

# Scientific Journal of Applied Social and Clinical Science

## COMPARATIVE ANALYSIS OF BASIC KNOWLEDGE FOR ENTRY TO A HIGHER EDUCATION INSTITUTION

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**Abstract:** A comparative analysis of the basic knowledge of entry to each of the engineering programs offered by the Orizaba Technological Institute belonging to the National Technological Institute of Mexico is presented. Candidates from different high school institutions that aspire to be part of the technological community must take their admission exam in which aspects such as: Mathematical Logical Reasoning (RLM) and Reading Comprehension (CLE) are evaluated. In the same way, they perform a diagnostic exam where the following areas are considered: Mathematics (MAT), Physics (FIS) and English (ING). The student's score expressed on a scale of the National Technology of Mexico, which consists of 800 points, whose limits are 200 points for the lowest grade and 1000 points for the highest possible grade. Based on these results, it can be determined whether the applicant is accepted or not, which will allow them in the future to take part in one of the courses taught at the Orizaba Technological Institute belonging to the National Technological Institute of Mexico.

**Keywords:** Comparative analysis, basic knowledge, income.

## INTRODUCTION

When choosing a professional career, enthusiasm makes the difference during the selection and admission process, so the student must know what the study program offered is about, the entry and exit profiles, and the possible fields of work. which you will face in the not too distant future and how in demand the career of your choice is. Considering that a wrong decision leads to frustration, loss of time and money for the applicant and the family. Choosing a career is a life decision.

There are very demanding and very saturated careers, such as, for example,

at the Orizaba Technological Institute, 8 more careers are offered; however, the most requested are Industrial engineering and Business management's engineering, which are difficult to enter due to their high demand. On the contrary, they are Computer, Electrical and Chemical Engineering are experiencing a decline in demand.

Until before the Covid-19 pandemic, the Orizaba Technological Institute used the EXANI II diagnostic exam carried out by the National Evaluation Center for Higher Education A.C. (CENEVAL). The EXANI II is an in-person admission exam, lasting 3 hours and 110 questions. This test evaluates the knowledge and aptitude of students in the modules: mathematical thinking, analytical thinking, reading comprehension and language structure.

Unfortunately, as a consequence of the Covid-19 pandemic, it was necessary to develop a new online admission exam so that candidates to enter the Orizaba Technological Institute would not have to run the risk of going to present a exam along with approximately fifteen hundred other people.

Therefore, July 24, 2020 was the first time that the online admission exam designed by the Orizaba Technological Institute, belonging to the National Technological Institute of Mexico, was applied. The design of this admission instrument was the responsibility of the Academic Development Department and it evaluates both knowledge and skills. On the knowledge side, the disciplinary areas that the admission instrument evaluates are: Mathematics, Physics and English, while, on the skills side, it evaluates mathematical logical reasoning and reading comprehension.

The admission instrument consists of 100 items, which are divided into 20 Mathematics items, 20 physics items, 20 English items, 20 mathematical logical reasoning items and 20 reading comprehension items. In this regard,

each block of items is weighted as follows: each mathematical logical reasoning item has a weight of 10 points, while each mathematics item has a weight of 9 points, each physics item has a weight of 8 points, each reading comprehension item has a weight of 7 points and each English item has a weight of 6 points.

The methodology to prepare each reagent was based on the methodology of the National Evaluation Center for Higher Education (CENEVAL), from which, teachers and researchers from the Orizaba Technological Institute, developed from scratch, 500 reagents of each of the topics that are evaluated in the exam, of which 20 items from each topic are randomly selected, so it is very unlikely that two people taking the exam will have to solve the same items, although the level of difficulty of each item is the same, to guarantee that the degree of difficulty of each exam is practically the same.

The rating scale for this evaluation instrument was also developed by ``National Technological Institute of Mexico``, Campus: Orizaba and was called Index of the National Technological Institute of Mexico Orizaba (ITNMO), which has a minimum rating of 200 points, to differentiate a person who took the exam and had all the wrong answers, from another person who did not take the exam, so he would not have a grade, that is, he would have 0 points. The following equation presents the equation by which the ITNMO is obtained for each person who has taken this exam:

$$\text{ITNMO} = 10*(\text{RLM}) + 9*(\text{MAT}) + 8*(\text{FIS})+7*(\text{CLE})+6(\text{ING})$$

In which:

RLM is the number of correct items from the Mathematical Logical Reasoning section.

MAT is the number of correct items from the Mathematics section.

FIS is the number of correct items from the Physics section.

CLE is the number of correct items in the Reading Comprehension section.

ING is the number of correct items from the English section.

## METHODOLOGY

In this research, the quantitative method will be used, given that all the data and processes with which we work are numerical in nature and the results obtained will be expressed in the same way.

## KINDS OF INVESTIGATION

**Quantitative Methods:** According to Yanetsys Sarduy Domínguez, quantitative methods are oriented towards studies that present only classifications of data and descriptions of reality.

“Quantitative research is dedicated to collecting, processing and analyzing quantitative or numerical data on previously determined variables. The data shown in the work is in total consonance with the variables that were declared from the beginning and the results obtained will provide a specific reality to which they are subject.” (Yanetsys Sarduy, 2007).

After ordering, classifying and analyzing the data of the results obtained in the EXANI-II test in each of its areas (Ceneval Index, Mathematical Thinking, Analytical Thinking, Language Structure and Reading Comprehension) it is possible to study the relationship of the different variables analyzed that exist among applicants for Mechanical engineering, Electric engineering and Business management’s engineering. The analysis variables are: School of origin, preparatory area studied in high school and average achieved throughout their upper secondary education.

Through the quantitative method, the relationship that exists between the variables shown in the research and their

future performance within the Orizaba Technological Institute will be inferred, considering that the data obtained allow us to determine if the school of origin is decisive to achieve a high index. of permanence, quality and sufficiency in their acquired elementary knowledge and academic performance. Through this information, we can establish which high school provides the best students for any of these engineering projects.

**Qualitative Methods:** “Focuses on collecting primarily verbal information rather than measurements. Then, the information obtained is analyzed in an interpretive manner.” (Catherin Jones,2013). This type of methodology will help us give a description of the results obtained, providing the reader with a more illustrative conclusion.

In this research, documentary analysis is essential because the base data for carrying out the study and the writing of efficient conclusions for the analyzed results of each of the areas will be obtained from these (Mathematical Logical Reasoning, Mathematics, Physics, Comprehension Reader and English) of the online admission

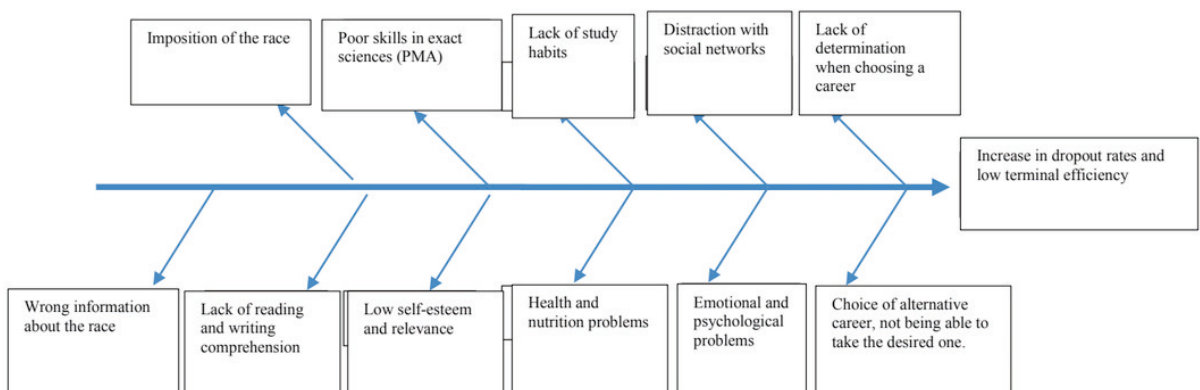
exam, which was developed by the Orizaba Technological Institute, belonging to the National Technological Institute of Mexico, as a consequence of the Covid-19 pandemic, for the careers offered by this Institute,

## RESULTS AND DISCUSSION

### TECHNIQUES AND INSTRUMENTS FOR OBTAINING DATA

**Note:** “Direct observation of the phenomenon under study is a fairly objective collection technique; With it, information can be obtained even when there is no desire to provide it and it is independent of the capacity and veracity of the people to be studied.”(Delgado, 2009).

**Ishikawa Diagram:** This diagram helps establish the cause-effect relationship of a conflict or problem in a synthetic way. Because it is a graphic tool, it provides a vision of the causes that have generated the conflict and the effects that it will have on other aspects of reality.



## Materials

For the analysis and comparison of data, the following were used: the general report of results of the online admission exam that was developed by the National Technological Institute of Mexico, Campus: Orizaba, through which the following background information was obtained: ITNMO (National Technological Index of Mexico Orizaba) obtained by each of the applicants and the score achieved in each of the areas of the admission exam, which are: RLM (Mathematical Logical Reasoning), MAT (Mathematics), FIS (Physics), CLE (Reading Comprehension) and ING (English), and the EXCEL program that was used to graph the data obtained and obtain trend measures such as: average or mean and percentages of the scores obtained.

## Population

For this case study, there was no need to obtain a sample of the population, because the number of elements is sufficient to be able to operate them without difficulty; The population of applicants for each of the Engineering were: Electric engineering: 146, Business management's engineering: 222, Computerstystems engineer: 223, Electronic Engineering: 99, Industrial engineering: 372, Mechanical engineering: 187, Chemical engineering: 234 and Informatics Engineering : 60, giving a total of 1543 applicants; and all the data from the analyzed areas were taken.

## CHARACTERISTICS OF THE POPULATION ACCORDING TO THE SCHOOLS OF ORIGIN

Considering the data obtained from the information collected, the schools of origin are obtained in general according to the socioeconomic environment of the students. It is important to consider that the name of the schools is not specified, whether they are public or private, which are mentioned below.

: It is important to mention that the data mentioned in this section correspond to the first half of 2021.

For the 1,543 applicants from all majors, to enter in the August - December 2021 semester, the schools of origin were classified as follows: General Baccalaureate with 40% corresponding to 617 applicants; Technical Baccalaureate with 37%, this corresponds to 571 applicants; Technical Professional is received by 17%, with a total of 262 applicants and Telebaccalaureate is received by 6%, from this institution 93 applicants were received.

Of 100% of the applicants, only 35% are women and 65% are men, which allows us to distinguish that the incidence of the male gender continues to prevail with regard to the area of Engineering.

Using the data obtained in the online admission exam, which was applied on June 4, 2021, to enter the different Engineering careers offered by the Orizaba Technological Institute, for the August - December 2021 semester.

Table 1 shows the average value of the National Technological Index of Mexico in Orizaba (ITNMO), obtained by applicants for each of the Engineering programs offered by this Institute.

ENGINEERING PROGRAM	NUMBER OF APPLICANTS	AVERAGE ITNMO
Electronic Engineering	99	490
Chemical engineering	234	488
Computerstystems engineer	223	482
Industrial engineering	372	465
Bussines managment's engineering	222	456
Informatics Engineering	60	456
Electric engineering	146	454
Mechanical engineering	187	453

Table 1: Average ITNMO by Engineering program

From the results shown in Table 1, it can be concluded that the candidates from the

three Engineering programs that obtained the highest average values of the ITNMO were the programs in which the greatest capacity for abstraction is required, the which are: Electronic Engineering, Chemical engineering and Computerstystems engineer. The rest of the Engineering programs obtained an average ITNMO value of 457 points  $\pm$  2%, which shows that the candidates to enter the Industrial engineering, Business management's engineering, Informatics Engineering, Electric engineering and Mechanical engineering programs, They have practically the same average ITNMO value, regardless of the demand and diversity of each of these Engineering programs. Below is a breakdown of each of the topics evaluated by the online admission exam that was designed by the Orizaba Technological Institute.

Table 2 shows the averages of correct answers obtained by the candidates to enter each of the Engineering programs offered by the Orizaba Technological Institute in the skill of Mathematical Logical Reasoning (RLM).

PROGRAM	NUMBER OF APPLICANTS	AVERAGE OF CORRECT RESPONSES OF RLM
Chemical engineering	234	7.28
Computerstystems engineer	223	7.21
Electronic Engineering	99	7.01
Informatics Engineering	60	6.45
Electric engineering	146	6.24
Mechanical engineering	187	6.14
Bussines managment's engineering	222	6.10
Industrial engineering	372	4.24

Table 2: Results of Mathematical Logical Reasoning

From the results shown in Table 2, it can be concluded that the candidates from the three Engineering programs that obtained the highest average values of correct RLM answers were the programs in which greater capacity for abstraction, which are: Chemical engineering, Computerstystems engineer and Electric engineering, which is consistent with the results presented in Table 1. On the other hand, the Informatics Engineering, Electric engineering, Mechanical engineering and Business management's engineering programs obtained a value ITNMO average of 6.23 correct answers  $\pm$  2%, which shows that the candidates to enter these Engineering programs have practically the same average value of correct RLM answers, regardless of the demand and diversity of each one of these Engineering programs. It is important to highlight that, in the particular case of the Industrial engineering program, an average value of correct RLM answers was obtained, of 4.24, which is a very low value compared to all other Engineering programs offered by the Technological Institute. of Orizaba, which is justifiable because this is the program with the greatest demand and the majority of the candidates, who obtained the lowest scores in the admission exam, did not manage to enter the Technological Institute of Orizaba, therefore, the value The average number of correct RLM responses of those accepted was close to the average of 6.23 correct responses.

Table 3 shows the averages of correct answers obtained by the candidates to enter each of the Engineering programs offered by the Orizaba Technological Institute in the skill of Reading Comprehension (CLE).

PROGRAM	NUMBER OF APPLICANTS	AVERAGE OF CORRECT READING COMPREHENSION RESPONSES
Chemical engineering	234	8.39
Electronic Engineering	99	8.15
Computersystems engineer	223	8.12
Informatics Engineering	60	8.07
Electric engineering	146	7.70
Bussines management's engineering	222	7.67
Industrial engineering	372	7.66
Mechanical engineering	187	7.22

Table 3: Reading Comprehension Results

From the results shown in Table 3, it can be concluded that the candidates from all the Engineering programs offered by the Orizaba Technological Institute obtained very similar average values of correct responses in Reading Comprehension (CLE), the which was an average CLE value of 7.87 correct answers  $\pm 7\%$ , which allows us to assume that all candidates have an acceptable level of Reading Comprehension.

Table 4 shows the averages of correct answers obtained by the candidates to enter each of the Engineering programs offered by the Orizaba Technological Institute in the knowledge of Mathematics (MAT).

PROGRAM	NUMBER OF APPLICANTS	AVERAGE OF CORRECT MATH ANSWERS
Chemical engineering	234	6.41
Electronic Engineering	99	6.09
Computersystems engineer	223	5.86
Industrial engineering	372	5.65
Informatics Engineering	60	5.45
Bussines management's engineering	222	5.36
Mechanical engineering	187	5.28
Electric engineering	146	5.13

Table 4: Mathematics Results

From the results shown in Table 4, it can be concluded that the candidates from the three Engineering programs that obtained the highest average values of correct answers in Mathematics were the programs in which greater capacity for abstraction, which are: Chemical engineering, Electronic Engineering and Computersystems engineer, which is consistent with the results presented in Tables 1 and 2. The rest of the Engineering programs obtained an average value of correct answers in Mathematics of 5.37 points  $\pm 4\%$ , which shows that the candidates to enter the Industrial engineering, Informatics Engineering, Business management's engineering, Informatics Engineering Mechanical and Electrical engineering programs have practically the same level of knowledge of Mathematics, which is a little low, compared to the candidates who obtained the highest averages, so it is recommended to teach remedial Mathematics courses, for those accepted to the Industrial engineering, Informatics Engineering, Business management's engineering, Informatics Mechanical Engineering and Electric engineering programs.

Table 5 shows the averages of correct

answers obtained by the candidates to enter each of the Engineering programs offered by the Orizaba Technological Institute in the knowledge of Physics (FIS).

PROGRAM	NUMBER OF APPLICANTS	AVERAGE OF CORRECT PHYSICS ANSWERS
Electronic Engineering	99	6.52
Chemical engineering	234	5.78
Computersystems engineer	223	5.56
Industrial engineering	372	5.52
Electric engineering	146	5.43
Bussines managment's engineering	222	5.28
Mechanical engineering	187	5.27
Informatics Engineering	60	4.65

Table 5. Physics Results

From the results shown in Table 5, it can be concluded that the candidates to enter the Electronic Engineering program have an acceptable level of knowledge of Physics, while the candidates to enter all the other Engineering programs offered by the Orizaba Technological Institute, they must receive remedial physics courses.

Table 6 shows the averages of correct answers obtained by the candidates to enter each of the Engineering programs offered by the Orizaba Technological Institute in the knowledge of English (ING). It is important to highlight that, in the admission instrument developed by the Orizaba Technological Institute, only basic English was evaluated, specifically reading and comprehension.

PROGRAM	NUMBER OF APPLICANTS	AVERAGE OF CORRECT ANSWERS IN ENGLISH
Computersystems engineer	223	8.75
Electronic Engineering	99	8.61
Chemical engineering	234	8.57
Industrial engineering	372	7.85
Bussines managment's engineering	222	7.81
Informatics Engineering	60	7.75
Electric engineering	146	7.32
Mechanical engineering	187	7.20

Table 6: English Results

From the results shown in Table 6, it can be concluded that the candidates from all the Engineering programs offered by the Orizaba Technological Institute obtained very similar average values of correct answers in English (ING), which It was an average ING value of 7.98 correct answers  $\pm$  9%, which allows us to assume that all candidates have an acceptable level of reading and understanding basic English.

## CONCLUSIONS

It is important to consider that any research work in this field has a long way to go, especially when the results achieved do not depend solely and exclusively on the skills of the teachers during the first semester, but also and largely on the students who enter.

All the skills that they acquire from their school of origin are important for their good performance during the school year, as well as study habits, health, economic, emotional and psychological issues. Likewise, the impact of the opinions of the people around them leads to the imposition of the career due to "family tradition" or simply not obtaining correct information about the study plan, field of



work, etc., about it. When all of the above is put together, they are a time bomb so that the future applicant is a potential candidate to fail most of the initial subjects or ultimately be a dropout, thereby affecting terminal efficiency,

which is a fundamental indicator within the Institutional Innovation and Development Program at the Orizaba Technological Institute.

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