ISSN 2523-0336

Volume 7, Issue 18 – July – December – 2023

Journal High School

ECORFAN®

Journal High School, Volume 7, Issue 18, December - 2023, is a semi-annual Journal edited by ECORFAN-Republic of Peru. Av. La Raza, No.1047 - Santa Ana, Cusco-Peru, CP: 11500
http://www.ecorfan.org/republicofperu/rj_educacion_superior.php, revista@ecorfan.org. Editor in Chief: Ramos Escamilla-María, Co-editor: Gabriel Suyo Cruz. ISSN: 2523-0336. Responsible for the last update of this issue ECORFAN Computer Unit. Imelda Escamilla Bouchán, PhD. Vladimir Luna Soto, PhD. Updated as of December 31, 2023.

Journal High School

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Knowledge Area

The works must be unpublished and refer to topics of Higher education curricular standards, higher education training fields, higher education curricular frameworks, higher education curricular parameters and other topics related to Humanities and Behavioral Sciences.

Presentation of Content

In the first article we present *Labor insertion from the perspective of university students: the current panorama of recently graduated alumni with social service and internship in covid confinement times*, by PÉREZ-DÍAZ, Luis Gustavo, IRETA-LOPEZ, Hugo and GÓNZALES-LÓPEZ, Olga Yeri, with assignment at the Universidad Juárez Autónoma de Tabasco, as a second article we present *Evaluation of the perception of a virtual learning object with activities to promote study habits in the subject of differential calculus*, by ARREDONDO-SALCEDO, Daniel, MIRELES-MEDINA, Antonia and MOLINA-WONG, Ma. del Refugio, with adscription in the Tecnológico Nacional de México, Instituto Tecnológico Superior Zacatecas Norte, as third article we present *Gender: learning styles*, by SÁNCHEZ-RIVERA, Lilia, ESPERICUETA-MEDINA, Marta Nieves, RAMOS-JAUBERT, Rocío Isabel and SOLÍS-RANGEL, Emmanuel, with adscription at the Universidad Autónoma de Coahuila, as fourth article we present *Project development with STEM features*, by MONTECILLO-PUENTE, Francisco Javier, with adscription in the Tecnológico Nacional de México campus Salvatierra, Instituto Tecnológico Superior de Salvatierra ITESS.

Content

Article **Journal High School**
December 2023, Vol.7 No.18 1-14

Labor insertion from the perspective of university students: the current panorama of recently graduated alumni with social service and internship in covid confinement times

Inserción laboral desde la perspectiva de los universitarios: el panorama actual de los recién egresados con servicio social y prácticas profesionales en tiempos de confinamiento

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DOI: 10.35429/JHS.2023.18.7.1.14 Received July 10, 2023; Accepted December 30, 2023

Abstract

In this research work, the current employment situation presented by graduates of the Public Accounting Degree of the Juárez Autonomous University of Tabasco who experienced their Social Service and Professional Practices in times of confinement was identified. A review process was carried out on the benefits of acquiring work experience before finishing the undergraduate studies and the main profiles or skills that accounting firms seek to hire an accounting assistant were analyzed. The methodological orientation at first had a descriptive approach. It started from secondary sources such as: books, articles, magazines and electronic pages. A review process was carried out in 4 different job boards related to accounting. In the second instance, through the survey technique, information was collected about the context and current situation of the graduates, about how they did in their social service and professional practices, what skills they learned and even how many have found a job or because they are not employed yet. At a last moment, this work had a correlational scope, since the impact or influence that the pandemic had on students was related with respect to their low or no opportunity to acquire work experience and how it affects their beginnings. In this sense, representative statistical information was obtained on the current employment situation of recent graduates. Thus, future Public Accounting applicants know information and hard data about the state of the labor market and what skills and competencies they will have to develop.

Practices, Pandemic, Employment, Statistical

Resumen

En este trabajo de investigación se identificó la situación laboral actual que presentan los egresados de la Lic. en Contaduría Pública de la Universidad Juárez Autónoma de Tabasco que experimentaron su Servicio Social y sus Prácticas Profesionales en tiempos de confinamiento. Se realizó un proceso de revisión sobre los beneficios de adquirir experiencia laboral antes de terminar los estudios de licenciatura y se analizaron los principales perfiles o habilidades que buscan los despachos contables para contratar a un auxiliar contable. La orientación metodológica en un primer momento tuvo un enfoque descriptivo, se partió de fuentes secundarias como: libros, artículos, revistas y páginas electrónicas y un proceso de revisión en 4 diferentes bolsas de empleos relacionados con la contaduría. En segunda instancia mediante la técnica de encuesta se recogió información sobre el contexto y la situación actual de los egresados, sobre cómo les fue en su servicio social y prácticas profesionales, que habilidades aprendieron y hasta cuántos han conseguido empleo o porque no están empleados aún. En un último momento este trabajo tuvo un alcance correlacional en donde se relacionó el impacto o la influencia que tuvo la pandemia en los estudiantes con respecto a su baja o nula oportunidad para adquirir experiencia laboral y cómo repercute en sus inicios. En este sentido se obtuvo información estadística representativa sobre la situación laboral actual de los recién egresados. Así, los futuros aspirantes a Contaduría Pública conocen información y datos duros sobre cómo está el mercado laboral y cuáles son las habilidades y competencias que tendrán que desarrollar.

Prácticas, Pandemia, Empleo, Estadística

Citation: PÉREZ-DÍAZ, Luis Gustavo, IRETA-LOPEZ, Hugo and GÓNZALES-LÓPEZ, Olga Yeri. Labor insertion from the perspective of university students: the current panorama of recently graduated alumni with social service and internship in covid confinement times. Journal High School. 2023. 7-18:1-14.

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Introduction

For university graduates, finding a job related to their bachelor's degree without having previous or sufficient experience, or having a poor mastery in their discipline, as well as the search for a work area where they can receive a sufficient income and if we add the few jobs they offer, are the main obstacles they encounter at the beginning of their working life.

In the results published in the National Survey of Graduates, (ENE, 2022) it is indicated that "the percentage of graduates who report an unemployment situation is 33.4%" (p.9).

On the other hand, the phenomenon of globalization causes companies to promote efficiency through competition and the division of labor, in this way "employers have a preference for hiring workers who have work experience, because they know the labor market better" (Ramírez, 1997, p. 14).

In this sense, so that future professionals can face the high competition that exists, universities propose as one of their main objectives to help the student to take their first steps in the labor market, incorporating in their curricula the "**Social Service**" as a curricular activity and the "**Professional Practice**" of course, both activities, as stated (UJAT, 2011), "acquire greater academic connotation, as they constitute educational alternatives to strengthen the student's professional training" (p.2).

However, covid-19 impacted all areas of society. So the mandatory confinement altered the development of social and educational relations and greatly impacted higher education. In this way, (Almonacid et al, 2021) mention that "the unexpected situation caused the abrupt interruption and modification of teaching processes, demanding quick decisions such as the start of teaching in *virtual mode*" (p.1), with these circumstances social service and professional practices in companies were no exception.

In fact, as of the first half of 2020, many of them were canceled or postponed, because most companies suspended their operations and therefore decided not to receive interns. This meant a delay in the insertion of students into the world of work.[1]

Justification

Considering the National Survey of Graduates (ENE) as one of the main sources of information in the country that is responsible for publicizing the work trajectory of graduates at the undergraduate level, it gives us data such as the skills acquired during their professional studies, how long they took to be employed and under what conditions and salary they did it, among others.

The purpose of the research is to adapt certain questions of the *ENE* and apply it specifically to recent graduates of Public Accounting from the *Universidad Juárez Autónoma de Tabasco* who finished their studies between *August 2020 and February 2023*, answering questions such as: where did they provide their social service and professional practices? Did they have ease or difficulty in employment? What is the monthly salary they receive? currently? Is your current job related to your career?, among multiple questions that access to obtain representative statistical information on the employment situation of recent graduates and, with these data, analyze and relate the impact or negative influence that the pandemic had on students in that period with respect to their low or no opportunity to acquire work experience and, as it affects its beginnings.

On the other hand, the people who will benefit from this research will be the future candidates for Public Accounting, since they will obtain information and hard data on how the labor market is and what skills and competencies they will have to develop. In this way they will have support to make the decision to enter to study or not the career in question.

[1] On March 11, 2020, Covid-19 was declared a pandemic worldwide. This significantly impacted all sectors of the economy and companies faced the challenge of having to keep their points of sale closed.

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ISSN-2523-0336

Problem

In the specific case of the Universidad Juárez Autónoma de Tabasco (UJAT), during that pandemic period, the students of the Academic Division of Administrative Economic Sciences (DACEA); in particular those of the Bachelor's Degree in Public Accounting, who were three and two semesters away from graduating or who already had more than 70% of curricular progress, had two options to give their services or practices:

The first was to wait for most of the companies and accounting firms in agreement with the university to receive students again in person, to get directly involved in the tasks.

The second choice was to carry out a collaboration service with some research professors of the university or with some companies in collaboration in the online modality.

For students who opted for the first option and decided to wait, they did so for at least a full year. This meant a considerable delay in their career considering that they were a couple of semesters away from completion.

Those who took the second option had no direct contact with the activities of a company or accounting firm. Their activities were small exercises in Excel or sending small research projects to teachers, slides for classes of different subjects, etc., where they only interacted by email or through the *Microsoft Teams application.*

"*In my case those activities did not help much, because they did not touch on issues related to the race. Let's consider that badly that time was invested in doing activities that did not benefit the professional future. You could not make policies, bank reconciliations or things that are developed in an accounting office. Considering a waste of time of 6 months*", (C.G. Cruz, personal communication, February 10, 2023), said student of the Lic. in Public Accounting who took his social service online.

In this context, the vast majority of Accounting students who graduated between *August 2020 and February 2022* did so very possibly without gaining work experience, an essential activity for a future professional. However, in terms of research, it was duly fulfilled in the student's graduation profile.

Similarly, for those who graduated between *August 2022 and February 2023*, they only experienced their professional practices without obtaining work experience.

Let us also consider that the established period is very short with only 4 months of practice in the case of DACEA and for an accounting intern it is not enough, considering that "the profession of an accountant and the tasks carried out in an office are very varied, therefore, it requires greater preparation and time to perform their tasks" (Bernal, 2021, para. 2).

Based on the above, the following questions were raised:

Did the lack of social service and professional practice due to confinement negatively affect the terminal training of students of Bachelor's Degree in Public Accounting at the Universidad Juárez Autónoma de Tabasco who graduated between August 2020 and February 2023?

What is your outlook in terms of employability, how many have jobs, how long do they take to be employed, their working conditions, their average biweekly salary, etc.?

This research can help stimulate its readers to be motivated to collect and analyze data from other specific degrees. In this way, each academic division will keep abreast of its graduates and will have an updated educational offer and will correspond to the historical moment of being able to structure or design better educational alternatives to strengthen the professional training of its students.

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Methodological description

Focus

For the development of this work, this study had a descriptive approach. At first, it was based on secondary sources, such as: books, articles, magazines and electronic pages, where information was obtained to highlight the importance of work experience for recent graduates, as well as, a review process was carried out in four different employment exchanges to specify the profiles and characteristics that companies and accounting firms seek to hire an accounting assistant in the state of Tabasco. Secondly, a survey collected information on the context and current situation of recent DACEA graduates, from how they fared in their social service and professional practices, what skills they learned and even how many have gotten a job, or why they are not yet employed. At the last moment, this work had a correlational scope because the impact or influence that the pandemic had on students was related to their low or no opportunity to acquire work experience and how it affects their beginnings. Whose information was obtained from the aforementioned survey.

Assumption

The following was proposed as a research case:

Exposing the current employment situation of recent graduates in Public Accounting who had no or little possibility of acquiring work experience, will allow restructuring or designing better educational alternatives to strengthen the professional training of students.

Objectives

General

Identify the current employment situation of Public Accounting graduates who finished their studies between August 2020 and February 2023 at the Universidad Juárez Autónoma de Tabasco to provide an analysis contribution on the panorama they experience at the beginning of their career.

Specific

- Conduct a process of reviewing the benefits of gaining practical experience before completing undergraduate studies.
- Analyze the main profiles or skills that companies or accounting firms are looking for to hire an accounting assistant.
- To know the opinion of graduates in Public Accounting about the difficulties and obstacles they face when trying to be employed for the first time.

Instruments

The collection of information on the context and current situation of recent graduates of the UJAT was obtained from the survey technique and the data collection instrument used was the questionnaire with prepared variables.

As the population is large and cannot be studied in its entirety, because the vast majority of graduates stop consulting their institutional emails (means by which they had chosen to send the questionnaires), the conclusions were based only on a part of it.

Therefore, the information was collected through a chain of former classmates and acquaintances of the degree who finished their studies between August 2020 and February 2023, this to comply with what was mentioned in the general objective. Likewise, they were asked for their school enrollment to make sure that they had indeed graduated during that period of time.

The variables that were prepared for the present research were the following:

Knowledge in the professional sector. The places where graduates provided their social service and professional practices during the pandemic period are announced. It is discovered that both they were involved in activities related to their area of study and the impact that confinement had on them to gain work experience.

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Current occupation of graduates. Data about your current employment situation. Where employees are located, whether the location is related to their bachelor's degree and/or the reasons why they are not currently gainfully employed.

Current working conditions. Percentage of graduates who have permanent, temporary or indefinite jobs. The means by which they receive their payment, average salaries, ratio of salary to time of experience and the main setbacks they had to be employed as accounting assistants.

Labor benefits. Percentages of graduates who do not have labor benefits in their jobs and in which sector they receive higher than those of law.

Skills acquired in college and their usefulness. Results were obtained on the skills they acquired in college and which ones have been most useful for their jobs. And what knowledge or skills recent graduates consider they should strengthen or involve in the classroom to strengthen their professional training.

Frame of Reference

The various companies and / or companies today need tools that help them make important decisions in a very fast way.[2]

Thus, the professional in charge of giving this important contribution of information-generating tools is the Public Accountant. The success and good management of companies and their economy depends largely on them.

The new dynamics that appear daily in the globalized market, new technologies and the high competition that exists, pressures companies to evolve day by day. In this sense, (García, 2018) mentions that these same circumstances "forces organizations to properly manage all the resources that are part of administrative and financial control, in order to anticipate future scenarios, and obtain the best economic and social results" (p.2), so it is necessary to have a person who is knowledgeable about everything related to the development of the company. That is, it has the ability to give an interpretation to the economic phenomena that develop in the environment and thus be able to provide advice. This is to face the challenges that arise in the economy. The public accountant is to a large extent.

For all of the above, a professional with these obligations "must be constantly trained, so that he can anticipate the future and interact with modern economic and social realities" (Delgado, 2021, para. 2).

From the perspective of a young recent graduate, this situation has a great impact. Well, previous experience became fundamental in a very competitive working world. Therefore, companies positively value any anticipated contact with the workplace, one where they have already established links and relationships with professionals. However, (Cháirez, 2003) in his work: E*strategias de prácticas profesionales del licenciado en contaduría pública del cucea*, states that on many occasions, he has observed that "there is a lack of professional techniques and lack of real approach of the university with companies" (p.13).

The lack of this approach creates a great void in the experience and in the learning of young graduates, making it more difficult for professionals to integrate into the world of work.[3]

[2]Carl Honoré in his book "*In Praise of Slowness*" mentions that today we all belong to the same cult of "speed". When everyone decides on speed, the advantage of going fast disappears and forces us to go even faster.

[3] Unemployment among young people is a circumstance that not only causes economic frustration, but also psychological frustration that is prolonged as the wait to find work becomes longer.

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Thus, the future professional (the public accountant) before leaving the university needs to face real and concrete experiences to be able to reflect on the different situations that arise in their professional area and in this way obtain their own concepts and ideas, which can be applied in future problems.

Most requested knowledge and skills for accounting assistant vacancies in Tabasco.

For all the above, it is important to have a clear idea of the type of experience that accounting firms request from young people today.

For this, the most requested knowledge for accounting assistant positions in the State of Tabasco was observed in vacancies. Which are shown in Figure 1.

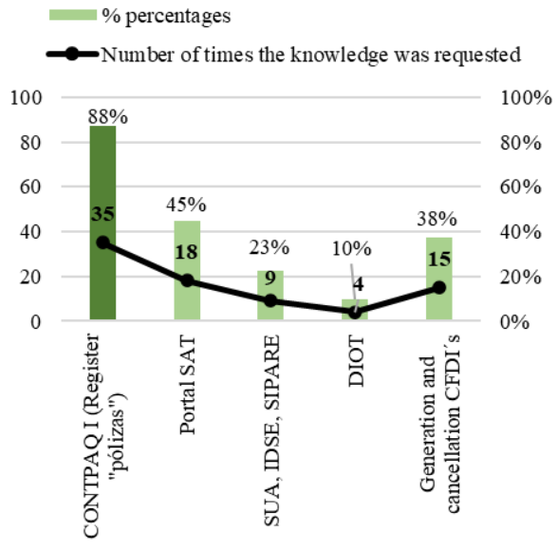

Figure 1 Most requested skills in Tabasco for accounting assistant vacancies
HOW TO READ THIS GRAPH: Of the 40 vacancies, 35 required knowledge in CONTPAQ i, this represented 88% of the time.
Source: Own elaboration with data obtained from 40 vacancies of accounting assistant in Tabasco, in 4 different job exchanges 2023

As we can see in the figure, the registration and management of policies through the *contpaqi* program [4] is the knowledge most requested by companies and accounting firms for an accounting assistant position with 88% of the time, followed by a wide familiarization with the SAT portal and the generation of invoices; on the other hand, The most required skills are:

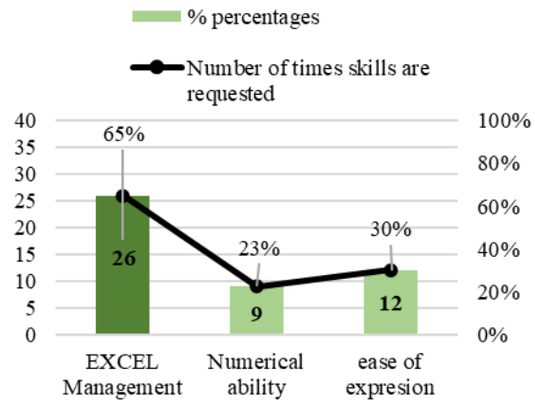

Figure 2 Most requested skills in Tabasco for accounting assistant vacancies
Source: Own elaboration with data obtained from 40 vacancies of accounting assistant in Tabasco, in 4 different job exchanges 2023

"Proficiency in excel" and "ease of speech" are identified as the most important skills to get a position as an accounting assistant. See Figure 2.

Importance of work experience for recent graduates

Given the immense theory in which university students immerse themselves throughout their career, professional internships almost always become the only opportunity they have to put their training into practice and learn more about the operation of companies.

[4] CONTPAQ i is an accounting and administrative software that helps the accountant to prepare electronic accounting and create reports and reports to present financial statements.

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The way in which young undergraduate students accumulate experience of situations that arise in real life is through social service and professional practices. In the same way, (Pavon *et al*., 2018) mention that these constitute "a moment of "initiation" in professional life because, it integrates students in a learning context, enabling the acquisition of knowledge, skills and competencies necessary for professional practice" (p.2), they even learn new ways of approaching problems from real situations, often in complex and uncertain environments.

Its main purpose is to publicize the labor areas of the profession and in the same way contribute to break the vicious circle in which many of them find themselves, of not being able to access a job due to lack of professional experience.

In fact, (Robles *et al*., 2012) in their work: *Professional practices as a strategy to contribute to the development of academic training. Case: Faculty of Accounting and Administration of the Autonomous University of Chihuahua.*, detail that "the practices represent a benefit for young people because, 66% of their respondents state that these professional practices have facilitated them to get a job" (p. 9).

Within the personal development of the student, the practices are very important because they provide a source of opportunity to face challenges and demonstrate their skills. "In addition to learning to work as a team, under pressure and form the character of professional ethics" (Díaz, 2019, p.2).

Results

Knowledge in the professional sector

Social service

For this variable, the results show us that because of confinement, 61% of graduates provided their **social service** online through Microsoft Teams or in email communication, carrying out research activities; or in libraries, classrooms, (assisting teachers / students), because most companies and / or accounting offices suspended operations.

Those who ran with more "luck" did so in public and private institutions but with activities NOT related to their area of study. Only 39% of them were fortunate enough to enter an accounting firm and get involved in the tasks of their area of study. See Figure 3.

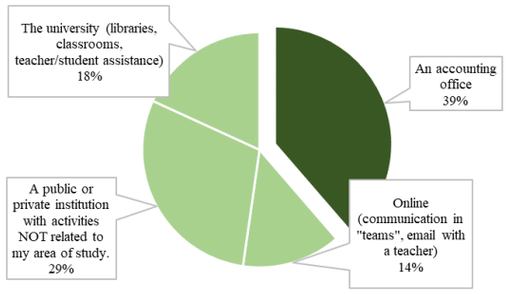

Figure 3 Places where they provided social service
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT.

Professional practices

There is an increase for the shift of **professional practices**. Where now 55% of graduates managed to lend it in a place directly related to their area of study.

However, in internships the time to obtain work experience is shorter than social service. Only 4 months. The data is shown in Figure 4.[5]

Even with this increase, of those who managed to link to an accounting office; 29% report that they were involved little or not at all in the tasks or activities performed by a public accountant.

[5] Although in Social Service the student has more time to explore and learn from the environment of an organization or interact with people, this is only focused on creating an awareness of solidarity and commitment to society. Therefore, most of the places where students arrive are not interested in letting them learn about their area of interest or discipline. In professional practices they do have that objective. However, it is very little time they attend. *This comparison is an element of future research.

ISSN-2523-0336

Impact of confinement on social service and professional practices

Similarly, 63% of graduates say that covid-19 and confinement had a "negative" or "very negative" influence on their social service and professional practice (in terms of their professional training and achievement of experience in their area of study). 32% indicate that it influenced positively and 5% affirm that it did not influence anything. See Figure 5.

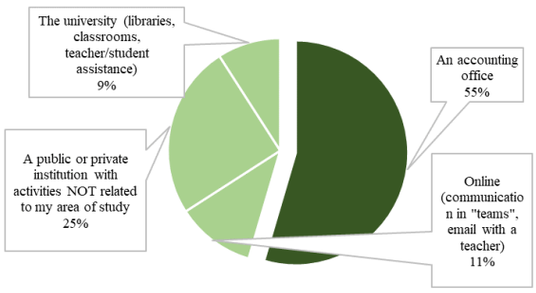

Figure 4 Places where they provided their "Professional Practices"
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

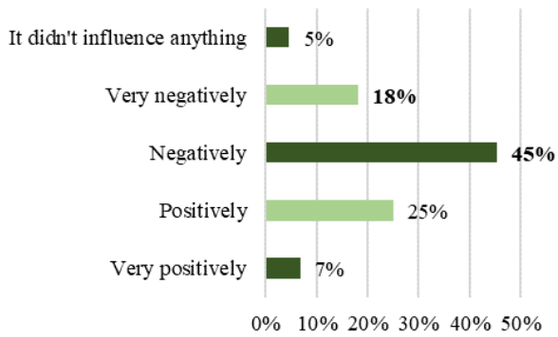

Figure 5 Impact of confinement on social service and professional practice (In terms of the achievement of experience and professional training)
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT.

Activities learned in social service and professional practices

As mentioned at the beginning, **social service** and professional internships seek to get students to start learning about the professional sector they chose as a career.

Thus, within the circumstances in which accounting graduates found themselves, in both educational alternatives, either in one or the other; managed to perform activities such as: Excel management with 75% of the time, SAT Portal management with 68% and 59% of the time they used CONTPAQ i. The data is shown in Figure 6.

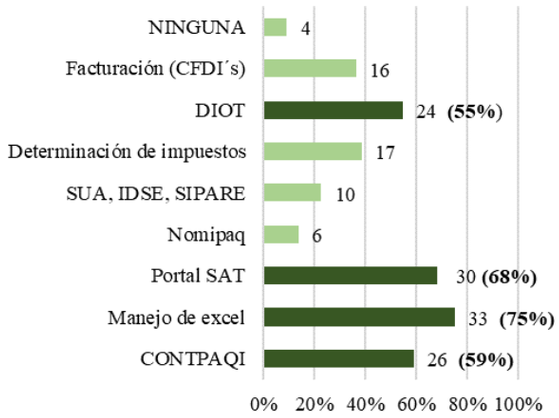

Figure 6 Activities they carried out in their social service and professional practice
HOW TO READ THIS GRAPH: Of the 44 respondents, 33 stated that they performed Excel Management activities, this represented 75% of the time
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJA

Current occupation of graduates

When graduates were asked about their current occupation, 61% said they were currently working, in turn, 2 out of 5 graduates reported unemployment. See Figure 7.

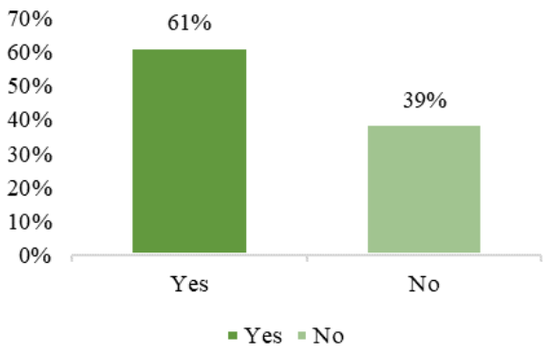

Figure 7 Are you currently working?
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

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Graduates with employment

52% of those who are employed are men, 48% are women.

Regarding where they were working, most of them claimed to be employed in a private institution with 82%, 11% are in a public institution and 7% are independent professionals. See Figure 8.

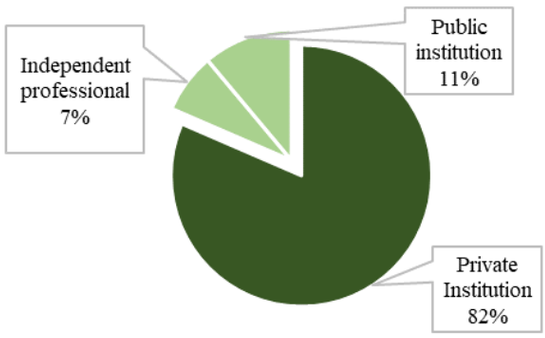

Figure 8 Where they are working
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

Likewise, 63% of them say that their current job is related to what they studied in the bachelor's degree, 3 out of 10 graduates carry out activities partially related to their area of study and 7% have a job not related to their career. The data are shown in Figure 9.

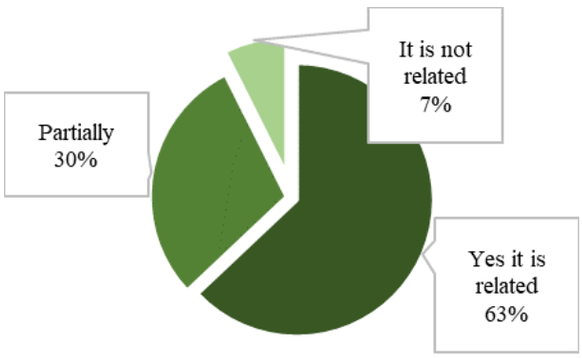

Figure 9 Work related to your bachelor's degree.
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

Unemployed graduates

Recent female graduates report a higher unemployment rate at 59%, while men account for 41%.

The reasons why they do not have a job or paid job is very varied: 18% mention that they are still in the process of titling, another 18% affirm that the job offer is little actractive. A considerable 23% say they are not because they did not develop the right skills. (It is important to mention that of the latter, 100% said that covid-19 and confinement negatively influenced their opportunity to achieve experience in their area of study, since they did not directly enter the activities of an accounting firm, that situation put them at a disadvantage), 12% more said that the labor market is saturated / there is a lot of competition. The data is shown in Figure 10.

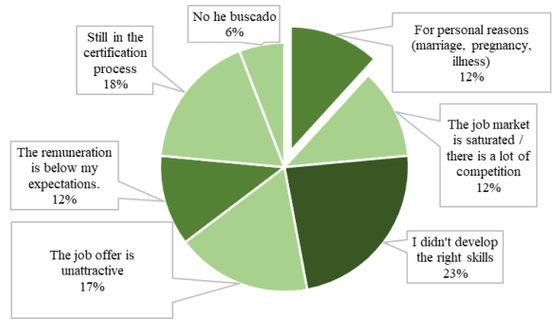

Figure 10 Reasons why they do not have employment or paid work
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

With respect to their current situation, 76% of unemployed graduates are looking for one. However, 3 out of 10 have not had the opportunity to gain work experience in their area of study. Another indication of the little or no opportunity that students had in the pandemic period. See Figure 11.

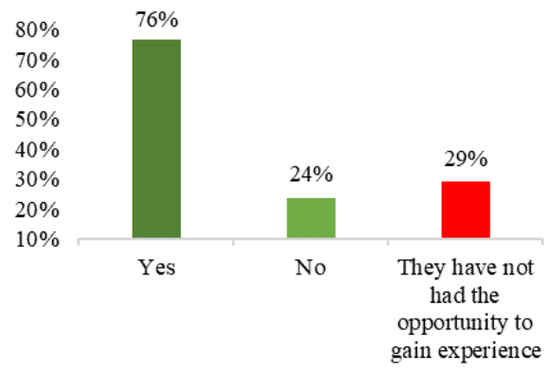

Figure 11 Are they currently looking for a job? And opportunity for experience in your area of study
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

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Current working conditions

44% of graduates who are already in a workplace are indefinite, 32% are temporary and only 24% have a permanent job.

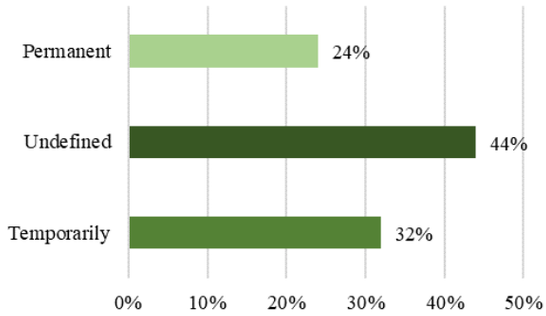

Figure 12 Current employment of recent graduates
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

74% of them receive their payment via payroll, 11% through fees and 15% indicate another form of payment. Those who receive their salaries by payroll are the ones who on average receive the highest salaries. See Figure 13.

How much do recent graduates of the UJAT earn working in an accounting firm in Tabasco?

Recent graduates who are working in an accounting firm earn an average of $ 5,067.65 on a biweekly basis.[6]

Of this population, males earn $1,052.80 MORE than females.

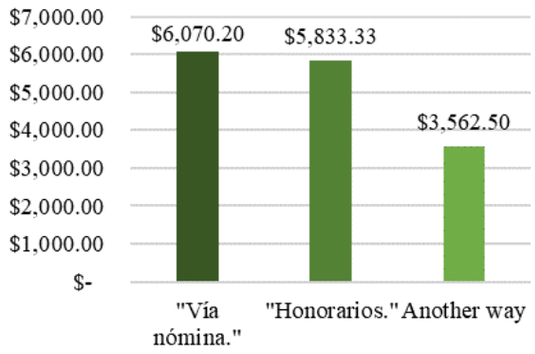

Figure 13 Average salary "biweekly" according to your form of payment
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

Relationship of salary to time of experience

The highest salaries tend to be for those who have graduated longer from college. With an average of $6,750.00.

In turn, the lowest salaries are for those who have less than a year of graduation. With an average of only $3,690.80. The data are shown in Figure 14

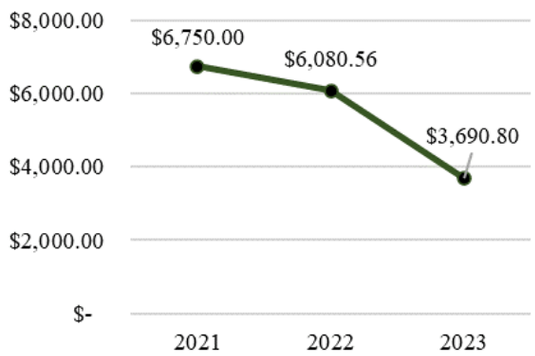

Figure 14 Average salary versus time of graduation
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

Means by which they obtained current employment

44% say they got their job "through a family friend or acquaintance", 30% got it in an "advertisement in a public place or media", 22% through their "social service" and only 4% through a job board of a public or private institution.

[6] The average salary earned by respondents who said they are in a job with activities "directly related to their bachelor's degree" was taken into account. With this it was inferred that his workplace is an accounting office.

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With this data, 2 important things are analyzed:

The first is that the means by which employment is obtained and the wage obtained are related. So the greater the formality of the channel, the greater the salary received. In this sense, those who on average receive a "lower" salary are those who got their job through a friend or acquaintance. A little or nothing formal medium. (These are usually the ones that don't ask for previous experience.) And most of them got it this way.

Graduates who receive a "higher" salary got their job in a public advertisement or through media (with minimum skills required). A medium, let's say, moderately formal.

When looking at those who obtained their employment through a job board of a public or private institution (with required knowledge and skills), that is, the "most formal" channel. A very low percentage is manifested by recent graduates. Only 4% got their jobs this way. Again, this population of graduates shows us the difficulty they had to find a job where previous work experience is requested.

The second thing that stands out from the data is that graduates who claim to have obtained their work through their "social service or internship", that is, in their professional area, on average earn much less. The data are shown in Figure 15.

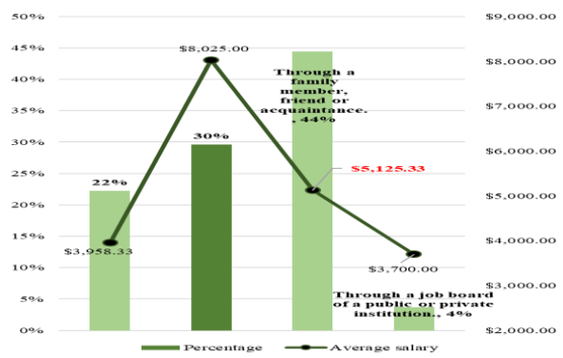

Figure 15 Relationship formality of the channel to obtain employment with average salary received
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT.

Main setback to finding a job related to the bachelor's degree

50% of graduates said that the main setback to finding a job related to the bachelor's degree is because of the "lack of experience or practice." Another 42% said that it is difficult or unattractive to enter a job as an accountant because the salary is very low or they offer little or no benefits. 4% have setbacks to be employed because they are not qualified and the last 4% are difficult because of the schedule. See Figure 16.

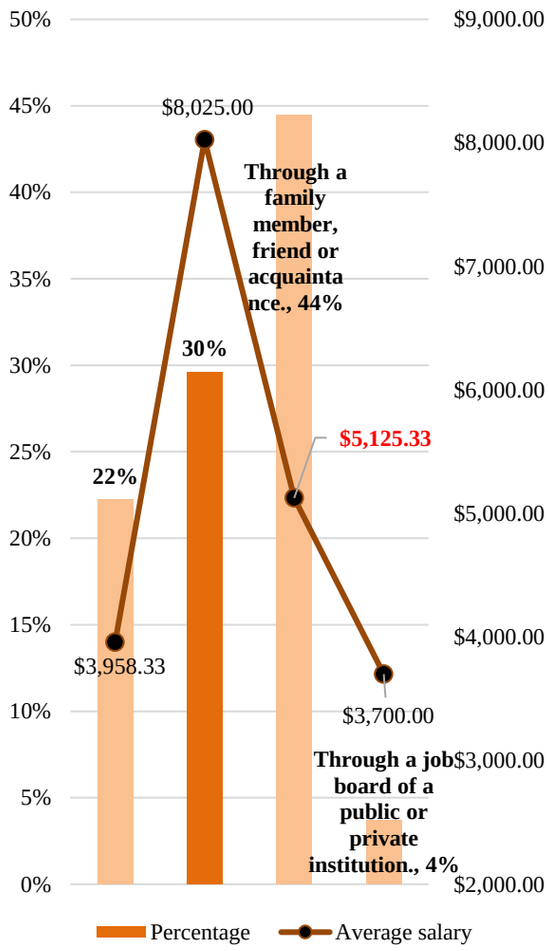

Figure 16 Main setbacks to finding a job related to your area of study
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

Employment benefits

When asked about their employment benefits at work, 48% said they had the minimum benefits of law, in turn, a considerable 37% do not. Only 15% claimed to be above the law. All of the latter are working in a private institution. See Figure 17.

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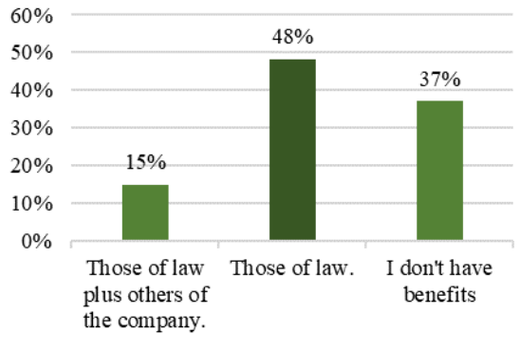

Figure 17 Employment benefits
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT.

Skills acquired at university and their usefulness

Among the skills they learned in college, they say that "problem solving" and "teamwork" are the most useful for their jobs.

Similarly, "decision making" and "numerical ability" have high utility in their workplaces with 56% and 52% of the time respectively.

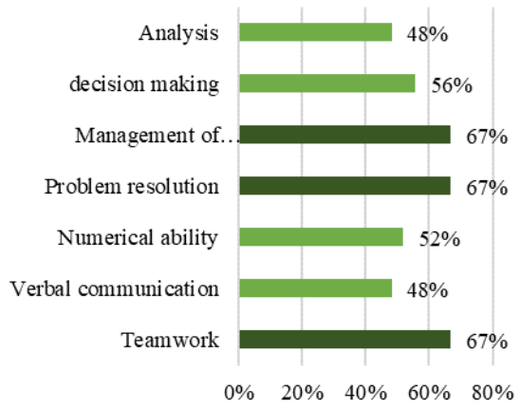

Figure 18 What skills have been most useful in your jobs?
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT

Knowledge to consider to strengthen the professional training of the future Bachelor in Public Accounting

Finally, the graduates surveyed were asked which activities (related to the bachelor's degree) they consider that they should have learned in the "university classroom", which in their criterio, would have strengthened their professional training.

86% of the time, they said, they wish a teacher had taught them how to navigate the SAT portal. Another 80% would have loved to leave university with a good handle on CONTPAQ i. Knowledge in the SUA, IDSE, SIPARE and CONTPAQ Payroll also stood out in the demands of the graduates. The data are shown in Figure 19.

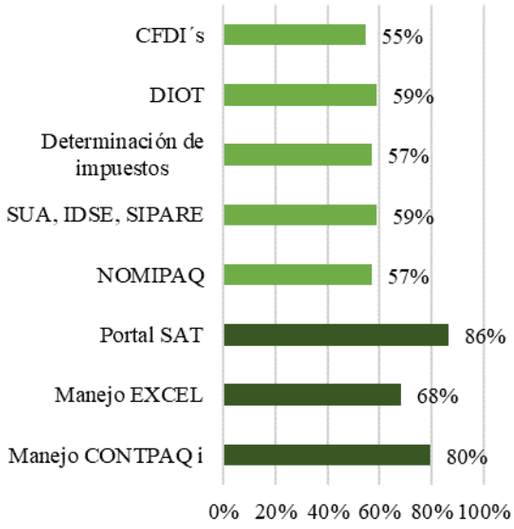

Figure 19 Activities demanded by graduates to strengthen their professional training
HOW TO READ THIS GRAPH: Of the 44 respondents, 38 stated that they would have liked to have known about the SAT Portal, this represented 86% of the time.
Source: Own elaboration with data from the survey of public accounting students who graduated between August 2020 and February 2023 at the UJAT.

Conclusions

Based on the results obtained, students who faced a social service and a professional practice from virtuality, increased the main obstacles encountered by any graduate at the beginning of their working life. They experienced a delay in insertion into the professional world and presented a lack of knowledge related to their area of study or discipline. In addition, it was difficult for them to find a job directly related to their bachelor's degree because they acquired little or no skills required by accounting firms.

ISSN-2523-0336

The impact that students had in this pandemic circumstance put them at a disadvantage compared to the labor market since, three out of ten did not have the opportunity to acquire work experience before leaving university. However, this research showed that, even leaving the issue of virtuality and pandemic, students who come to provide professional practices in a normal way, in a workplace that is directly related to their degree, get little or no involvement in the activities.

In this sense, the university is urged to monitor the work centers that have an agreement with it, so that they comply with the objective of a professional practice: to strengthen the professional training of the student.

The issue of having work experience was one of the central elements for this research. It was shown that this factor has a great impact on the salary of a recent graduate in public accounting. Thus, the data showed that the highest salaries tended to be for those who had more time to have graduated and their workplace was formal labor. That is, they had a considered accumulation of experience and situations related to their discipline, therefore, they had a greater degree of confidence in them and were paid more. Likewise, the remuneration was high, when they obtained the jobs in labor exchanges of public or private institutions. However, they were required to have previous knowledge to fill the position. Only four percent could be employed in this way. This showed little "professional training" for this graduate population.

The respondents were well aware of the lack of knowledge with which they had left university. They considered that in the university classroom they should have learned to: "manage the SAT portal", "manage CONTPAQ i", "familiarize themselves with the SUA, IDSE, SIPARE", and even learn to send "DIOT".

In this sense, these considerations were taken as proposals for improvement by the alumni to reinforce knowledge to the future professionals of the Bachelor's Degree in Public Accounting of the Universidad Juárez Autónoma de Tabasco and, when going out to the labor market, they do not continue to encounter the obstacles exposed and presented in this research.

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ISSN-2523-0336

Article **Journal High School**
December 2023, Vol.7 No.18 15-25

Evaluation of the perception of a virtual learning object with activities to promote study habits in the subject of differential calculus

Evaluación de la percepción de un objeto de aprendizaje virtual con actividades para fomentar hábitos de estudio en la asignatura de cálculo diferencial

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DOI: 10.35429/JHS.2023.18.7.15.25 Received July 15, 2023 Accepted December 30, 2023

Abstract

The study and understanding of Differential Calculus are essential for Engineering, providing the bases for the topics in the development of Competences of Integral Calculus, Vector Calculus, Differential Equations and physics subjects. This study proposes to evaluate the perception of a virtual learning object with activities to promote study habits in the subject of differential calculus. The proposal consists of analyzing the perception of a virtual learning object about Functions of the Differential Calculus subject, which includes activities of study habits, obtained from a group of students of the second semester of engineering level. The results are encouraging since the students identified as positive aspects the dynamism of the object, the usefulness of using technological tools to strengthen learning.

Learning objects, Study habits, SCORM

Resumen

El estudio y comprensión del Cálculo Diferencial es esencial para las Ingenierías, proporcionado las bases para los temas en el desarrollo de las competencias del Cálculo Integral, Cálculo Vectorial, Ecuaciones Diferenciales y asignaturas de física. Este estudio propone evaluar la percepción de un objeto de aprendizaje virtual con actividades para fomentar hábitos de estudio en la asignatura de cálculo diferencial. La propuesta consiste en analizar la percepción de un objeto de aprendizaje virtual de tema de Funciones de la asignatura de Cálculo Diferencial, que incluye actividades de hábitos de estudio, obtenida de un grupo de estudiantes del segundo semestre de nivel ingeniería. Los resultados son alentadores ya que los estudiantes identificaron como aspectos positivos el dinamismo del objeto, la utilidad de usar herramientas tecnológicas para fortalecer el aprendizaje.

Objetos de aprendizaje, Hábitos de estudio, SCORM

Citation: ARREDONDO-SALCEDO, Daniel, MIRELES-MEDINA, Antonia and MOLINA-WONG, Ma. del Refugio. Evaluation of the perception of a virtual learning object with activities to promote study habits in the subject of differential calculus. Journal High School. 2023. 7-18:15-25.

† Researcher contributing as first author.

Introduction

The confinement forced humanity to make pedagogical changes and generated new scenarios in the teaching-learning process, physical spaces were adapted to virtual spaces; and consequently, changes in strategies to generate skills and competencies in students, which will allow them to apply them in different situations or use them as resources to acquire new knowledge. To achieve this behavior, habits fulfill an essential task since they are behaviors that are learned by repetition and are powerful factors in students.

The virtual space is an opportunity for students to develop study habits since they are the methods and strategies that a student usually uses to deal with a quantity of learning content. This study proposes to evaluate the perception of a virtual learning object with activities to promote study habits in the subject of differential calculus.

The methodology consisted of analyzing the perception of a virtual learning object, which includes study habits activities, obtained from a group of second semester engineering level students.

The methodology was the generation of a learning object, the implementation of the learning object (VLO) in an educational platform, the experience of a group of students using the VLO, and the application of a survey and analysis of results at the end of the VLO.

Problem statement

According to (TecNM, 2016) the specific competence of unit 2 of the differential calculus subject indicates that the student analyzes the definition of real function and identifies types of functions and their graphic representations, has several proposed learning activities to be carried out, which take time and complexity:

1. Identify when a relation is a function between two sets. Identify the domain and range of a function. Represent real functions of a real variable in the Cartesian plane (graph of a function).

2. Recognize when a function is injective, surjective, or bijective.

3. Thoroughly analyze the sine and cosine functions; It is suggested to use traditional methods and Technology of the information and communication (ICT).

4. Graphing various functions.

5. Investigate the graphs and characteristics of the remaining trigonometric, inverse trigonometric, and hyperbolic functions using ICT.

6. Given any function, build its graph by using ICT, varying its arguments and parameters.

7. Recognize the graphs of circular trigonometric functions and graphs of exponential functions of base e.

8. Graph functions with more than one correspondence rule.

9. Graph functions involving absolute values.

10. Perform the operations of addition, subtraction, multiplication, division, and composition of functions.

11. Recognize the graphical change of a function when its parameters are varied.

12. Through an exercise, use the concept of a bijective function to determine if a function has an inverse, obtain it, and check through composition that the function obtained is the inverse.

13. Identify the relationship between the graph of a function and the graph of its inverse.

14. Propose functions with domain in the natural numbers and range in the real numbers.

15. Prepare in work teams a mathematical modeling (obtaining the function) that corresponds to the professional profile, depending on the application, with the use of ICT.

ISSN-2523-0336

General objective

The objective of this research is to evaluate the perception of a virtual learning object with activities to promote study habits in the subject of differential calculus.

Specific objectives

- Design and develop a virtual learning object related to the topic of Functions in the Differential Calculus subject, which includes activities to improve reading optimization, through techniques to strengthen reading comprehension.
- Apply the learning object to a group of second semester engineering students.
- Evaluate the perception of students regarding the activities and strategies for the promotion of study habits.
- Get feedback on the areas of improvement of the features topic learning object.

Justification

Education in the modern situation has denoted the need to strengthen various learning mechanisms, including e-learning and self-learning and the trend of using technology as a fundamental tool in the teaching-learning process. According to a study carried out by (Lezama & Galdámez, 2017), it indicates the existence of a correlation between the levels of study habits and the levels of academic performance of students who study algebra.

It is also important to highlight that the study and understanding of Differential Calculus is essential for Engineering, providing the bases for the topics in the development of Competences of Integral Calculus, Vector Calculus, Differential Equations, and physics subjects. The implementation of learning objects seeks to support self-learning and strengthening the academic performance of students, organizing educational content in a modular, reusable, and flexible way using information technologies, including the ExeLearning tool, the SCORM set of technical standards, the GeoGebra tool and the Moodle educational platform.

Referential Framework

Teaching learning process

In the present investigation that consists of the evaluation of the perception of a virtual learning object with activities to promote study habits in the subject of differential calculus, It is essential to start from this referential framework of the teaching-learning process, which is the process par excellence to train students in order for them to acquire knowledge, skills, competencies and, preferably, proactive attitudes to solve problems in the context that develop; it is the process where teacher and student are involved, where the first is responsible for the instruction of their students and the second are the receivers and reproducers of the knowledge acquired once the teacher provides them with the didactic strategies to achieve this task.

The most complex and frequent challenges faced by higher education in Mexico are dropout, student lag, and low terminal efficiency rates. In general figures, as a national average, it is mentioned that of 100 students who enter the University, only between 50 and 60 students finish taking all the subjects of the study plan five years later, and of these, only 20 are awarded a degree during the first year of graduation, as stated in their study (Mondragón Albarrán *et al*., 2017). These are alarming figures in the sense that terminal efficiency is disrupted from the beginning of a professional career in students, since in the case of this research, the subjects related to mathematics, which are regularly taught in the first semesters of the entire educational offer, are triggers not only for failure but also for desertion.

"The learning process in the human being differs from everyone —some may be more responsible and skilled; others, feel motivated, or quite the opposite—; commitment to studies and cognitive ability even vary from person to person. Therefore, if the habit of study is not put into practice as a discipline, there will be no academic progress, that is, only the implementation of good study habits will allow the learning process to improve (López, 2009)", as they refer to (Aguirre & Advíncula, 2021) in their research.

ISSN-2523-0336

According to (Fernández & Batista, 2020) the teaching-learning process is historically conditioned in response to the demands of learning knowledge, the intellectual and physical development of the student and the formation of feelings, qualities, and values, all of which achieve, in general sense and, with the objectives proposed at each level and type of educational institution. On this occasion, the authors of this manuscript, to promote study habits in students in the subject of differential calculus on the topic of functions, have provided them with a virtual learning object so that they can acquire skills for the implementation of functions in daily life.

In order to understand the teaching-learning process, it is necessary to return to what they point out (Fernández & Batista, 2020) who affirm that considering that learning forms a unit with teaching; through teaching, not only learning, but human development is strengthened, as long as contexts are designed in which the participating subjects appropriate the resources that allow them to operate with the environment and face the world with a scientific, personalized and creative attitude, it is a process that places everyone in a variety of situations that challenge the way they think, feel, and act. In this process, the contradictions between what is said, what is experienced and what is executed in practice are revealed.

Study habits

In his article (García, 2019) he mentions that according to the Royal Spanish Academy "study habits are a special way of proceeding or behaving acquired by repetition of the same or similar acts or originated by instinctive tendencies". Study habits are conceptualized as the methods and strategies that a student usually uses to deal with several learning contents. The study habit requires strong amounts of effort, dedication, and discipline. But it is also fed by impulses that may be generated by the expectations and motivations of the student who wishes to learn (Mondragón Albarrán et al., 2017).

(Sánchez, 2017) says that study habits are fundamental in the life of each student, because with their impulse their academic performance will be reflected, depending on how effective they are, the student will generate good results. The student's context has a lot of influence on his daily activities, since he may have various obligations that prevent him from doing certain tasks, in this way the context, culture and various ideologies can generate changes in the student's academic and social environment. In this regard, the authors of this article consider that for a student to acquire and practice study habits in the learning process, they require tenacity, perseverance, and openness; and in this way they can facilitate the uptake of knowledge and consequently, obtain a good academic performance.

Study habits correspond to behaviors established and associated with the way in which the student achieves or does not achieve his academic objectives. Currently there are productive study habits such as completing tasks on time, maintaining order in the material, studying with a strategy and in an appropriate environment, underlining, making schemes, etc., and unproductive such as postponing academic activities, studying in an inappropriate environment and without an orderly strategy, studying tired, copying summaries from other classmates, etc. with negative implications at the level (Ramírez Montaldo et al., 2020). "Good study habits help to comply with learning strategies, improving academic performance" (Meza et al., 2020).

Subjects related to mathematics are considered complex in most undergraduate students, since there are regular failure rates above 40%, such is the case of students from the Tecnológico Nacional de México Campus Zacatecas Norte. In the study by (Lezama & Galdámez, 2017) whose purpose was to determine the relationship between study habits and the academic performance of algebra students from a private university institution in San Pedro Sula during the 2016 academic year, in the research results demonstrate the existence of a statistically significant relationship between the levels of study habits and the levels of academic performance of students who study algebra. This is an example of efforts carried out in universities to promote and identify study habits in the context of mathematics.

ISSN-2523-0336

It has been observed that motivated students learn more quickly and effectively than students who are not motivated (Jiménez Reyes et al., 2019), in common agreement with the authors of this research, given that even motivation is part of the set of habits of study that a student must have, in such a way that, as teachers, we must implement different strategies to motivate students in subjects related to mathematics, so that for this occasion virtual learning objects have been provided not only to motivate, but to promote study habits in students.

It is important that the university student knows that there are different study methods and techniques, analyzes them and can incorporate them into their habits. Currently, one of the limitations of the professional future is the lack of knowledge of modalities to learn and understand with repercussions on academic performance (Soto & Rocha, 2020). Similarly (Bedolla Solano & others, 2018) mention that reflecting on the habits that should be formed and the study techniques that students should apply to obtain sustainable learning contributes to improving their academic performance at the university.

Virtual learning objects

"In recent years, several initiatives have emerged at the national and international level, to provide digital materials at the service of the academic community, supporting the teaching and learning processes" (Herrera, 2007). (Callejas Cuervo et al., 2011) mention that the Virtual Learning Objects suggest three phases of development, the first is joint planning, composed of gathering requirements and brainstorming for the gestation of the project, which is supported by a group of design experts, the second part consists of didactic and computer proposals where a preliminary graphic design is carried out and its approval is evaluated, finally a navigation map based on a script writing information.

A Virtual Learning Object, commonly called a VLO, is also known in some contexts as LO, which stands for Learning Object. (Uptc, 2014) consulted by (I. I. S. Medina, 2014). On the other hand, according to (J. M. C. Medina et al., 2016), Virtual Learning Objects allow the generation of concepts and thought structures from the development of activities proposed by the educational institution on a specific area of knowledge, they are considered as learning resources. great potential for the teaching process.

A Virtual Learning Object is understood as "structures organized and designed by multidisciplinary teams that can use the advantages provided by AR (augmented reality) to accept the attention of the public, which is aimed at teaching" (Tovar, 2014; quoted in Bravo 2014), this is how they integrate it in their study (Bucheli et al., 2018). The learning objects are intended to facilitate a flexible and personalized education, allowing students and teachers to appropriate teaching resources according to their own needs, concerns, learning and teaching styles according to (Maldonado et al., 2015).

According to the Universidad Nacional Abierta y a Distancia (UNAD) (2008), some of the relevant benefits that can be obtained by maintaining an approach associated with the construction of objects are: streamlining research processes, being aligned for the development of skills, facilitating the tailored learning, dynamic and permanent adaptability to the demand for information and communication, time savings for teachers and students and researchers, simultaneous access, which allows the utility in more than one sequence for training processes in various areas of knowledge, promote collaborative work and autonomous learning, hypertexts and remote access to updated learning content, as mentioned (Pascuas Rengifo et al., 2015) in their manuscript. While (Veytia Bucheli & Contreras Cipriano, 2019) argues that VLO can be used through different mobile devices and are compatible with various browsers (eg, Mozilla FireFox, Internet Explorer, Safari, Google Chrome and Opera), which support the HTML language regardless of the operating system you have (Windows, Mac, Android or Linux).

ISSN-2523-0336

Diferential calculus

(TecNM, 2016) points out that the subject contributes to developing a logical-mathematical thought for the profile of the engineer and provides the basic tools to introduce the study of calculus and its application, as well as the bases for mathematical modeling. In addition, it provides tools that allow modeling context phenomena; This subject is taught in most of the careers offered by the Tecnológico Nacional México, it contains a total of 5 units: Real numbers, functions, limits and continuity, derivatives, and derivative applications respectively. It is worth mentioning that the virtual Learning Object is based on the theme of functions that corresponds to unit 2 of differential calculus.

Methodology

This paper analyzes the perception of a virtual learning object, which includes study habits activities, obtained from a group of second semester engineering level students.

The methodology was as follows:

- Generation of a learning object.
- Implementation of the virtual learning object (VLO) in an educational platform.
- Use of the object by a group of students.
- Apply of a survey at the end of the learning object and analysis of results.

In the generation stage of a virtual learning object, it was based on the methodology published in the Guide for the design of virtual learning objects (Martín et al., 2016) and the proposal of strategies to promote study habits in virtual learning objects (Arredondo-Salcedo et al., 2022), focusing on functions of the Differential Calculus subject and included activities to promote study habits of time distribution, reading optimization and exam preparation, see Figure 1.

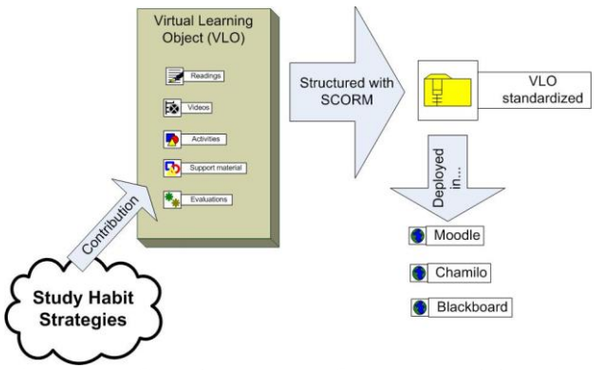


Figure 1 VLO Implementation. *Source: own elaboration.*

In implementation stage of the virtual learning object, the Open-source eXeLearning software was used to package the educational contents using the Shareable Content Object Reference Model (SCORM) set of specifications, later the SCORM package was included in a course on the Moodle platform available as a learning activity. In the learning activities, the free digital tool was used for the graphic representations of the examples and exercises.

In the next stage, 32 students from the second semester of the Computer Systems Engineering and Public Accountant careers were invited, who entered the course "Introduction to Differential Calculus" available on the Moodle platform of the institution itself and carried out the activities of the learning object for the topic Functions.

As a last stage, a survey was applied to evaluate the perception of the students regarding the learning object and its activities for the distribution of time, optimization of reading and exam preparation, the survey applies a Likert scale to evaluate the experiences they had students regarding the use and perception of learning activities and promotion of study habits.

Results

After using the learning object, the students had the following perceptions (See table 1), where SA indicates strongly agreed, A means agree, N indicates neutral, D means disagree, and SD indicates strongly disagree:

ISSN-2523-0336

Question	SA	A	N	D	SD
The learning object of Functions in Differential Calculus helped me understand the topic.	38%	56%	3%	3%	0%
The underlining technique in the topics helped me to read more efficiently.	34%	56%	6%	0%	3%
The topic sheet where he proposes the goal of the topic, helped me focus when studying.	38%	50%	9%	3%	0%
The topic sheet where he proposes the difficulty of the subject, helped me to establish my degree of concentration.	22%	59%	16%	3%	0%
The topic sheet where it proposes the estimated time of the topic, helped me organize my time.	25%	63%	9%	3%	0%
Review activities and examples helped me prepare for exams.	41%	50%	6%	3%	0%
The activities of the learning object helped me to promote study habits (time distribution, optimization of reading and exam preparation).	31%	63%	3%	0%	3%

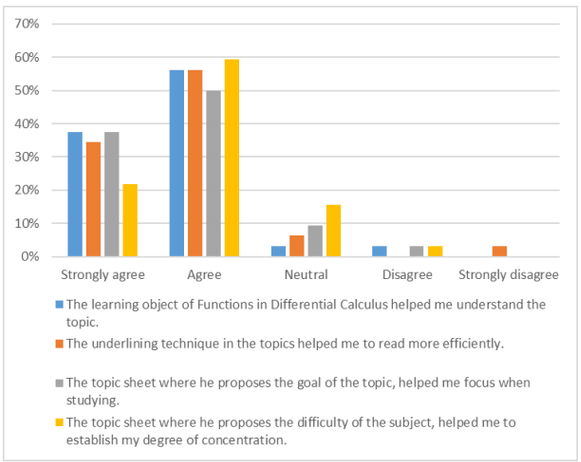
Table 1 Survey results
Source: Own elaboration

About the general panorama of whether the Differential Calculus Functions learning object helped me understand the subject, 94% denote that they perceive a good degree of usefulness of the learning object as support in the self-learning of the subject.

Regarding whether the underlining technique in the topics helped to read more efficiently, 90% positively perceived the use of colors to highlight the main ideas and examples.

Concerning whether the subject sheet where the goal of the topic is proposed helped to focus when studying, 88% had a positive perception regarding the usefulness of the goal.

Referring to whether the subject sheet where it proposes the difficulty of the topic helped to establish my degree of concentration, 81% indicated a good degree of usefulness, it should be noted that 19% perceived this aspect indifferently or negatively, linked to feedback from suggestions for improvement, indicates that the topic sheet can be improved or complemented, see graphic 1.



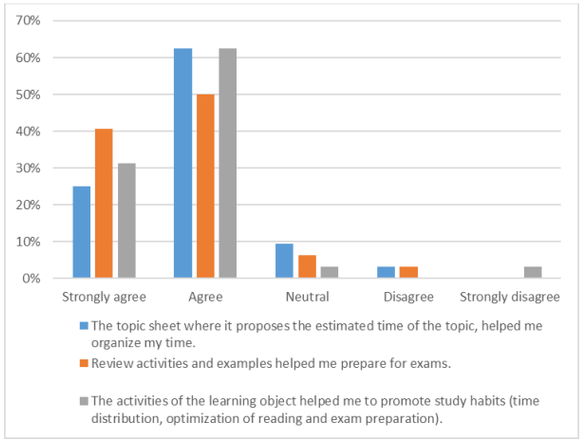
Graphic 1 Results of survey part 1
Source: Own elaboration

Regarding whether the topic file where it proposes the estimated time of the topic helped to organize my time, 88% indicated a good degree of utility, in the general feedback, the students indicated problems with the loading of the contents, which altered the time dedicated to that topic.

About the review activities and examples helped to prepare for the exams, 91% had a good acceptance of the activities, it should be noted that this was the aspect with the best perception by the students.

Concerning whether the activities of the learning object helped me to promote study habits (time distribution, optimization of reading and exam preparation), 94% thought that the object helped them to promote their study habits, it is important point out that a more detailed follow-up and analysis is required to measure the degree of impact of the use of this type of learning objects on study habits, see graph 2.

ISSN-2523-0336



Graphic 2 Results of survey part 2
Source: Own elaboration

As general feedback, the students identified as positive aspects the dynamism of the object, the usefulness of using technological tools to strengthen learning, the simplicity and speed to address the topics. In the negative aspects, the difficulty to visualize some external content, technical difficulties and internet connectivity, the need for the teacher's intervention were pointed out.

Some suggestions for improvement obtained were, give more focus to complex topics, include activities with a higher level of challenge, improve the loading times of digital content, add more strategies to better understand the content and add more practical activities.

Acknowledgment

This proposal was made with the support of the Instituto Tecnológico Superior Zacatecas Norte (TecNM campus Zacatecas Norte) and the Tecnológico Nacional de México (TecNM).

Financing

This work has been supported by the Instituto Tecnológico Superior Zacatecas Norte (TecNM campus Zacatecas Norte) and the Tecnológico Nacional de México (TecNM), in its program of internal research projects under the academic group ITESZAN-CA-2 entitled "Ubiquitous computing and emerging technologies". Open-source software was used to generate non-profit teaching materials, with the purpose that future virtual learning objects can be freely shared on e-learning platforms.

Conclusions

Once the investigation was completed and according to the results obtained, it was possible to determine and analyze the impact of the use of information technologies in the Differential Calculus subject to promote study habits.

Despite setbacks such as technical difficulties and internet connectivity, it was shown to be a simple and concrete way to generate learning and help in exam preparation, since it includes reading, comprehension and problem-solving activities and mentioning that, including GeoGebra in the virtual learning object helps the student solve problems interactively.

An opportunity for improvement that was detected in the virtual research work is to add more activities in such a way that the degree of complexity of the exercises is greater as the student progresses.

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ISSN-2523-0336

Article **Journal High School**
December 2023, Vol.7 No.18 26-31

Gender: learning styles

Género: estilos de aprendizaje

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DOI: 10.35429/JHS.2023.18.7.26.31 Received July 20, 2023; Accepted December 30, 2023

Abstract

The general objective of this article was to identify the differences in opinion between gender and learning styles of higher-level students. The Schmeck ILP-R questionnaire was applied to 1412 people with non-probabilistic convenience sampling. The results were analyzed with descriptive and comparative analysis with the Student's T test for independent samples and significant data were obtained on the scales of self-efficacy, self-affirmation, self-esteem and elaborative processing of learning styles. The contribution of the comparative analysis was that the female gender, in terms of self-efficacy when performing a school task, presents greater problems such as confusion and nerves, unlike the male gender, in addition, they have a different elaborative processing than the male gender, in relation to having a greater interest in their self-development, they are women who give more attention and interest to the values learned in the family, they follow their intuition, their experience and their decisions are influenced by their feelings.

Gender, Styles, Learning

Resumen

El objetivo general del presente artículo fue identificar las diferencias de opinión entre género y estilos de aprendizaje del estudiantado de nivel superior, se aplicó el cuestionario de Schmeck ILP-R a 1412 personas con un muestreo por conveniencia no probabilístico. Los resultados se analizaron con el análisis descriptivo y comparativo con la prueba T de Student para muestras independientes y se obtuvieron datos significativos en las escalas de autoeficacia, autoafirmación, autoestima y procesamiento elaborativo de los estilos de aprendizaje. El aporte del análisis comparativo fue que el género femenino en cuanto a la autoeficacia al realizar una tarea escolar presenta mayores problemas como la confusión y nervios a diferencia del género masculino, además, poseen un procesamiento elaborativo diferente que el género masculino, en relación a tener un mayor interés en su autodesarrollo, son mujeres que dan más atención e interés a los valores aprendidos en la familia, siguen su intuición, su experiencia y sus decisiones se ven influidas por sus sentimientos.

Género, Estilos, Aprendizaje

Citation: SÁNCHEZ-RIVERA, Lilia, ESPERICUETA-MEDINA, Marta Nieves, RAMOS-JAUBERT, Rocío Isabel and SOLÍS-RANGEL, Emmanuel. Impact of theoretical teaching, laboratory practice and the use of specialized software in the meaningful learning of university students. Journal High School. 2023. 7-18:26-31.

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† Researcher contributing as first author.

Introduction

Castañeda & Díaz (2020) mention that the gender approach gives rise to an understanding of what development processes imply and the differences that each society has when thinking about how men and women should act, regardless of the biological sex assigned to a person at birth, which intersects with the different identities and sexual orientations that exist.

Vera (2020) states that, traditionally in a patriarchal culture, the male gender is attributed the power to make decisions about situations that are considered more complicated in a woman's life, in addition to being taught to be independent and make these decisions on their own and without consulting anyone, while the female gender is taught that they should look for someone who can decide and answer for them.

Citing (Ramírez et al., 2019) gender is widely understood as a binary construct, i.e. society is used to taking into account only heterosexual cisgender men and women as the only categories that exist to define the gender spectrum.

For Guerra (2016), the word gender has been debated by different currents and schools, it can be identified that gender studies begin with the biological characteristics of human beings and their behaviours based on sexual differentiation, as well as different aspects such as individual traits, psychological traces and cultural constructions of kinship.

Gauché & Lovera (2019) mention that gender identity is a manifestation of the right we all have to have a general identity as persons, which is acquired and can be learned over time, and changes depending on different factors such as the culture of the community in which a person is immersed.

The United Nations (2023) defines gender equality, in addition to being a human right, as a fundamental part of societies in order for them to be peaceful and capable of developing in a sustainable way.

It is important to reflect on the term gender, different authors according to their conceptualisation limit it in a dichotomous way: man and woman, however, at present this is only biological aspects, independently of the cultural, social and psychological constructions that allow the development of the gender focus of the human being.

Before addressing the issue of learning styles, it is important to talk about learning, for Mendoza & Vigueras (2019) state that, although the learning outcomes of students in a school environment depend a lot on the knowledge, skills and values acquired or developed previously, another factor that is also paramount, is the quality of the teacher, i.e. the way and extent to which teachers manage to build the foundations of learning and prior knowledge.

Olmedo-Plata (2020), citing Gagné (1965) in his work, mentions that "learning is a change in the disposition or capacity of people that can be retained and is not attributable to the process of growth" (p. 5).

Padilla et al. (2020) point out that adolescents and young people have developed the ability to seek information and learn autonomously, and, although they generally do so for recreational purposes or to satisfy a personal need, these habits can be applied in their school life.

Rodríguez-Saltos et al. (2020) are of the opinion that psycho-pedagogy optimises the teaching-learning process through the correct application of didactic resources that can facilitate the construction of knowledge and lead to a much more complete learning process.

Coello (2019) affirms that cooperative learning is a positive contribution in the educational context, as it seeks to increase knowledge through coexistence among students who have common goals and interests.

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Now, the term learning styles has been developed by various authors; they are defined as cognitive, psychological and affective characteristics that the student community uses as constant determinants to some extent of their style of perception, reaction and interaction, which allows them to obtain and process knowledge when faced with difficult and new information (Moussa, 2014), likewise, Velasco Yañez (1996) comments that they are the set of biological, motivational, social and environmental characteristics that a human being develops to perceive, process, retain and accumulate information, which constitutes their particular way of learning and cognitive processing. While (Schmeck & Lockhart, 1983) mention that learning styles should be analysed as the tendency of a learner to absorb a particular learning strategy independent of the environment. (Cited by Tarazona et al., 2021).

Domínguez et al. (2015), according to the results of the analysis of variance (anova) the sample grouped by the gender variable, it can be read that both the female and male gender have a moderate preference for the reflective and active, pragmatic and theoretical Learning Styles; it stands out that the male gender has a low preference with moderate tendency the reflective style. With regard to the results of the Student's t-test for independent samples, significant differences are observed in that the male gender has a greater preference for the active learning style.

In relation to learning style and gender; Torales et al. (2018) according to their research results mention that there is a relationship between the pragmatic and reflective styles and the male gender. In turn, Freiberg et al. (2017) showed that there was a greater tendency for the pragmatic style in the male gender (cited by Porras et al., 2021).

Castaño (2012) in his research work observes the significant differences between genders with learning styles, his objective is to check if there are differences between women and men in the learning styles of reflective, active, pragmatic and theoretical of the CHAEA questionnaire.

The style that shows significant differences between women and men is the theoretical learning style.

With the female group scoring lower than the male group.

Therefore, gender and learning styles are topics that observe individual differences, which can be part of the various elements that build the gender approach, as well as the first approach to knowledge, in order to later process, retain in memory and elaborate information in various learning contexts.

Methodology to be developed

In this article, the ILP-R (Schmeck) learning styles questionnaire was applied. The main question was: What contrasts are significant between gender and learning styles? It was applied by means of Google Forms to 1412 higher education students, with a non-probabilistic convenience sampling. The instrument was analysed for gender and scales addressing the topic of learning styles measured from 1 to 6.

The responses obtained were exported to an Excel spreadsheet and the database was cleaned, and then subjected to the statistical processing of Cronbach's Alpha, which gave a result of 0.91, and a descriptive and comparative analysis was also carried out; this being a type of quantitative, synchronic, cross-sectional, descriptive and comparative type of research.

Results

Descriptive analysis

Frequencies and Percentages

In this section the variables that characterise the gender of the student body were processed by means of an analysis of frequencies and percentages of the 1412 subjects.

The results of the survey show that females are the most represented with 64.38% of the total population (n=909), while males are represented with 36.06% of the total population (n=495).

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Comparative analysis

In this section, an analysis is carried out using the Student's t-statistic procedure for independent samples, with a confidence level of 95%. The purpose is to observe the significant differences between the means of the gender group and the scales of the questionnaire being self-efficacy, self-affirmation, self-esteem and elaborative processing of learning styles.

The working hypothesis H1 = there are significant differences between the comparison groups.

Gender in contrast to self-efficacy

The first analysis shows 9 utility variables between gender and the self-efficacy scale, it is observed according to the mean comparison analysis that the female gender has problems to mentally organise the information they store in their mind, although they know they have carefully studied the subject, they have problems to remember it before the exam; they often feel confused about what they have studied and when they take the exam, they sometimes get extremely nervous unlike the male gender. On the contrary, men consider that they think faster, get good marks in term papers, do well in exams that require a lot of facts, that for them, taking exams is like a sport they can win and that they are good at choosing the right answer in a multiple-choice exam, unlike women.

Gender in contrast to self-affirmation

The second analysis shows 3 utility variables between gender and the self-affirmation scale, from which we read that the male gender strengthens their self-affirmation by expressing that they disagree with an opinion, they find it easier to speak in public and they consider themselves outgoing and open, unlike the female gender.

Gender in contrast to self-esteem

The third analysis shows 5 variables of usefulness between gender and self-esteem, in the analysis it is observed that the female gender tends to feel bad about criticism they may receive, they need guidance, they get angry easily when things do not go as planned, they value what other people may think of them and they tend to be more nervous in contrast to the male gender.

Gender versus elaborative processing

According to the comparative analysis of the means of the variables, it can be seen that the female gender shows greater interest in self-development, associate words, invent a system of study, relate to real life, believe that experience is important, consider life an adventure, make decisions based on feelings, consider other people's ideologies, show interest in family values, are intuitive, deviate with their own ideas and think with images, in contrast to males.

Conclusions

According to the results, the working hypothesis H1 = there are significant differences between the comparison groups.

And it is concluded that the female gender has more confusion and nerves than the male gender, i.e. in terms of self-efficacy when performing a school task the female gender has more problems.

In addition, the male gender is more extroverted in relation to self-affirmation while the female gender is more introverted.

It is concluded that men feel good when expressing their disagreement with the ideas of someone important, do not find it difficult to speak in public and have a more extroverted personality than women.

It is noted that the male gender has a higher self-esteem than the female gender, because they attach importance to criticism and what they may think of them.

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The feminine gender has a different elaborative processing than the masculine gender, in relation to having a greater interest in their self-development, they are women who pay more attention and interest to the values learnt in the family, they follow their intuition, their experience and their decisions are influenced by their feelings.

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ISSN-2523-0336

Article **Journal High School**
December 2023, Vol.7 No.18 32-41

Project development with STEM features

Desarrollo de proyectos con características STEM

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DOI: 10.35429/JHS.2023.18.7.33.41 Received July 25, 2023; Accepted December 30, 2023

Abstract

This article presents an analysis of selected projects developed at the Tecnológico Nacional de México Salvatierra (TecNM-ITESS). These projects help students to develop STEAM skills. Mechatronics and TIC's engineering programs are included in our case of study. The first part of this article, the ITESS operational framework is presented. Then, it is described Bloom's taxonomy and the PISA tests as reference tools for the development and measurement of student's capabilities. Also, education quality indicators are presented for the TecNM-ITESS and state government of Guanajuato. Indicator and STEM skills are studied to find relationships. In addition, different academic events and calls for projects that facilitate the participation of students in activities that promote STEAM skills are discussed. In a second part, some projects where students have participated are presented, the strategies used for the dissemination, identification and training of students are discussed. As well as, a sentiment analysis is presented where data has been collected from students who were involved in projects.

STEM, Learning approaches, Academic project, Educational quality

Resumen

En este artículo se presenta un análisis sobre los proyectos desarrollados en el Tecnológico Nacional de México campus Salvatierra (ITESS) para la formación de alumnos en habilidades STEAM. Por una parte, se presenta el marco operativo del ITESS y describen la taxonomía de Bloom y las pruebas de PISA como herramientas de referencia para el desarrollo y medición habilidades. También, se presentan como el TecNM y el gobierno del estado de Guanajuato en sus indicadores de calidad, estas habilidades indirectamente se incluyen. Además, diferentes eventos académicos y convocatorias que facilitan la participación de alumnos en proyectos que fomentan las habilidades STEAM son discutidas. En una segunda parte, se presentan algunos proyectos donde alumnos han tenido participación, se discuten las estrategias empleadas para la difusión, identificación y formación de alumnos. Así como, un análisis de sentimiento de los alumnos que participan en proyectos.

STEM, Técnicas de aprendizaje, Proyectos académicos, Calidad educativa

Citation: MONTECILLO-PUENTE, Francisco Javier. Project development with STEM features. Journal High School. 2023. 7-18:32-41.

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Introduction

This section discusses the definition of STEAM and an overview of the development of these skills. It also presents the Bloom taxonomy and the PISA framework for the evaluation of student performance levels. And finally, the educational quality indicators of the TecNM and the state of Guanajuato in relation to STEAM skills are presented.

STEAM

In a simplistic way STEAM is the acronym for Science, Technology, Engineering, Arts and Mathematics. STEAM in a broader sense can be defined as an educational model where STEAM knowledge areas are integrated into the teaching and learning process (Greca et al. 2021; Ortiz-Revilla et al. 2021; Aguilera and Ortiz 2021). Some of the activities reported as STEAM are: problem solving, teaching approaches that integrate two or more features; and/or teaching content with real problems containing two or more features. The incorporation of the term A, aims to include the arts and creativity in the development of academic activities, (Marín-Marín et al., 2020).

There are different models proposed for teachers to effectively implement this educational approach, (Greca et al., 2021). A method for teaching-learning sequencing with STEAM characteristics considers the epistemological, psychological and didactic axes. In this approach, research-based design (IBD) is used and assessable learning standards (ALE) are defined. In order to plan the activities, the subjects, the contents to be addressed, the ALE, the objective and the situations to be resolved are defined. In its implementation, an iterative process is followed to improve the prototype to be developed and the teachers serve as a guide in the execution of the activities. This method is presented for basic education level.

However, one of the questions about the STEAM approach is that it lacks an instrument to determine which academic activity is STEAM (Aguilera and Ortiz-Revilla et al., 2021). In this sense, for the evaluation of characteristic A (Arts) of an activity, one proposal is to identify: the degree of creativity, the context, the individual's ability to demonstrate creativity and the final product.

STEAM skills formation

Bloom's taxonomy seeks to define the stages of learning development in students, while the PISA test seeks to measure students' level of learning. Bloom's taxonomy of cognitive skills has six levels: remembering, understanding, applying, analysing, evaluating and creating (del Moral, 2012). This taxonomy sets a benchmark for defining teaching-learning processes. In terms of skills assessment frameworks, the PISA (Programme for International Student Assessment) test focuses on assessing the competencies of 15-year-old students in the areas of reading, mathematics and science. The S (Science) and M (Mathematics) components are assessed prior to higher education. In each area, performance levels of as indicated in Table 1 are assessed. This test shows the individual assessment of the S: science and M: mathematics characteristics.

Performance level Mathematics	Performance level Science
Level 5. Develop and work with models for complex situations.	Identify, explain and apply scientific knowledge and knowledge about science in complex life circumstances.
Level 4. Work with explicit models in complex situations.	Level 5. Identify scientific components of many complex life situations and apply scientific concepts.
Level 3. Execute clearly described procedures.	Level 4. Engage explicit phenomena to make inferences about the parallel of science or technology.
Level 2. Interpret and recognise contexts with direct inferences.	Level 3. Clearly identify scientific problems described in a variety of contexts.
Level 1. Answer questions with familiar contexts where all information is present and the question is clear.	Level 2. Able to offer possible explanations known to them or draw conclusions based on simple investigations.
Below Level 1. Not able to perform the most elementary mathematical tasks.	Level 1. Have very limited scientific knowledge which can only be applied to a few situations they are familiar with.

Table 1 Performance levels in PISA tests, contains two characteristics (SM)

ISSN-2523-0336

Regarding higher education, the Ibero-American Association of Engineering Education Institutions (ASIBEI) and the National Association of Engineering Schools and Faculties (ANFEI) agree on the development of technological competences, social, political and attitudinal competences (ASIBEI, 2016; ANFEI, 2016). Table 2 shows the list of competences for engineering. From this, two educational strategies can be observed: the development of student learning under academic projects and the ability to communicate.

Technological competences	Social, political and attitudinal competences
Identify, formulate and solve engineering problems.	Performing effectively in work teams.
Conceive, design and develop engineering projects.	Communicate effectively.
Manage, plan, execute and control engineering projects.	Act ethically, with professional responsibility and social commitment, considering the economic, social and environmental impact of their activity in their local and global context.
Effectively use the techniques and tools applied in engineering.	Learn continuously and autonomously.
Contribute to the generation of technological developments and/or innovations.	Act with an entrepreneurial spirit.

Table 2 List of competences for engineering students

Following on from the previous point, the EDUSIMSTEAM project, (Aydos, 2023; Australia, 2019), lists a set of pedagogical practices for implementing STEAM education. These practices include: traditional direct instruction, teaching with experiments, problem/project-based approach, inquiry-based approach, collaborative learning, peer teaching, flipped classroom, personalised learning, integrated learning, differentiated instruction, summative assessment, formative assessment and self-assessment. In addition, this project takes as references the principles defined by The Australian Government Department of Education for the successful implementation of these practices. These principles are:

- PSTEAM1 use inquiry-based learning,
- PSTEAM2 solve real problems,
- PSTEAM3 teach integrated STEAM learning,
- PSTEAM4 empower and resource teachers,
- PSTEAM5 create school-business-community collaborations,
- PSTEAM6 use technology as an enabler of knowledge, differentiate teaching,
- PSTEAM7 linking education to 21st century learning (critical thinking, creativity, communication, collaboration).

In these STEAM principles some of the technological competences proposed by ASIBEI and ANFEI: solving engineering problems can be related to PSTEAM2, effective use of techniques and tools to PSTEAM6; and social competences to PSTEAM7.

Following this line of identifying STEAM projects or activities, (Connor et al., 2015), four engineering-level case studies are evaluated according to pedagogical characteristics: problem-based, project-based, inquiry-based and discovery learning. These characteristics and the field of application define whether the project is STEAM. In these case studies, a student-centred and active learning approach is used for project development. Also, it is established that there is confusion in applying these approaches and that it may be caused by a self-centred discipline of those involved. This refers to a lack of preparedness to deal with interdisciplinary education on the part of students and academics. In this sense, the provisions of the EDUSIMSTEAM project can be used as a guide to overcome this difficulty.

TecNM and consideration of STEAM skills

The Instituto Tecnológico Superior de Salvatierra (ITESS) is a decentralised campus of the TecNM located in Salvatierra in the state of Guanajuato that is aligned to the quality indicators of the State. Within the guiding development plans under which it is governed, the development of STEAM skills is not explicitly stated.

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However, according to the vision, objective and indicators, these can be identified. In terms of government, the Guanajuato State Plan 2040 sets out two points related to STEAM training as a vision (iplaneg, 2023):

- Excellence in upper secondary and higher education in the areas of science, technology and innovation. At this point, the ST (Science, Technology) characteristics are present.

- We have highly qualified human capital and the development of new technologies and innovation in production is promoted. At this point, there is the T (Technology) characteristic aimed at students.

Regarding ITESS, it has the Institutional Innovation and Development Programme 2019-2024 (PIID), aligned to the State quality indicators. Some of the thematic axes related to STEAM are: academic programmes for digital transformation in higher education, professional certifications, start-ups and spin-off companies that participate in value chains, linking with companies to produce innovation products and technological development, (PIID-ITESS, 2019).

From here it is noted that the following principles suggested by EDUSIMSTEAM, (Aydos, 2023; Australia, 2019), are present: PSTEAM2 problem solving and PSTEAM5 school-business-community collaboration, as well as the T (Technology) characteristic. In this same sense, for entry to the TecNM in the programmes of Information and Communication Technologies and Mechatronics Engineering, an entry profile is sought for students with the following qualities: knowledge of the physical-mathematical area, self-learning ability, basic level of English, analysis and synthesis of practical problems, study habits and methods, willingness to work in a team, interest in applying technology and research methods, as well as basic operation of a computer. STEM characteristics are present, as well as the problem solving principle, PSTEAM2.

The TecNM within its development plan, in terms of educational quality, has as indicators the participation of students in research, entrepreneurship and innovation projects, Table 3. This table presents the STEAM characteristic and the EDUSIMSTEAM principle that is applied to achieve it. PSTEAM4, the teacher can access resources by applying to calls for projects where the themes are in line with his or her area. The PSTEAM3 principle, which refers to applying STEAM practices, was not identified. However, the TecNM suggests as a learning activity the development of integrative projects, here is an opportunity for teachers to include STEAM practices and principles.

Line of action TecNM	Indicator	Feature STAEM
2.2 Increase attention to demand.	2.2.4 Undergraduate terminal efficiency rate .	E
4.1 Promote the training of highly specialised human capital to generate research and technological development, innovation and entrepreneurship.	4.1.5 Number of undergraduate students participating in research projects .	STEM PSTEAM1 PSTEAM2 PSTEAM4 PSTEAM5 PSTEAM6
5.1 Optimise institutional linkage mechanisms.	5.1.6 Students with occupational certificates .	E PSTEAM1
5.3 Development of entrepreneurial talent and the creation of technology-based companies.	5.3.3 Students participating in entrepreneurship models .	E PSTEAM1, PSTEAM5.

Table 3 *Table of indicators with impact on STEAM skills development*

TecNM campus Salvatierra

The case study of this article focuses on an analysis of student participation in academic events that require or develop STEAM skills within the TecNM campus Salvatierra. In the absence of an instrument that correctly assesses the STEAM level, the strategies and principles defined in the EDUSIMSTEAM project (Aydos, 2023; Australia, 2019) are considered. This study focuses on the educational programmes of Mechatronics Engineering and Information and Communication Technologies (ICT) that after pandemic have collaborated in the development of projects.

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Events and academic programmes for STEAM skills development

The TecNM within its guideline marks the participation in academic events, integrative projects and integral degrees. An integrative project involves the development of a project that includes several subjects, different semesters and different disciplines. Regarding innovation, the TecNM has the INNOVATEC event where the objective is to develop technology-based projects (innovatec, 2023). A second academic event is the Coding Cup programming competition where teams participate and the problems involve mathematics and computer science, (codingcup, 2023). A third event is the TecNM Summer of Scientific Research, which aims to integrate TecNM undergraduate students into the work of scientific research and technological development (cenidet, 2023). The DELFIN programme, which is of an international nature, seeks to bring students closer to scientific work (DELFIN, 2023). There is also a call for the development of projects with TecNM funding and an internal call for ITESS research projects where teachers can incorporate students (dpii, 2023). As far as the state government is concerned, there are different programmes and calls for proposals. IDEA Guanajuato is a space created to promote the economic and social development of the state through innovation, entrepreneurship, science and technology, (idea, 023). Also, the Secretary of Education of Guanajuato in 2020 with the Internationalisation programme in Casa SEG for the development of projects. Likewise, the Institute for the Development and Attention to Youth of the State of Guanajuato (JUVENTUDESGTO) also has a programme of "support for mobility" for the development of competences, (juventudes, 2023).

There are other events organised by private companies where students can participate to develop their STEAM skills. In terms of competitions, there are: the ICPC programming competition and the PLC programming competition Bushido organised by SMC Mexico, a leading automation company, created in 2021, (smc, 2021).

There is also the NASA Space Challenge, now in its 12th edition, where they will solve challenges, show their teamwork and coordination skills, and seek impactful solutions that address the needs of space, the environment, space exploration and the world, (space, 2023). INROADS occupational certifications in collaboration with google, for the development of competencies in ICT, project management, user experience and data analytics, (inroads, 2023). Table 4 presents a summary of activities that students have shown interest in and that are directly related to the contents of the mechatronics and ICT programmes. The activities proposed by the TecNM, government and private initiative are contemplated.

Event	STEAM feature of the event	Participating teams/projects	Students	Alumnae
INNOVATEC TECNM (anual)	STEM	Local stage 5 teams of 4 members.	15	5
TecNM Summer of Science (annual)	STEAM	4 projects, 3 students per project.	8	4
Coding Cup TecNM (annual)	TEM	National stage: 4 teams of 3 pupils.	8	4
Youth Mobility (annual)	STEM	1 project of 4 students	2	2
Internationalisation at Casa SEG (once a year)	STEM	1 project of 4 students.	2	2
SMC BUSHIDO PLC competition (annual)	TE	4 teams of 3 people.	8	4
NASA Space Challenge	STEM	1 team of 6 pupils	4	2
Hackaton idea GTO (annual)	TEM	1 team of 3 students	2	1
ICPC International Collegiate Programming Contest (annual)	TEM	1 team of 3 pupils	2	1
TecNM research project funded (annual)	STEM	1 project with 3 pupils	1	3
Internal research project (annual)	STEM	3 projects involving 6 students	3	3

Table 4 *Participation in STEAM events and capacities, the event can be annual or a single call, this in the years 2022 and 2023 (post-pandemic).*

From this table it can be seen that the characteristic Science appears 7 times, Technology 11 times, Engineering 11 times, Arts 1 time and Mathematics 10 times. In these projects or academic events 86 students have participated in an event with a STEAM characteristic, and in terms of demographics there are 55 males and 31 females. It is important to mention that the programmes or calls for proposals depend on government and company programmes, so they are not permanent. Therefore, teachers and students must be constantly monitoring the different calls for applications that have an impact on the quality indicators of the institution.

Characteristics of STEAM students at TecNM ITESS

Relevant questions about the number of STEAM-trained students at ITESS and the opportunity to incorporate more are:

- Why do students participate?
- What is their feeling about participating?

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- What are the qualities of the students who participate?

- Why do students not participate?

To answer these questions, students were asked to answer these questions. To answer, they were asked to indicate 4 qualities, causes or reasons according to the question. Sixty-two students responded, their answers were grouped into similar terms and categories were created. Figure 1 shows the percentages of responses from students who have participated in projects. It is observed that the first three qualities for participating in projects are: responsible, disciplined and respectful. As an observation, technical and capacity skills are in the fourth position. As for the feeling that these have a positive connotation, the top three are: happiness, satisfaction and excitement.

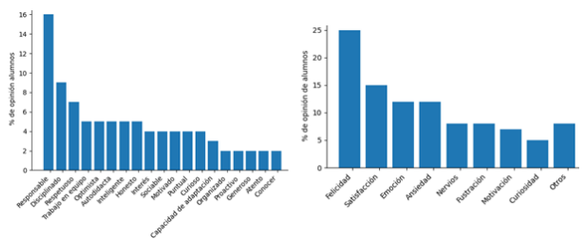

Figure 1 *Responses from students participating in events. Left: qualities. Right: feeling*

Regarding students who do not participate, the main reasons are lack of time, lack of skills and lack of interest, see Figure 2. This opens the door to create and evaluate strategies that fit in with classroom activities and encourage participation in STEAM academic activities.

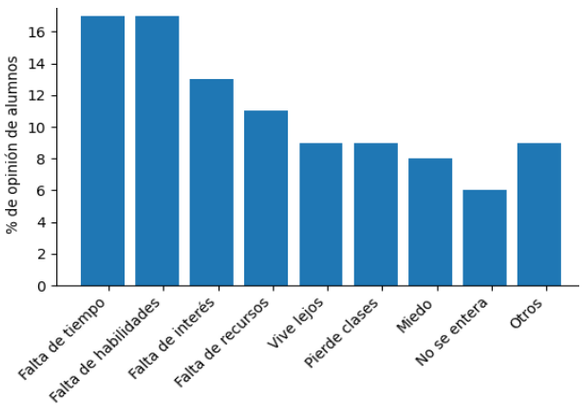

Figure 2 Reasons why students do not participate in projects

Student participation in STEAM projects

In this section we analyse some of the projects where there was student participation based on STEAM characteristics and principles. We present the development of an application for teaching English using augmented reality, the development of a video game for teaching numbers and letters, the development of a greenhouse for cacti, an automatic hydroponic system, an interface for water treatment and a database for disease detection using pytorch.

STEM projects with student participation

The project classification of fungal diseases of foliage based on Deep Learning in the TecNM 2022 call, where 3 students participated and the characteristics are STEM. The students worked with image capture systems, pytorch for neural networks and infection of plants with fungi, Figure 3. In addition, the students created a database to identify the developmental stages of foliage diseases with different fungi and plants.

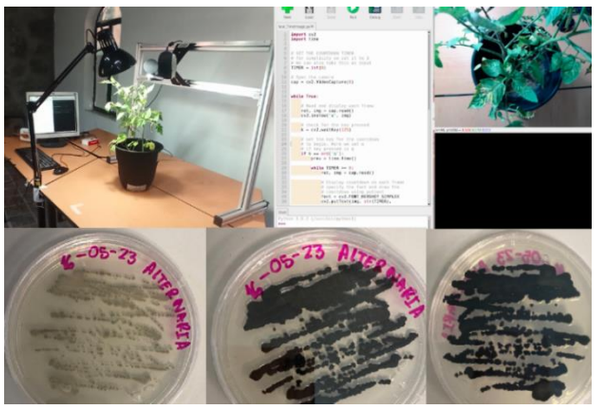

Figure 3 Images from working with students on the fungal disease project. Above: image capture for disease development level. Below: *Alternaria* fungus

As far as the scientific summer in the TecNM and Dolphin programmes is concerned, 12 students participated in three projects. The first project is the development of a mobile application to learn numbers and syllables for pre-school children, using the STEAM feature. Where audio, animations, graphic design and feature A were used. A similar project is the development of an application for teaching English using augmented reality, this project also considers STEAM features.

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A third project is the development of a Kuka robot simulator using the unreal video game engine, this project involves STEM, where students modelled the DH parameters of the robot, implemented the direct and inverse geometric model, loaded the robot geometry and created a basic scenario. In Figure 4, some images of these projects are illustrated. The top part shows the educational applications and the bottom part shows the kuka robot simulator.

i	α_i [rad]	d_i [mm]	a_i [mm]	θ_i [rad]
1	$-\pi/2$	$d_1 = l$	$a_1 = 25$	$q_1 = \pi/2$
2	0	0	$a_2 = H$	$q_2 = -\pi/2$
3	$\pi/2$	0	$a_3 = 35$	$q_3 = 0$
4	$-\pi/2$	$d_4 = -(G-1.4)$	0	$q_4 = 0$
5	$\pi/2$	0	0	$q_5 = 0$
6	π	$d_6 = -80$	0	$q_6 = 0$

Figure 4 Images of TecNM and Delfin Science Summer projects. Top: English with AR, Middle: video game for children. Bottom: Kuka robot simulator.

Innovation and mobility projects, one for agricultural applications and a stay at the University of Bristol. The first, the development of an automated greenhouse for the cultivation of cacti. In this project the students modelled and designed the greenhouse to control variables such as pH, conductivity, humidity, temperature, fertilisers and fungicides. The second was an automatic hydroponic system for growing lettuce in urban environments. It controls ph, conductivity, dosage of nutrients A and B, as well as the control of the irrigation cycle. The mobility project was developed at the University of Bristol and consisted of applying clustering algorithms for image classification to locate locations on maps using k-means, Gaussian mixtures and hierarchical clustering. This was also with STEM features, as well as involving foreign language skills. Illustrative images of these projects are shown in Figure 5. At the top is the greenhouse and at the bottom are the clustering algorithms.

Applying the STEAM characteristics and EDUSIMSTEAM principles, (Aydos, 2023; Australia, 2019), to each project generates the following Table 5. The experiences of the teachers involved are the ones who determined the STEAM principles or characteristics applied. From this table it can be seen that characteristic A (arts) is present in only one of the projects. The video game project for children was supported by a graphic designer and in the case of music, principles of composition and harmonisation were considered.

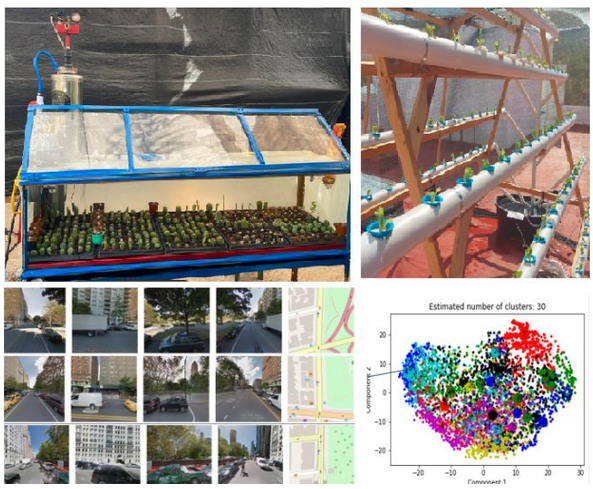

Figure 5 Images of the innovation and mobility projects. Above: greenhouse, hydroponic system. Below: clustering

Proyect	STEAM feature of the event	STEAM Principle, [22,23].
Cactaceae greenhouse: AutoSrpout	S: natural sciences T: sensors, actuators, microcontrollers E: CAD modelling and design M: fertiliser and fungicide dosing. Control of variables.	PSTEAM1, PSTEAM2, PSTEAM4, PSTEAM5, PSTEAM6, PSTEAM7
Hydroponic system for growing lettuce.	S: natural sciences T: sensors, actuators, microcontrollers E: CAD modelling and design. Control of irrigation cycles. M: A and B fertiliser dosing.	PSTEAM1, PSTEAM2, PSTEAM6, PSTEAM7
Evaluation of clustering methods to describe images on maps.	S: computer science T: video cameras, GPS E: data analysis, algorithms M: clustering models	PSTEAM1, PSTEAM2, PSTEAM4, PSTEAM6, PSTEAM7
	ST: computer systems. T: telecommunications, augmented reality. E: software development M: 3D space	PSTEAM1, PSTEAM2, PSTEAM6
Augmented reality applied to learning in pre-school education.	S: computer systems. T: smart phones A: music, visual art E: software development M: 3D space, animations.	PSTEAM1, PSETAM2, PSTEAM6.

Table 5 STEAM projects, principles and characteristics

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Strategies for training students with STEAM skills

In this section the strategies to encourage the participation of students in academic events that develop STEAM skills within ITESS are presented. In the institute there are different mechanisms that allow motivating students, such as: granting credits, social service, extracurricular activities, professional residencies, integral degree, transport and food scholarships. Some of the strategies that have been implemented to encourage student participation are the following:

- National or international mobility is an attraction where students can travel within the country or abroad.
- State calls for applications generally have economic incentives, so it is also an attractive option for students.
- Transport or food scholarships.
- Extra-curricular credits, release from social service, and graduation for thesis projects.
- Extra points in related subjects.
- Experience in project development and STEAM skills training.
- Testimonials from students in their job placement.
- Institutional recognition.
- Consideration of these students in occupational certifications.
- Testimonials about their experience in participating in events by participating students.
- Individual and/or group motivation to improve their skills.

However, within the indicators of the TecNM campus Salvatierra, there is a goal for the ICT and mechatronics programmes as follows: 30 students participating in research projects, 20 students participating in entrepreneurship events and 10 students with occupational certifications.

If we group them annually into a fictitious STEAM indicator, the target would be 60 students participating. Table 6 below shows student participation in 2022 and 2023: In 2023, 28 students participated in 2023 and in 2022 only 25, indicating that less than half of the desired indicator is achieved.

Year	Event	Participants
2023	TecNM Summer 2023	12
	Innovatec TecNM regional 2023	4
	TecNM Research projects 2023	3
	Research internal project ITESS 2023	3
	Coding Cup TecNM 2023	6
2022	Summer TecnNM 2022	8
	Innovatec TecNM regional 2022	4
	Research internal project ITESS 2022	3
	Coding Cup TecNM 2022	6
	Evaluation of clustering algorithms in maps and images	4

Table 6 Table of events 2022 and 2023, after the pandemic

Acknowledgements

The Tecnológico Nacional de México campus Salvatierra is thanked for the development of this work.

Conclusions

The TecNM and the ITESS within its development plan are aligned to the State and National objectives, so indicators are created to evaluate the quality of the programmes. An analysis of the indicators related to STEAM characteristics is presented. Explicitly they are not considered, but according to the STEAM characteristics and principles in the indicators, types of academic activities and state objectives they are implicit. An analysis of the projects in which students participated and an analysis of the different academic events where ITESS students have participated, mainly the engineering programmes in mechatronics and ICTs, was carried out. Also, some of the strategies used to involve students in projects and/or academic activities were presented, as well as their limitations. The skills of the students participating in these projects were also discussed. The result was responsibility as the main quality of the participants and happiness as an emotion. From the academic side, and specifically tutorials, an analysis or strategies for time management and skills development should be carried out, as these are the two reasons why more students participate in STEAM projects.

ISSN-2523-0336

On the teaching side, it is suggested that the work assigned contemplates the STEAM practices and principles established in the EDUSIMTSTEAM project. This is to have a point of reference, as each teacher can develop their own activities to apply these principles. As mentioned in the literature, there is no frame of reference that indicates or evaluates what a STEAM activity is. In our study we consider a STEAM event or project when it has some of the characteristics and applies some of the principles set out in EDUSIMSTEAM. However, there is no framework or instrument that measures whether a project is considered STEAM.

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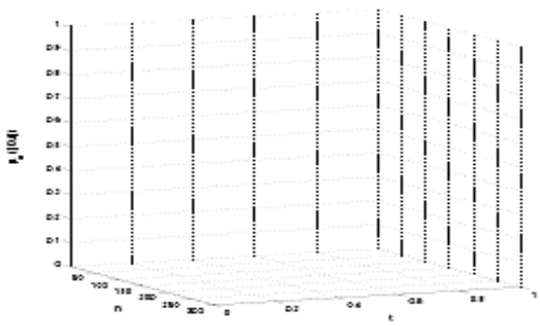

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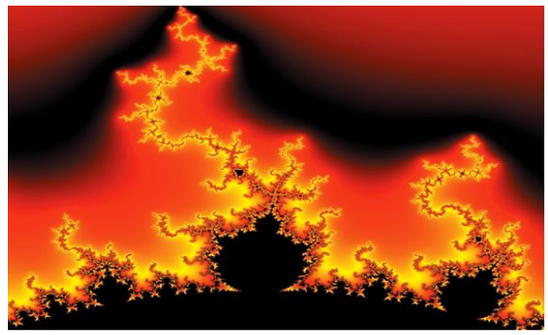

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