baccalaureate of origin of the applicant, in ICNE index of Ceneval.

	General Average	General Baccalaureate	Technological Baccalaureate	Technical Professional
Global at ITCM (1,581 applicants)	1,027	1,020	1,031	1,018
Global at Tamaulipas (24,973 applicants)	978	978	987	968
Global at Mexico (748,562 applicants)	999	1,005	993	979

Source: Own elaboration with data from CENEVAL (2016).

Likewise, the hypothesis was analyzed that the results obtained by the students in the four areas of the admission exam presented the same distribution by the student's gender, by the regime and the modality of the baccalaureate of origin. The results were: the averages in Structure of the Language and in Reading Comprehension have significant differences according to the gender of the applicants, resulting in the women with greater successes; according to the regime of the baccalaureate of origin, the applicants coming from private schools were more successful; the averages in Mathematical Thought also presented significant differences in the case of the baccalaureate modality, the graduates of technological baccalaureate had the greatest successes.

Graph 2. Average percentage results per area of the admission exam and per engineering program.



Source: Own elaboration with data from CENEVAL (2016).

Table 3. ANOVA table for the results of the admission exam by engineering program.

		Sum of squares	fg	Half quadratic	F	Sig.
Mathematical Thought	Between groups	27655.431	9	3072.826	8.585	.000
	Within groups	562336.787	1571	357.948		
	Sum	589992.218	1580			
Analytical Thinking	Between groups	14971.261	9	1663.473	5.693	.000
	Within groups	459028.486	1571	292.189		
	Sum	473999.747	1580			
Structure of the Language	Between groups	16582.298	9	1842.478	6.160	.000
	Within groups	469922.284	1571	299.123		
	Sum	486504.582	1580			
Reading Comprehension	Between groups	20721.891	9	2302.432	5.532	.000
	Within groups	653830.539	1571	416.187		
	Sum	674552.430	1580			

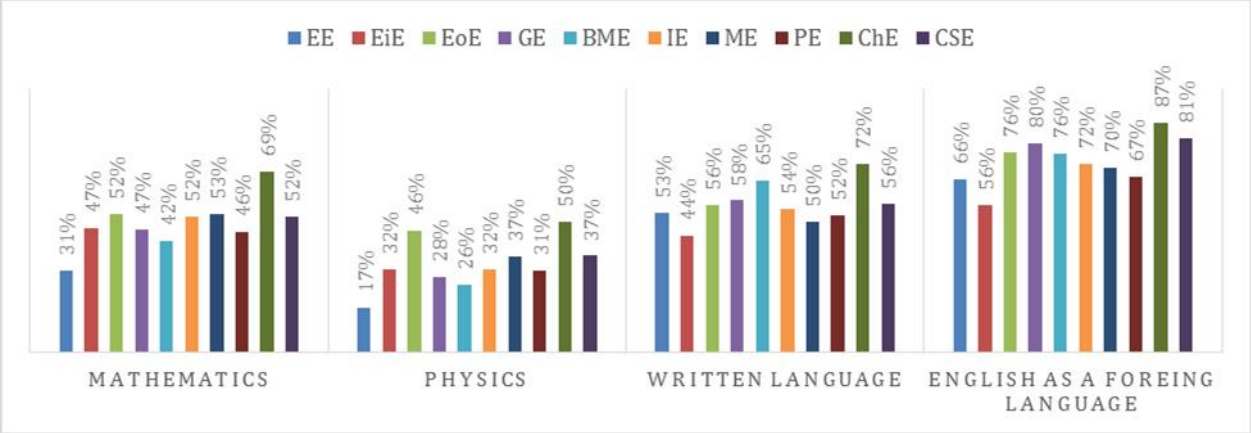
The results for Analytical Thinking did not have significant differences by the gender of the applicant nor by the regime and modality of the baccalaureate of origin. The results of the applicants in Mathematical Thought, Analytical Thought, Language Structure and Reading Comprehension presented significant differences related to the engineering program to which they aspired. In this sense, the significant difference between the results of the candidates for ChE, in all the areas of the admission exam, with respect to the rest, was conclusive. The multiple comparison test of Scheffe on the difference of means showed that in Mathematical Thought, the candidates for ChE did not have significant differences with those who aspired to EoE and CSE.

The test on the results of Analytical Thought showed that the students of ChE, EoE, GE, IE, ME and CSE do not present significant differences. That same test showed that the results in Structure of the Language of the candidates for ChE, EE, EoE, GE, BME and IE do not show significant differences. Finally, in the case of the results of Reading Comprehension, candidates for ChE, EE, EoE, GE, BME, IE and CSE did not show significant differences.

About the diagnostic test for engineering programs

The percentage of all applicants that obtained a Satisfactory result in each of the areas of the diagnostic test were: Mathematics 51.6%, Physics 34.9%, Written Language 57.4% and English as a Foreign Language 74.3%. The analysis per engineering program showed significant differences according to the program desired – see graph 3.

Graph 3. Percentage of the population that obtained a Satisfactory result by area of the diagnostic test and by engineering program.



Source: Own elaboration with data from CENEVAL (2016).

The reiterative case was the results of the ChE ones, as can be seen in tables 4 and 5, for each of the areas of the examination. However, in the case of the area of Physics, for the applicants of EE there were also significant differences with other three careers, while those of EoE also have differences with the results for BME - see tables 6 and 7. In the case of the Written Language area, the applicants of EiE also presented significant differences with those that go for BME, in addition to the results for ChE. The analysis of the results for the English area also showed that the applicants for EiE have significant differences with those for G, BME and CSE –table 8.

Table 4. Tamhane test for multiple comparisons in Mathematics and Physics.

Independent variable:		Mathematics			Physics		
(I) Engineering	(J) Engineering:	Mean Diff. (I-J)	Dev. Error	Sig.	Mean Diff. (I-J)	Dev. Error	Sig.
Chemical	Environmental	.375*	0.065	0	.324*	0.057	0
	Electrical	.214*	0.053	0.003	.178*	0.051	0.027
	Electronic	0.163	0.062	0.345	0.032	0.063	1
	Geosciences	.220*	0.052	0.001	.212*	0.05	0.001
	Management	.263*	0.046	0	.246*	0.045	0
	Industrial	.169*	0.042	0.002	.183*	0.042	0.001
	Mechanical	.162*	0.044	0.013	0.131	0.045	0.156
	Petroleum	.229*	0.059	0.006	0.184	0.057	0.063
	Systems	0.171	0.053	0.059	0.129	0.053	0.498

*. The difference in means is significant at the 0.05 level.

Table 5. Tamhane test for multiple comparisons in Written Language and English as a Foreign Language.

Independent variable:		Written Language			English as a Foreign Language		
(I) Engineering	(J) Engineering:	Mean Diff. (I-J)	Dev. Error	Sig.	Mean Diff. (I-J)	Dev. Error	Sig.
Chemical	Environmental	0.21	0.064	0.063	0.21	0.064	0.063
	Electrical	.308*	0.049	0	.308*	0.049	0
	Electronic	0.105	0.052	0.873	0.105	0.052	0.873
	Geosciences	0.071	0.041	0.981	0.071	0.041	0.981
	Management	0.111	0.039	0.172	0.111	0.039	0.172
	Industrial	.151*	0.035	0.001	.151*	0.035	0.001
	Mechanical	.168*	0.038	0.001	.168*	0.038	0.001
	Petroleum	.200*	0.053	0.011	.200*	0.053	0.011
	Systems	0.054	0.041	1	0.054	0.041	1

*. The difference in means is significant at the 0.05 level.

Table 6. Tamhane test for multiple comparisons in Physics.

(I) Engineering	(J) Engineering:	Mean Diff. (I-J)	Dev. Error	Sig.
Environmental	Electrical	-.146	.063	.626
	Electronic	-.292*	.072	.004
	Geosciences	-.113	.061	.957
	Management	-.078	.058	1.000
	Industrial	-.141	.055	.423
	Mechanical	-.193*	.058	.046
	Petroleum	-.141	.067	.826
	Chemical	-.324*	.057	.000
	Systems	-.195	.064	.113

*. The difference in means is significant at the 0.05 level.

Table 7. Tamhane test for multiple comparisons in Physics.

(I) Engineering	(J) Engineering:	Mean Diff. (I-J)	Dev. Error	Sig.
Electronic	Environmental	.292*	.072	.004
	Electrical	.146	.068	.788
	Geosciences	.180	.067	.308
	Management	.214*	.064	.045
	Industrial	.151	.062	.502
	Mechanical	.099	.064	.997
	Petroleum	.152	.073	.823
	Chemical	-.032	.063	1.000
	Systems	.097	.069	1.000

*. The difference in means is significant at the 0.05 level.

Table 8. Tamhane test for multiple comparisons in Written Language and English

Independent variable:		Written Language			English as a Foreign Language		
(I) Engineering	(J) Engineering:	Mean Diff. (I-J)	Dev. Error	Sig.	Mean Diff. (I-J)	Dev. Error	Sig.
Electrical	Environmental	-0.089	0.077	1	-0.098	0.074	1
	Electronic	-0.118	0.07	0.988	-0.204	0.064	0.075
	Geosciences	-0.127	0.062	0.845	-.237*	0.056	0.001
	Management	-.199*	0.057	0.027	-.197*	0.054	0.015
	Industrial	-0.101	0.053	0.931	-0.158	0.052	0.107
	Mechanical	-0.028	0.058	1	-0.14	0.054	0.365
	Petroleum	-0.079	0.067	1	-0.109	0.065	0.99
	Chemical	-.268*	0.053	0	-.308*	0.049	0
	Systems	-0.105	0.064	0.993	-.254*	0.056	0

*. La diferencia de medias es significativa en el nivel 0.05.

About the answers in the questions of attitudes to performance in school

The answers to the questions of the context questionnaire linked to the attitudes of the students can be classified into two categories: the first three ones - see table 9 - become positive thoughts, a focused mentality to strive and achieve what you want. The following four statements are associated with blaming others for successes or failures, assuming that situations beyond the control of the student themselves are the cause of their results and, therefore, do not merit great efforts to achieve success.

The positive thoughts of the students shown in the first three statements of Table 9 show high average results in general, while the negative thoughts had results well below the previous ones. In the statement that least coincided is the one referring to the need for greater family support with almost a point-of-three in the standard deviation.

Table 9. Descriptive statistics of the answers on some attitudes of the applicants.

Statement	Mean	Mode	St. Dev.	Minimum	Maximum
If I try hard enough I will succeed in school	3.52	4	0.57	1	4
Whether I do well or badly depends entirely on me	3.51	4	0.62	1	4
If I propose it, I do better in school	3.60	4	0.58	1	4
With other teachers, I would do better in school	1.86	2	0.85	1	4
If my family support me more, I would do better	1.86	1	0.99	1	4
My grades in school are due to my luck	1.28	1	0.59	1	4
My grades at school are due to things I can not change	1.41	1	0.69	1	4

With this information, hypothesis tests for independent samples were conducted to determine whether the distribution of responses to each of these statements was similar according to different categories such as: gender, origin-public or private-regime, high school modality - technological baccalaureate, general baccalaureate, technical professional, or other - with the engineering program to which they aspired to enter, and with the results in each of the four areas of the diagnostic test - Mathematics, Physics, Written Language and English - and of the admission exam - Mathematical Thought, Analytical Thought, Language Structure, Reading Comprehension.

Also, in the cases that merited, the correlation coefficients were calculated, and, although they are weak - between 0.07 and 0.16-, it is considered an opportunity to consider it in the attention strategies of the new students. The results are shown in tables 10 and 11.

Table 10. Results of hypothesis tests and correlation between the answers to the questions about students' attitudes by categories of diverse variables.

Statement	Gender	Baccalaureate		Eng. Program	Diagnostic examination area			
		Regime	Modality		Math	Phy	WL	EFL
If I try hard enough I will succeed in school	(+)	No	No	No	(+)	No	(+)	(+)
Whether I do well or badly depends entirely on me	(+)	No	No	(+)	(+)	(+)	(+)	(+)
If I propose it, I do better in school	(+)	No	No	No	(+)	No	(+)	(+)
With other teachers, I would do better in school	(-)	No	No	No	No	No	No	No
If my family support me more, I would do better	No	No	No	No	(-)	(-)	(-)	(-)
My grades in school are due to my luck	(-)	No	No	No	(-)	(-)	(-)	(-)
My grades at school are due to things I can not change	(-)	No	No	No	No	No	(-)	No

(+) Positive correlation (-) Negative correlation

Table 11. Results of the hypothesis tests and correlation of students' attitudes by categories of variables in admission exam area.

Statement	MT	AT	LS	RC
If I try hard enough I will succeed in school	(+)	X	(+)	(+)
Whether I do well or badly depends entirely on me	(+)	(+)	(+)	(+)
If I propose it, I do better in school	(+)	(+)	(+)	(+)
With other teachers, I would do better in school	X	X	X	X
If my family support me more, I would do better	(-)	(-)	(-)	(-)
My grades in school are due to my luck	(-)	(-)	(-)	(-)
My grades at school are due to things I can not change.	(-)	(-)	(-)	(-)

(+) Positive correlation (-) Negative correlation

Discussion

The exploration of the information obtained from the applicants of the admission exam at ITCM in June 2016 shows that the majority of them came from a technological baccalaureate (58.6%), from a public regime (76%), and they are men (65.5%) . 60% of applicants applied to enter four of the 10 engineering programs offered by the institution (Industrial, Chemical, Mechanical and Business Management). The least demanded were Environmental (4%) and Electronics (5.3%).

The averages obtained in the admission exam at ITCM are significantly higher than those obtained at the

national and state level, and those applicants coming from a technological baccalaureate were those who showed the best results. The latter is verified for the area of influence at ITCM and for the federative entity, although at the national level the same situation is not present.

The averages reached by the applicants in the admission exam - Mathematical Thought, Analytical Thought, Language Structure and Reading Comprehension - present significant differences according to the gender of the applicant for Language Structure and Reading Comprehension, resulting in better grades for the students. women; according to the regime of the baccalaureate of origin - public or private - of the student have significant differences for Language Structure and in Reading Comprehension, resulting with better averages who come from private baccalaureate. The results in Mathematical Thought presented significant differences in the case of the baccalaureate modality, being the aspirants that come from a technological baccalaureate who obtain better averages.

These averages of the admission exam also presented significant differences according to the engineering program to which they wish to enter, the candidates to ChE result with better averages in all the areas of the examination; those that go for EoE show similarity with those of ChE in all areas; applicants for CSE have similar results except in Language Structure. See Table 12 where these similarities were expressed. With this one could say that, removing the candidates for ChE, all the others would have results without significant differences.

Table 12. Table of multiple comparisons by difference of means in admission exam by engineering program.

	There are no significant differences for:			
Engineering Program	Mathematical Thought	Analytical Thought	Language Structure	Reading Comprehension
EE	All except ChE	All except ChE	All	All
EiE	All except ChE	All except ChE	All except ChE	All except ChE
EoE	All	All	All	All
GE	All except ChE	All	All	All
BME	All except ChE	All except ChE	All	All
IE	All except ChE	All	All	All
ME	All except ChE	All	All except ChE	All except ChE
PE	All except ChE	All except ChE	All except ChE	All except ChE
ChE	EoE, CSE	EoE, GE, IE, ME, CSE	EE, EoE, GE, BME, IE	EE, EoE, GE, BME, IE CSE
CSE	All	All	All except ChE	All

In the case of the engineering diagnostic test, the results in all areas are clearly better than the rest for the candidates for ChE, however, the candidates for EoE and CSE also present similarities in all areas. It also stands out that, in Physics, in addition to the previous ones, only the results of ME and PE are similar. See table 13 where the similarities are shown for the results in these exams that are of knowledge about the areas. In this case there is more variability among the profiles of the candidates for different careers, although in general it could be said that, even if the applicants of ChE and EoE were removed, there would still be some cases like EE or EiE that would have weaknesses in some areas, beyond those common to all.

In the case of attitudes, one could say that positive attitudes are stronger in applicants than weak ones. Positive attitudes are correlated with gender and women are the ones who are most present; whereas negative attitudes are more frequent in men. The expectation of greater family support does not show significant differences between genders or between the regime and the baccalaureate modality. In fact, for these last categories there is no difference in the results. By engineering program, only the perceptions that everything depends on me are different between one and other applicants, being those of ChE and CSE who think the most.

In terms of admission exams and engineering diagnosis, positive attitudes are directly correlated with all areas except Analytical Thinking with attitude *If I try hard enough I will succeed*. Similarly, in the case of Physics results, the attitude about *Everything depends on me* is the only one that is correlated, the rest makes no difference.

Table 13. Table of multiple comparisons by difference of means of the diagnostic test by engineering.

	There are no significant differences for:			
Eng. Program	Mathematics	Physics	Written Language	English as a Foreign Language
EE	All except ChE	All except EoE, ME, ChE	All	All
EiE	All except ChE	All except ChE	All except BME, ChE	EE, IEoE, IE, ME, PE
EoE	All	All except EE, BME	All	All
GE	All except ChE	All except ChE	All	All except EiE
BME	All except ChE	All except EoE, ChE	All except EiE	All except IE
IE	All except ChE	All except ChE	All except ChE	All except ChE
ME	All except ChE	All except EE	All except ChE	All except ChE
PE	All except ChE	All	All	All except ChE
ChE	EoE, CSE	EoE, ME, PE, CSE	EE, EoE, GE, BME, PE, CSE	EE, EoE, GE, BME, CSE
CSE	All	All	All	All except EiE

The negative attitudes associated with It is the luck that I have, *There are things that I can not change* and *With other teachers I would go better*, they are only related to the gender of the aspirants, men are more convinced of it. The other categories associated with the type of baccalaureate and career do not have differences between them.

In the case of the categories of results on the admission exams and engineering diagnosis, the negative attitudes are inversely related to those; that is, those who have better results in Mathematical Thought, Analytical Thought, Language Structure, Reading Comprehension, Mathematics, Physics, Written Language and English present lower incidence in these thoughts; with the exception of *There are things that I can not change* that is only related to Structure of the Language, also in reverse. This last attitude is not related to the results in Mathematics, Physics or English as a Foreign Language.

Conclusion

The analysis of the results of the EXANI-II exam for engineering of 2016 shows that the averages are better than their similar ones in the Tamaulipas and national levels. Also, that, on average, the applicants graduated from the technological baccalaureates obtain better results than the rest; and that the aspirants to enter Chemical Engineering stand out from all the rest in all the areas - Mathematical Thought, Analytical Thought, Structure of the Language, Reading Comprehension, Mathematics, Physics, Written Language and English - although in some of them the aspirants to Electronic Engineering and Computer Systems Engineering also have results with significant differences from others.

The applicants who come from the different baccalaureate regimes -public and private- do not present differences in the general, with the exception of the results for Structure of the Language where the applicants of baccalaureate under the private regime had better results. The positive and negative attitudes of the applicants, in general are associated with their gender, women have more positive attitudes than men and vice versa. The thought *With other teachers I would do better in school* is present in the same way in all categories of analysis, it makes no difference except in the gender of the aspirant, who most think about it are men.

The analysis of the performance of the applicants of the admission exams to an engineering program, associated with their perception of a series of assertions related to these positive or negative attitudes towards their success in school activities, showed that, the convictions about the need of striving to achieve the goal, are related to better results in all areas except Analytical Thinking and Physics. The answers to other teachers would be better do not present, on average, significant differences in each of the categories of analysis.

Those aspirants who weighed the negative attitudes to a greater extent on *It is the luck that I have* and *If my family supported me more* they presented lower results in all the areas of the exams. Whereas, those who think that *there are things that I can not change* showed lower results in the areas of the admission exam - Mathematical Thought, Analytical Thought, Language Structure and Reading Comprehension - as well as in English as a Foreign Language.

From all of the above, in general it is possible to conclude that the results of the candidates to study engineering in the areas of the admission exam - Mathematical Thought, Analytical Thought, Language Structure, Reading Comprehension - and the diagnostic test - Mathematics, Physics, Written Language and English as a Foreign Language - are related to the attitudes towards the study that they have sustained in their school trajectory. Thoughts like *If I try hard enough I will succeed in school*; *Whether I do well or badly depends entirely on me*; and *If I propose it, I do better in school*, they are associated with better grade averages in almost everything, except in Analytical Thinking and in Physics. On the other hand, *if my family supported me more, I would do better*; and *My grades in school are due to the luck I have*, they are associated with lower grade averages in all areas of the admission and diagnostic exams. The conviction that *my grades in school are due to things that I can not change* is only related to lower scores in the areas of the admission exam involving skills -Mathematical Thought, Analytical Thought, Language Structure and Reading Comprehension- and in Written Language of the diagnostic test.

In conclusion: the results of the examinations of skills and knowledge are related to the attitudes of students towards the study; these attitudes are associated with the gender of the students, women tend to have more positive attitudes and men towards negative ones; these attitudes do not vary from one high school of origin to another. The applicants of Chemical Engineering have results far above the rest of the candidates, although in some areas the candidates for Electronic Engineering and Computer Systems Engineering also have results above others.

Therefore, it is feasible to apply a differentiated strategy of income to the institution where not only elements of reinforcement in the basic areas for engineering are included, but also the attitudinal improvement towards the study of the students and with that of the results in their school trajectory. Teachers should also be aware of the attitudinal variables in learning and the role they should assume in a differentiated way with students of different engineering programs. Students of Chemical Engineering require greater challenges while those of Electrical Engineering or Environmental Engineering of greater support.

Biography

Ana Maria Soto-Hernandez has a Doctorate in International Education from the Autonomous University of Tamaulipas, Mexico; a Master of Science in Educational Mathematics from the Center for Research and Advanced Studies, Mexico; a University Expert in Educational Indicators and Statistics by the National University of Distance Education, Spain. She is 40 years old as a Math teacher, 25 years in educational research, 11 years in management roles, and 8 years as an Evaluator of high school education. She is a Professor with Desirable Profile, and Leader of the Academic Team Applied Tic's of the National Technological Institute of Mexico.

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