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EFFECTIVENESS OF HIGH SCHOOL GRADUATES FOR ENTERING ENGINEERING STUDIES

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Abstract: A statistical analysis is presented to determine if there is a correlation between the results obtained by applicants to enter the Technological Institute of Pachuca in the Exani II selection exam and the type of upper secondary education institution of origin. The information provided by Ceneval and that obtained at the institute was collected and analyzed. In each case, the average value recorded (ICNE) was used, generally placing them in three blocks or levels. With the support of data obtained from the analysis of the context and the additional study carried out at the institute, the information was classified according to the schools of origin, emphasizing those with the highest incidence. The analysis of the results showed a logical relationship, although more specific, and, above all, the need for an approach to upper secondary level institutions to seek to strengthen the processes of both educational levels.

Keywords: Exani II, ICNE, preparatory, dual baccalaureate

INTRODUCTION

The Pachuca Institute of Technology (ITP), like any higher education institution, faces the challenges imposed by the demand for professionals who are up to date in their area of training and competent to develop in the workplace. But it must also respond to the changes that social evolution establishes, reflected in ways of acting, customs, tools and also distractions and various problems of students.

One of the common perceptions of undergraduate professors, and especially of engineering professors, is the lack of correspondence between the academic background of many students and those required to adequately complete the study programs and promote the competencies established in them. This situation is visible

from the first semester and, as there is no remedial situation, it increases throughout their career in the institution.

Since this is a common and complicated situation, teachers and researchers at educational institutions seek strategies that allow them to apply timely actions to improve student performance. This involves analyzing the initial situation; that is, the results of the selection exam and, in some cases, the grades from the previous level.

Studies have been published focused on the analysis of personal, family and socioeconomic factors that influence the results of the entrance exam for undergraduate studies. (Guzmán and Serrano, 2011). Other authors have focused their work on the relationship between academic achievement in the degree and the score obtained in the entrance exam (Wong, Banda, Medina and Cruz, 2017), (Rodríguez and Gómez, 2010), (Gómez, Rosales, Marín, García and Guzmán, 2012), (Chaín, Cruz, Martínez and Jácome, 2003), (Castaño, 2008).

Important contributions have emphasized the prediction of performance in bachelor's degrees based on the entrance exam (Chávez, Castillo and Gamboa, 2008) and Gómez, et al. (2018) present a predictive model for performance in the area of mathematics in engineering, with the same basis.

On the other hand, a certain relationship has also been documented between performance in the degree and the school of origin (Arias, Chávez and Muñoz, 2006), (Cu Balán, 2005). This relationship would seem important, given that the previous skills of first-semester students and some of those in higher semesters were acquired at the high school level.

This paper establishes the relationship between the results of the selection exam for applicants to enter engineering courses at the ITP and the high school institutions of origin.

This provides guidelines for identifying improvement strategies that reduce the academic inequalities that affect the score obtained.

A classification of higher secondary education institutions places them in three fields: general culture, preparation to continue higher education and they have focused their work on the relationship between academic achievement in the career and the score obtained in the entrance exam (Wong, Banda, Medina and Cruz, 2017), (Rodríguez and Gómez, 2010), (Gómez, Rosales, Marín, García and Guzmán, 2012), (Chaín, Cruz, Martínez and Jácome, 2003), (Castaño, 2008).

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A classification of higher secondary education institutions places them in three fields: general culture, preparation for continuing higher education and training for work (Villa, 2010). Coincidentally, for Benítez,

Ramos and González (2015) the higher secondary education institutions existing in Mexico can be classified within the following three categories:

- a) University (Propaedeutic Core): They consolidate knowledge acquired in secondary school and prepare the student in all areas of general knowledge.
- b) Technological (Bivalent Core): They prepare the student to integrate into productive fields and to continue studies at a higher level.
- c) Middle Professional: Students are trained in productive and service activities to enter the labor market.

Table 1 shows this classification for high school levels in the state of Hidalgo.

Type of baccalaureate	Denomination
Upper Secondary University Education (Propaedeutic core)	College of Bachelors (COBAEH)
	High Schools of the Autonomous University of the State of Hidalgo (UAEH)
	State Baccalaureates (BEH)
	Federal preparatory schools by cooperation (Prefeco)
	Private Preparatory Schools
	Center for High School Studies (CEB)
Technological Higher Secondary Education (Bivalent core)	Industrial and Services Technological Baccalaureate Center (CBTis)
	Center for Scientific and Technological Studies of the State of Hidalgo (CECyTEH)
	Agricultural Technological Baccalaureate Center (CBTA)
	Centre for Industrial and Service Technology Studies (CETIS)
Secondary Vocational Education	National College of Professional Technical Education (Conalep)
	Industrial Work Training Centers (Cecati)

Table 1. Classification of high school institutions in the state of Hidalgo

METHODOLOGY

A quantitative research was carried out, with a descriptive approach. A sample of 4,190 applicants was studied, a population that corresponds to those applying to enter the Civil Engineering, Business Management, Computer Systems, Industrial, Mechanical and Chemical Engineering, offered at the ITP, during periods between 2017 and 2020.

The sources of information were:

- The results of the Exani II selection exam provided by the National Evaluation Center (Ceneval). The average obtained was considered and reported as the Ceneval index (ICNE).
- A survey conducted by the Academic Development Department to each candidate at the time of pre-registration for the exam. Through this instrument, information was obtained about the school of origin, the number of schools in which the exam would be taken and the option that the ITP represents for the candidate (first or some other).

The analyses were carried out in three phases:

1. By type of high school
2. By name of the school that is of interest.
3. By specific campus.

RESULTS

ANALYSIS BY TYPE OF HIGH SCHOOL

Number and proportion of applicants. Based on the classification proposed by Benítez et al. (2015) adapted according to Table 1, the data shown in Figure 1 were obtained. It is observed that in global terms there is a greater contribution of applicants who graduate from a dual-purpose high school, although not very different from that of the propedeutic

core, however, that of secondary vocational education is very low, which is understandable due to the limited number of schools and because its purpose is more directed towards training for graduates to join the workplace.

Average results in Exani II. Based on the indexes obtained, which Ceneval establishes between 700 and 1300 points, Figure 2 shows that graduates of dual-core high school have a higher general average.

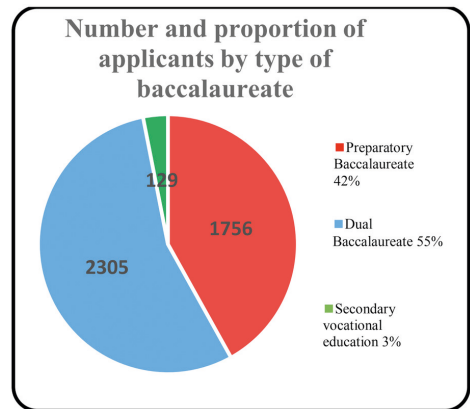


Figure 1: Applicants by type of baccalaureate

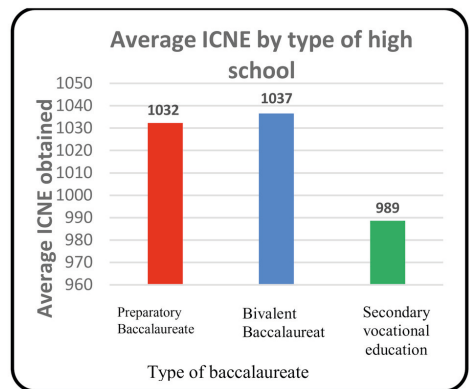


Figure 2: Average ICNE of Exani II applicants by type of baccalaureate

We observed that there is little difference between the dual-purpose baccalaureate and the preparatory baccalaureate, in fact, some private high schools and some of the UAEH surpass several dual-purpose schools. However, a more in-depth analysis shows that the majority of applicants from these high schools have the ITP as a secondary option and many no longer stay. Concluding at this point

that it is proven that our main market is still in the dual-purpose baccalaureates. Therefore, the analysis is repeated with these schools.

ANALYSIS BY DUAL-PURPOSE HIGH SCHOOLS OF ORIGIN

Number and proportion of applicants. An analysis by schools of origin, carried out only on dual-purpose high schools, is shown in Figure 3.

Average results in EXANI II. Table 4 shows the number and proportion of candidates and the average result in Exani II, respectively. It can be observed that there is a marked prevalence of candidates from the CBTis.

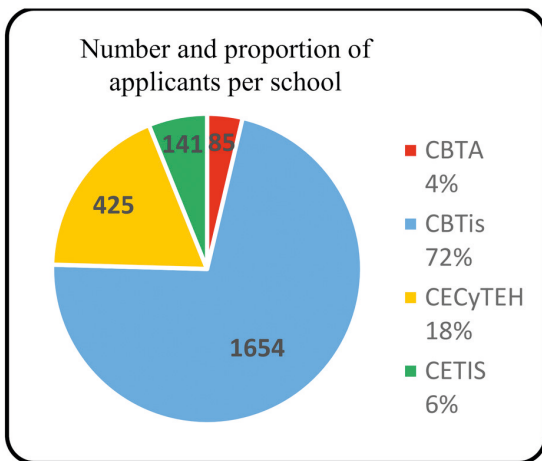


Figure 3: Applicants for dual-purpose high school

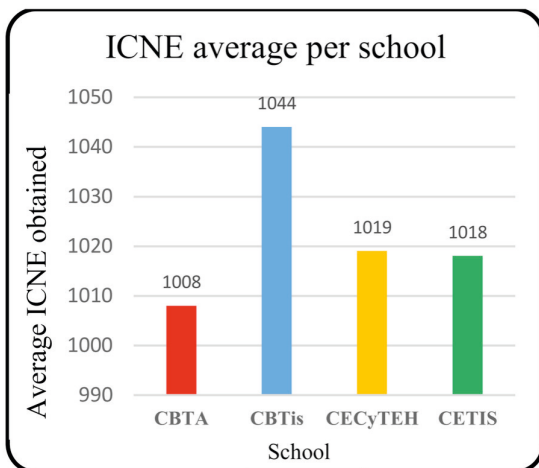


Figure 4: Average ICNE of candidates in the Exani II by school

Similarly, CBTis greatly exceed the average scores on the selection exam.

ANALYSIS BY SCHOOL OF ORIGIN

In accordance with what was shown in the previous section, the situation of the CBTis by existing campus in the region was analyzed in the same sense and the following results were obtained:

Number and proportion of applicants. Of the 13 schools from which the applicants come, 2 of them have minimal numbers and only in some periods; the total does not reach 0.1% of those quantified, therefore, only 11 of them are considered here.

Figure 5 shows that of the 1044 applicants from specific schools called CBTis, the one with the highest number of graduates applying to ITP with 31% of them is 222, located in the city of Pachuca, followed by 83, from Actopan Hgo and 8 also from Pachuca, with 23% and 18% of graduates respectively. Also worthy of attention are CBTis 199 from Mixquiahuala, 5 from Zacualtipán, 59 from Tepeapulco, 179 from Tulancingo and 218 from Tlaxcoapan; which present 9%, 5%, 4.3%, 3.6% and 3.6% respectively.

Average results in EXANI II. In this sense, Figure 6 shows that the best results are from CBTis 59 in Tepeapulco, closely followed by 222 in Pachuca and shortly after 199 in Mixquiahuala. A little further down are 5 in Zacualtipán, 83 in Actopan and 8 in Pachuca.

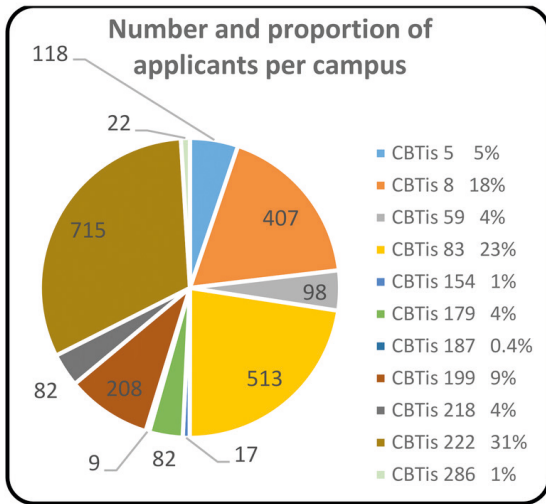


Figure 5: Applicants by squad

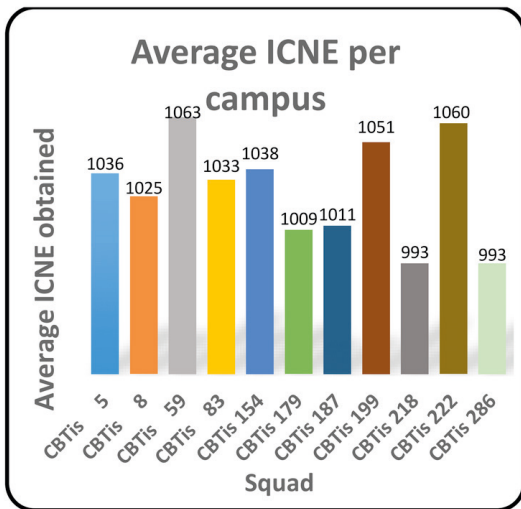


Figure 6: Promedio del ICNE de los aspirantes en el Exani II por plantel

CONCLUSIONS

The analysis carried out shows that, in fact and as already intuited from the existing general statistics, the institutions that supply clients to the ITP are mainly those that offer bivalent profiles and of these, the CBTis are the most numerous, followed by CECyTEH. In these schools, as in all those with a bivalent core, the preference for a career is normally related to the technical career studied, without this being definitive, nor does it ensure good information or guidance. The above motivates us to analyse and continue or rethink the schemes for promoting the educational offer of the ITP.

As for the results in the admission exam, the general average in all cases is not desirable, although the ITP has this exam as its only selection criterion and admits only the best. From this and as part of the national educational system and mainly in this region, the concern arises that a large number of young people do not access higher education due to unsatisfactory results in this test. Therefore, these results must lead to generating feedback strategies for higher secondary education institutions with elements that serve as support for the improvement of their educational processes.

REFERENCES

- Arias, F., Chávez, A. y Muñoz, I. (2006). El aprovechamiento previo y la escuela de procedencia como predictor del aprovechamiento futuro: un caso. *Enseñanza e investigación en Psicología*, 11(1), 5-22. Recuperado de <https://www.redalyc.org/pdf/292/29211101.pdf>
- Benítez M. G., Ramos A. E. y González C. (2015). Influencia de los Antecedentes Académicos para el Ingreso en una Universidad Pública Mexicana: Un Estudio de Caso. *Revista Iberoamericana sobre Calidad, Eficacia y Cambio en Educación*, 13(3), 107-119. Recuperado de: <https://revistas.uam.es/reice/article/view/2786>
- Castaño, J. (2008). Correlación entre criterios de admisión y desempeño académico en estudiantes de la facultad de Medicina de la Universidad de Manizales. Manizales, Colombia. Recuperado de: <https://www.redalyc.org/pdf/2738/273820368006.pdf>
- Chain, R., Cruz, N., Martínez, M. y Jácome, N. (2003). Examen de selección y probabilidad de éxito escolar en estudios superiores. Estudio en una universidad pública estatal mexicana. *Revista Electrónica de Investigación Educativa*, 5(1), 1-17. Recuperado el 12 de mayo de 2019, de http://www.scielo.org.mx/scielo.php?pid=S1607-40412003000100005&script=sci_abstract&tlng=en
- Chaves, E., Castillo, M. y Gamboa, R. (2008). Correlación entre el examen de admisión y el rendimiento en el primer año de la carrera Enseñanza de la Matemática en la UNA. *Revista Electrónica Educare*, 12(2), 65-80. Recuperado de: <https://www.redalyc.org/pdf/1941/194114586007.pdf>
- Cu Balán, G. (2005). El impacto de la escuela de procedencia del nivel medio superior en el desempeño de los alumnos en el nivel universitario. *Revista Electrónica Iberoamericana sobre calidad, eficacia y cambio en educación*, 3(1), 764-769. Recuperado de: <https://www.redalyc.org/pdf/551/55130171.pdf>
- Gómez, A., León, Y., López, N., Islas, C. y Ortiz, N. (2018). Rendimiento académico de estudiantes de Ingeniería en el área de matemáticas. Caso: Sistemas Computacionales. *Revista de Aplicación Científica y Técnica*, 4(14), 13-23.
- Gómez, V., Rosales, S., Marín, G., García, J. y Guzmán, J. (2012). Correlación entre el examen de selección y el rendimiento académico al término de la carrera de Medicina. *Revista Cubana de Educación Médica Superior*, 26(4), 502-513. Recuperado de: <https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=38858>
- Guzmán, C. y Serrano, O. V. (2011). Las puertas del ingreso a la Educación Superior: el caso del concurso de selección a la licenciatura de la UNAM. *Revista de la Educación Superior*, 40(157), 31-53.
- Rodríguez, M. y Gómez, V. (2010). Indicadores al ingreso en la carrera de Medicina y su relación con el rendimiento académico. *Revista de la Educación Superior*, 39(153), 43-50.
- Villa, L. (2010) *La educación media superior: su construcción social desde el México independiente hasta nuestros días*. México: El Colegio de México. Recuperado de: <https://repositorio.colmex.mx/concern/books/w66345843?locale=es>
- Wong, J., Banda, H., Medina, J. y Cruz, V. (2017). Análisis de correlación de los resultados obtenidos en el examen de admisión vs el desempeño académico de alumnos de Ingeniería Industrial. *Revista de Docencia e Investigación Educativa*, 3(8), 31-41.