Journal University

Management

Journal University Management

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Support the international scientific community in its written production Science, Technology and Innovation in the Field of Social Sciences, in Subdisciplines University school management, management of university academic counseling, elements and conditions for reform in university school management, specific management models for each university context, inclusion as a fundamental tool for attending university diversity.

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Knowledge Area

The works must be unpublished and refer to topics of university school management, management of university academic counseling, elements and conditions for reform in university school management, specific management models for each university context, inclusion as a fundamental tool for attending university diversityand other topics related to Social Sciences.

Presentation of Content

As first article we present, *Didactic strategies to strengthen soft skills in the graduate profile of the Industrial Maintenance engineer*, by AGUILAR-DUARTE, Gladys Melissa, CASTILLO-SALCIDO, Paola Fernanda, CASTILLO-PÉREZ, Martha Lina and ROGELIO-RUIZ, Janeth Margarita, with , as second article we present, *Analysis of the mechanical and electrical laboratory service at the faculty of electrical mechanical engineering of the Universidad Veracruzana in Poza Rica Veracruz, Mexico,* by SOLTERO-SÁNCHEZ, Jazmín del Rocío, HUERTA-CHÁVEZ, Irma Alicia, GONZÁLEZ-QUEZADA, Esperanza and FIGUEROA-OCHOA, Edgar Benjamín, with adscription in the Universidad de Guadalajara and Universidad Autónoma de Guadalajara, as third article we present, *Design and validation of an instrument to assess the quality of life of university students in the state of Sonora*, by MOROYOQUI-ALCANTAR, Edith Angelica, QUIROZ-CAMPAS, Celia Yaneth, MURILLO-FÉLIX, Cecilia Aurora and HINOJOSA-RODRÍGUEZ, Carlos Jesús, with adscription in the Instituto Tecnológico de Sonora, as last article we present, *Measurement of the management skills of academic directors in a higher education institution*, by DÍAZ-ALVA, Angelina, RAMÍREZ-HERNÁNDEZ, Moramay and LEÓN-PÉREZ, Francisco, with adscription at the Universidad Tecnológica de Tecámac.

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Didactic strategies to strengthen soft skills in the graduate profile of the Industrial Maintenance engineer

Estrategias didácticas para fortalecer las habilidades blandas en el perfil de egreso del ingeniero en Mantenimiento Industrial

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Abstract

Currently, organizations give greater importance to soft skills as part of the profile of those who integrate into their organizations and not only that they have the necessary technical knowledge to develop their jobs. The program of the Industrial Maintenance career is made up of technical, training and administrative subjects, but the latter two are not recognized as important by the enrollment of students. The graduates of the engineering in Industrial Maintenance have a recognized level of hard skills according to what the industry requires, by comments of the same students at the time of entering the labor field, they realize how necessary it represents to have an effective and efficient performance in companies integrated not only with technical knowledge but also with soft skills. The objective of this research isto propose and implement didactic strategies to strengthen soft skills in the graduate profile of the Industrial Maintenance Engineer. It consists of a bibliographic and / or documentary and field research through interviews and surveys to teachers, students and graduates to determine the importance of soft skills in the graduation profile of engineering students in Industrial Maintenance of the Technological University.

Skills, didactic, graduates

Resumen

Actualmente las organizaciones proporcionan mayor importancia a las habilidades blandas como parte del perfil de quienes se integran a sus organizaciones y no solo que cuenten con los conocimientos técnicos necesarios para desarrollar sus trabajos. El programa de la carrera de Mantenimiento Industrial está conformado por materias técnicas, formativas y administrativas, pero a estas dos últimas no se les reconoce como importantes por parte de la matrícula de alumnos. Los egresados de la ingeniería en Mantenimiento Industrial cuentan con un reconocido nivel de habilidades duras acorde a lo que la industria requiere, por comentarios de los mismos alumnos al momento de ingresar al campo laboral, se dan cuenta lo necesario que representa contar con un desempeño eficaz y eficiente en las empresas integrado no solo con el conocimiento técnico sino también con habilidades blandas. El objetivo de la presente investigación es proponer e implementar estrategias didácticas para fortalecer las habilidades blandas en el perfil de egreso del ingeniero en Mantenimiento Industrial. Consiste en una investigación bibliográfica y/o documental y de campo mediante entrevistas y encuestas a docente, alumnos y egresados para determinar la importancia de las habilidades blandas en el perfil de egreso de los alumnos de ingeniería en Mantenimiento Industrial de la Universidad Tecnológica.

Habilidades, Didáctica, Egresados

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Introduction

Nowadays, organizations are more aware of the importance of integrating personnel with transversal skills, that is to say, integral professionals in all aspects, because technical knowledge can be easily substituted by machines, but the human part or soft skills cannot.

Graduates of Industrial Maintenance Engineering have a recognized level of hard skills according to what the industry requires, but according to comments from the students themselves when they enter the labor field, they realize how necessary it is to have an effective and efficient performance in companies to have not only technical knowledge but also soft skills.

Therefore, it is necessary to implement didactic strategies that contribute to the students of Industrial Maintenance Engineering to recognize the importance of soft skills as part of the graduation profile, avoiding or minimizing that they classify the formative and administrative subjects as filler, and that they really value the learning that this type of subjects provide in their professional performance.

The objective is to propose and implement didactic strategies to strengthen the soft skills in the graduate profile of the Industrial Maintenance Engineer, by planning an awareness program that includes not only the formative and administrative subjects, but also the technical subjects where teachers contribute to change the paradigm that only technical or empirical knowledge is required, but also emphasize the importance of the student developing soft skills in the practices that are carried out as part of the subjects, as well as with extracurricular activities.

One general and two specific hypotheses are posed.

General hypothesis: Soft skills are an important part of the graduation profile of Industrial Maintenance Engineering students at the Technological University of Chihuahua.

First specific hypothesis: In order to improve the professional performance of Industrial Maintenance graduates, it is necessary to plan an awareness program about the importance of soft skills.

Second specific hypothesis: It is necessary to implement extracurricular activities to develop the soft skills of Industrial Maintenance students.

The first section addresses the need for professionals to have developed soft skills for an efficient performance in Industry 4.0.

The second section presents the results of the analysis of the subjects that make up the curriculum of the Industrial Maintenance Engineer career at the Technological University of Chihuahua.

In the third section, the student perception of the formative, technical and administrative subjects can be visualized.

The fourth section analyzes the results in relation to the activities to strengthen the learning of soft skills according to the responses of students, teachers and graduates.

Industry 4.0 and soft skills

The concept of soft skills is practically new, it goes hand in hand with the advances in the industrial revolution, so it is necessary to consult publications in relation to the requirements of the profile of personnel who intend to join the labor sector.

Currently with the fourth industrial revolution, companies are looking for employees not only with technical knowledge but also with band skills that allow personnel to make decisions, negotiate, lead work teams, communicate assertively, among other skills. According to Gómez - Gamero (2019, p. 2) "robotization and technological change implies opportunities and increases productivity and demand for jobs that require problem-solving capabilities, abstract and creative thinking, as well as social skills".

The 2020 curriculum of the Industrial Maintenance Engineering program at the Technological University of Chihuahua was consulted to analyze the hours assigned by type of skills (hard or soft). As well as the subject sheets of the different subjects to know the knowledge, learning objectives and competencies, and to determine how they contribute to the development of soft skills.

Skills 4.0

Deveci & Nunn (2018) and Holguín et al. (2018), assert that "engineering students are considered weak in soft skills, which should be further developed during their university career and which are requested by employers in today's labor market".

According to (Elena Zepeda-Hurtado et al., 2019) "the main tool for the realization of an engineer's work is knowledge, and the central task is to generate ideas. These knowledge workers add value to the company and its products through their ideas, analysis, judgments, synthesis capacity and designs".

According to Perez (2020, p. 10) universities need to focus "not only on training all members of their community in the basic knowledge of disciplines or work, but also on encouraging the development of multiple skills and competencies, specific to the needs of the technological context, so that, from soft skills such as collaborative work, creativity and critical thinking, graduates are prepared with a vocation for innovation and technological management, from the various areas of knowledge, but with strong support in digital and analytical tools supported in the processing of large volumes of information and technological development".

Nowadays, applying for a job represents a great challenge for graduates, due to the accelerated technological and social advances. According to Gómez (2019, p. 3) "the development of technical as well as soft skills is determinant to join the future jobs of university students with the challenges that arise in a globalized world, educational institutions must direct their efforts for the achievement of these competencies that in the labor world are valued and that students must face upon entry".

The website Ernst & Young Global Limited (2020), based on studies of the World Economic Forum, published in March 2020 an article comparing the most required soft skills in 2005 with the most demanded in 2020. The results are presented in Table 1.

Ranking	2005	2020
1	Complex problem solving	Complex problem solving
2	Coordination with others	Critical thinking
3	Talent management	Creativity
4	Critical thinking	Talent management
5	Negotiation	Coordination with others
6	Quality control	Emotional intelligence
7	Service orientation	Judgment and decision making
8	Judgment and decision making	Service orientation
9	Active listening	Negotiation
10	Creativity	Cognitive flexibility

Table 1 Comparison of soft skills 2005 - 2020
Source: Ernst & Young Global Limited

As shown in Table 1, since 2005 the ability to solve problems continues to be a priority, while aspects such as critical thinking, creativity and emotional intelligence are gaining importance.

There are a number of traditional competencies that continue to be relevant. These include: authenticity, talent building, customer focus and results. However, new soft skills such as empathy, resilience, mental clarity, inspiration and cultural connection are emerging in the business context, due to the balance that must exist between technology and humans.

Similarly, soft skills are also evolving in terms of their fundamentals, including relationship building, change management, learning orientation, problem solving, communication and teamwork. Table 2 shows this evolution.

Past	News
Building relationships with super connector	Communication for purposeful work
Problem solving for 360° thinking	Teamwork for virtual coworking
Manage change to embrace disruption	Learning for intellectual innovation - creativity

Table 2 Evolution of the rationale for soft skills.
Source. Ernst & Young Global Limited

General analysis of the Industrial Maintenance Engineering curriculum

An analysis is made of the percentage of representation of the subjects that make up the 2020 competency-based curriculum of the Industrial Maintenance Engineering career, where according to Graph 1, 10% contribute to management training, 13% allow the development of scientific training applied to the career, 16% contribute to the learning of a foreign language, 51% are related to technological training and 10% are made up of elective subjects, which is known as relevant training.
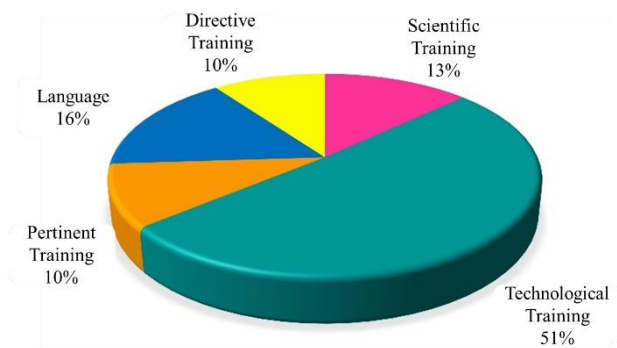
Graphic 1 Learning areas in Industrial Maintenance Engineering
Source: Own elaboration

Soft and hard skills are segmented by the competence they provide to the student, as part of the hard skills that are developed during the course of the Industrial Maintenance engineering career, 13% is made up of scientific training, 33% technical subjects related to the profession and 13% promote technological development, which gives a total of 59%.

The soft skills that are developed as part of the curriculum for the industrial maintenance engineer, 21% is made up of the development of administrative competencies, 16% allows the learning of a foreign language. The remaining 4% is represented by the integrating subjects, as can be seen in graph 2.
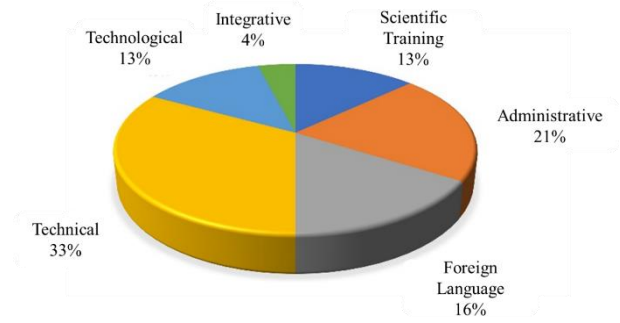
Figure 2 Competences developed in Industrial Maintenance Engineering
Source: Own elaboration

Importance of formative, administrative and technical subjects

Students from the seventh to the tenth semester of engineering were surveyed using the Likert scale, and it was observed that the perception of technical subjects had an average score of 4.74 stars, administrative subjects obtained 4.41 points and formative subjects 4.31 stars of importance according to the students. With this it can be determined that the subjects that contribute to the development of soft skills are the ones that students consider the least important.

In this section the results are not filtered considering employment status or marital status, since the level of maturity reached by the students each term has a tendency to increase the perception of the importance they give to each of the subjects, as shown in Graph 3.
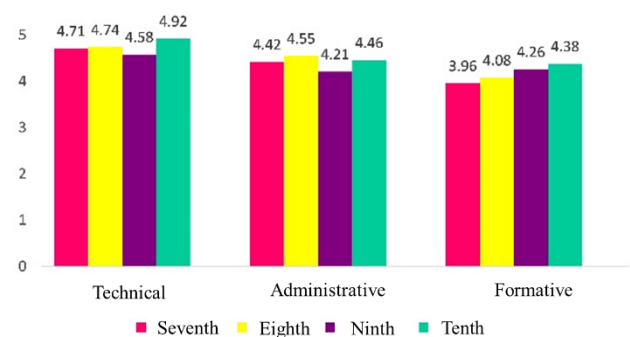
Graphic 3 Comparison of the importance of the subjects by term
Source: Own elaboration

A survey was applied to graduates of Industrial Maintenance Engineering between January and May 2022, in order to know their perspective of the subjects they took, and the results were filtered by applying variables such as employment status and marital status.

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Subject	Overall average score	Filter by employment status	Filter by marital status and employment status
TSU and engineering technical subjects	4.58	4.60	4.36
Engineering administrative subjects	4.61	4.76	4.71
TSU administrative subjects	4.55	4.64	4.57
Formative subjects of TSU	4.45	4.64	4.64

Table 3. Comparison of the perception of the subjects among the graduates
Source: Own elaboration

In the comparison in Graph 3, the results of the graduates are added and an increase is observed in the importance given to all the subjects taken; a noteworthy fact is that they assign the same level of importance to the technical subjects that strengthen the hard skills and to the administrative subjects that strengthen the soft skills, for professional and labor performance with 4.58 points on a scale of 5 points; the formative subjects, although they increase the importance score in a linear manner, reach only 4.45 points, as is observed in Graph 4.
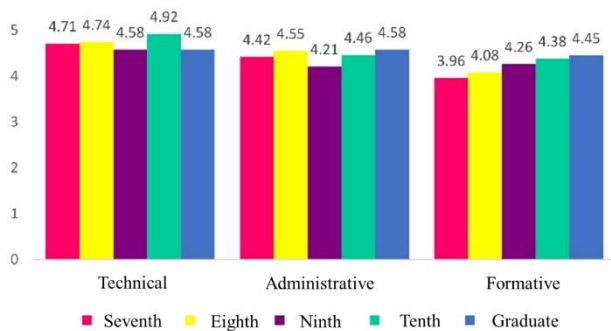
Graphic 4 Comparison of the importance assigned from seventh grade to graduation
Source: Own elaboration

Determination of didactic strategies for the strengthening of soft skills

The students were asked about the activities that they consider can contribute to strengthen the assessment of the level of importance for the work performance of the administrative and formative subjects. The students consider it important to attend conferences related to the formative and administrative subjects, as well as to carry out internships, projects and solve practical cases that allow them to apply the topics contained in these subjects.

Another relevant aspect for the students is the professor's experience in the application of these subjects in the work environment, as shown in Graph 5.
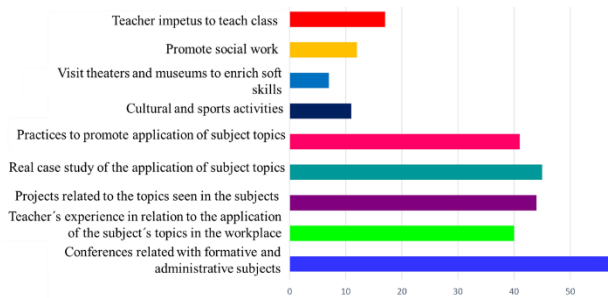
Graphic 5 Activities to reinforce the learning of soft skills according to the students
Source: Own elaboration

The same question is posed to the teachers, i.e., what activities do they consider can be carried out to strengthen the students' interest in formative and administrative subjects? 60% agree that it is necessary to encourage social work, 55% think that it is necessary to work on the contents of the subjects through projects and real practical cases.

50% of the professors agree that it is necessary for students to attend conferences related to the formative and administrative subjects, to promote cultural and sports activities, and to carry out internships related to the topics covered in the subjects.

Finally, 45% of the professors consider important the professor's experience with the application in the work environment of the contents of the formative and administrative subjects. Graph 6 shows the trend.
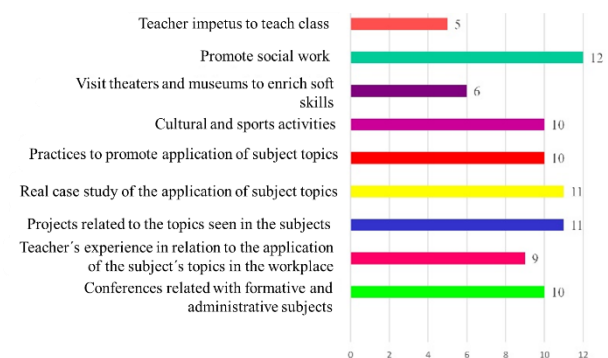
Graphic 6 Activities to strengthen the learning of soft skills according to teachers
Source: Own elaboration

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The teachers were also asked about the application of the topics seen by the students during their studies in the formative and administrative subjects, for an efficient professional performance. Eighty-five percent agree on the importance of teamwork in the workplace, 75% consider the need to develop emotional intelligence, 70% focus on fostering personal and professional values, 65% think that leadership is fundamental, 60% believe that effective communication and negotiation are necessary for the graduate to be able to perform in the workplace. Finally, 55% agree on the importance of covering planning and creativity, while only 40% consider it necessary to organize time and delegate activities. This is shown in Figure 7.

Graphic 7 Soft skills required by students in the workplace according to teachers' perception
Source: Own elaboration

Teachers also consider it necessary to carry out activities that allow the development of soft skills in students, among these activities they mention working on internships and projects as in the integrative subject, but focused on strengthening soft skills; they also propose collaborative work with other careers at the university, designing and exhibiting prototypes using the topics seen in the formative and administrative subjects, research work, dynamic classes, practices in computer labs, but above all, relating the contents with the application in the work environment.

The teachers affirm that they personally need to develop cultural skills, adaptation, effective communication, conflict management, time management, resilience, customer orientation, teamwork, leadership, proactivity, negotiation, proactivity and adaptation to change. They also consider it necessary to work on issues to improve critical thinking, socialization and social adaptation.

Didactic strategies for the development of soft skills in industrial maintenance engineering students

A documentary research is carried out on teaching-learning strategies that contribute to the strengthening of soft skills of students, among them are the following:

Inverted class and m-Learning

The inverted classroom methodology proposes to turn the current teaching methods upside down, the teacher provides the theoretical contents and the student interacts, practices and actively participates in the class. Outside the school context, the student studies the lessons and analyzes the material, participates in forums, debates, brainstorming and develops team work with the teacher as facilitator and curator of information.

At the professional level, the application of this model is facilitated by the maturity of the students; it is the key to distance education modalities, such as those implemented for more than two years as a result of the COVD-19 contingency.

An essential tool for the Inverted Classroom methodology nowadays are cell phones, in this regard Sánchez-Rivas, E.; Sánchez-Rodríguez, J. & Ruiz-Palmero, J. (2019) mention that m-Learning is an evolution of online education (e-learning) based on the incorporation of mobile devices to didactic contexts.

The materials that the teacher can share with the student are magazine or newspaper articles, videos, digital books.

Lego Serious Play

Lego is a brand of building blocks of bright colors, it gives the user the opportunity to imagine whatever he can imagine, although it can be categorized as a children's toy, its versatility makes it an excellent strategic ally of training for schools and organizations, because it encourages imagination and teamwork, which helps to develop innovative processes.

The Lego Serious Play methodology is a tool with which the student can learn to create through playful exercise, it is based on a phrase of Albert Einstein "Games are the highest form of research". This tool allows the balance between a rigid, square adult, who looks to the future with the inner child who is creative and curious.

The main benefits of this technique are that it contributes to strengthen multiple intelligences, integrates social, cognitive and emotional dimensions in group activities, allows to face conflicts in a productive way, promotes creative thinking, encourages participation, equality and effective communication.

Education in values

Education in values requires the participation of teachers, students and the university community. This methodology is not limited to classroom teaching, to the learning contents of the subjects, and to the skills and topics related to the career that the students are studying, but it must also set objectives related to moral and civic issues, with the purpose of forming responsible professionals.

In today's environment, characterized by social complexity and economic and cultural globalization, this tool becomes important in order to train professionals capable of taking on new challenges and committing themselves actively and effectively in the construction of a much more just, inclusive, equitable and intercultural environment.

The education in values in professional training consists of humanizing the profession, developing an integral personality, through the example of the teaching exercise and university environment that allows developing integral future engineers in Industrial Maintenance.

Social Work

Promoting social work, either by visiting nursing homes, hospitals and boarding schools, allows the student to develop a feeling of empathy towards other people, as well as to value that they have health, a home, a family.

These types of activities help to humanize the professionals, putting them in contact with perspectives that they may never have had to face.

Conferences on administrative and formative topics

Facilitate conferences by professionals with experience in leadership, motivation, emotional intelligence, strategic planning, negotiation, environmental aspects, resilience.

It is also important to promote talks with graduates to share with students the importance of soft skills in their professional performance and how they apply them, to raise awareness among students regarding the application of the topics covered in administrative and formative subjects.

Stays

In the process of learning soft skills, it is very important that the student "after the modeling, performs in the educational context the practice of what has been observed" (Guerra-Baez, 2019, p. 5). This aspect is carried out through professional internships and students' stays in the productive sector, which they carry out at the end of the TSU and engineering levels.

During the period where the student develops a stay in the productive sector, he/she continues to receive advice both from a teacher who serves as an educational advisor, as well as from a business advisor who monitors the student's behavior in the company. According to Guerra- Baez (2019, p. 5). "it is expected that the student manages to generalize the application of the soft skills that were trained in the context of higher education to work and personal interaction scenarios".

Methodology to be developed

Hypotheses

General hypothesis: Soft skills are an important part of the graduation profile of Industrial Maintenance Engineering students at the Technological University of Chihuahua.

First specific hypothesis: In order to improve the professional performance of Industrial Maintenance graduates, it is necessary to plan an awareness program about the importance of soft skills.

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Second specific hypothesis: It is necessary to implement extracurricular activities to develop the soft skills of Industrial Maintenance students.

Research techniques

Bibliographic and/or documentary

Consultation of publications related to the concept of soft skills, the importance in the graduation profile of professional level students at the time of integrating into the labor sector in the era of industry 4.0.

Consult the curriculum to analyze the hours assigned by type of skills (hard or soft). As well as the subject sheets of the different subjects taken in Industrial Maintenance engineering, to know the knowledge, learning objectives and competencies, to determine the contribution to the development of soft skills. It is also necessary to investigate teaching methods to develop soft skills.

In the field

Interview with professors of the Industrial Maintenance career who work in the industry, in order to know the importance of the development of soft skills in the sector as an entry profile to the company.

Survey to professors to determine the importance they assign to the different subjects that are part of the industrial maintenance curriculum.

Survey to students who are studying Industrial Maintenance Engineering to determine the importance they assign to the different subjects that are part of the four-month period they are studying.

Survey to graduates to determine if they consider that they have developed their soft skills and the application and importance in the labor field.

Definition of the population and sample

The research is developed in the Industrial Maintenance career of the Technological University of Chihuahua, the population is made up of all students enrolled in the engineering level from the seventh to the eleventh semester, the latter corresponds to those who are in the period of stay in the industry.

A non-random sampling is performed, since the objective of the research is to know the factors that influence the perception of the application of the soft skills of the students of all the semesters that make up the educational program at the engineering level; therefore, descriptive statistics is used for the analysis of the data. One group per quarter is selected from seventh to eleventh semester of the night shift, who are mostly composed of male students, so the survey is applied to a total of 105 students and 31 engineering students.

A survey was also applied to all teachers of the evening shift of the Industrial Maintenance career to know their opinion regarding the soft skills that a student should have as part of their graduation profile and the activities that can contribute to develop them. These data can be seen in Table 4.

Quarter	Sample size
7th	24
8th	38
9th	19
10th	24
11th (stays)	31
Evening teachers	14

Table 4 Population and sample size

Three independent variables are identified for the purposes of this research and are shown in Table 5.

Independent	Dependent
1. Quarter in which they are studying. Determine whether it is variable or constant	1. Perception of soft skills according to the four-month period the student is studying.
2. Work experience. Determine if variable or constant.	2. Perception of soft skills according to marital status.
3. Marital Status. Determine if it is variable or constant.	3. Perception of soft skills according to work experience.

Table 5 List of variables

Instrument

With the support of the Outlook Forms tool, a survey is applied to teachers of the afternoon shift, to students from seventh to tenth year of engineering and to those who are in the period of internships in the companies. A Likert scale with values from 1 to 5 is used to measure the perspective in relation to the degree of importance they assign to the different subjects of the educational program that contribute to the development of soft skills, in order to analyze the trends and correlation with the different factors (marital status, work situation and term of study) that are taken into account. Table 6 shows the questions posed in the surveys and the response categories to determine the factors that intervene in the perception of the formative and administrative subjects for work and professional performance.

1. Quarter 　　Multiple Choice	Seventh Eighth Ninth Tenth Stays
2.　　Marital Status 　　Multiple Choice	Single Engaged Married or Unmarried Divorced
3. Do you have any work experience? Multiple choice	Yes No
4. Is the work you do related to the Industrial Maintenance Engineering career? Multiple choice	Completely Very Related Poorly Related Not related.
Assign according to your perception of importance for your job performance from ☆ to ☆☆☆☆☆ (answered by students from seventh to tenth grade)	
5. How important to you are the technical subjects you took during your TSU?	
6. How important are the administrative subjects that you took during the TSU for you? (Personnel Administration, Costs and Budgets, Safety and Environment)	
7. How important are the formative subjects you took during the TSU for you? (Sociocultural Formation I, II, III, IV and Oral and Written Expression I and II).	
Assign according to your perception of importance for your job performance from ☆ to ☆☆☆☆☆ (answered by students from seventh to tenth grade)	

5. How important to you are the technical subjects that you took during your TSU and engineering studies?	
6. How important are the administrative subjects you took during engineering for you?	
7. How important are the administrative subjects that you took during TSU? (Personnel Administration, Costs and Budgets, Safety and Environment)?	
8. How important are the formative subjects you took during the TSU for you? (Sociocultural Formation I, II, III, IV and Oral and Written Expression I and II).	
Teachers, students and alumni answer	
9. What activities do you think can be carried out to strengthen the students' interest in formative and administrative subjects?	The impetus with which the teacher teaches this type of subjects. The promotion of Social Work. Visits to museums and theaters to strengthen soft skills. Cultural and sports activities Internships to promote the application of the topics covered in the subjects. Projects related to the topics of the subject in the work environment. Conferences related to training and administrative subjects..
Teachers, students and alumni answer	
10. What topics seen during the course contribute to be more efficient in the work environment?	Planning Time management Delegating activities Effective communication (oral and written) Negotiation Personal and professional values. Creativity Emotional intelligence Teamwork Leadership

Table 6 Battery of questions of the questionnaire

Interpretative frame of reference

Phenomenology

Instrument validation

To validate the instruments, a pilot test was conducted with students from the tutored group (IMI81N and IMI91N) and with students who finished their internship during the transition period of the September-December 2022 term, where data was collected and the effectiveness of the consultation instrument was verified, as well as the comprehension of the questions and answers.

Data validation

The reliability of the survey was calculated using Excel with Cronbach's Alpha formula in order to determine the reliability of the instrument, results and consistency. Figure 1 shows the result of 73%, which gives an acceptable reliability.

Numero de items del instrumento		4		
Sumatoria de la varianza de los items	VARS	2.876893442	VARP	2.83964855
Varianza total del instrumento	VARS	5.239742296	VARP	5.201214779
Coeficiente de confiabilidad del cuestionario	α	0.73	α	0.73

| Resumen del proceso de casos			
		N	%
Casos	Valido	136	100
	Excluido	0	0
	Total	136	100

Estadistica de fiabilidad	
Alfa de Cronbach	N. Elementos
0.73	8

Figure 1 Calculation of reliability with Cronbach's Alpha

Results

General analysis of the Industrial Maintenance Engineering curriculum

It is concluded that 59% of the subjects taken during the Industrial Maintenance Engineering course contribute to the development of hard skills or skills related to the profession the student is studying, while soft skills are represented by only 37%. The remaining 4% is made up of the integrating subjects, which are taken in the eighth quarter, where a project is proposed and in the tenth quarter the follow-up for the design and execution of the project is carried out. The main objective of these subjects is for the student to apply the hard and soft skills acquired during the course of the course, as shown in Graph 8.
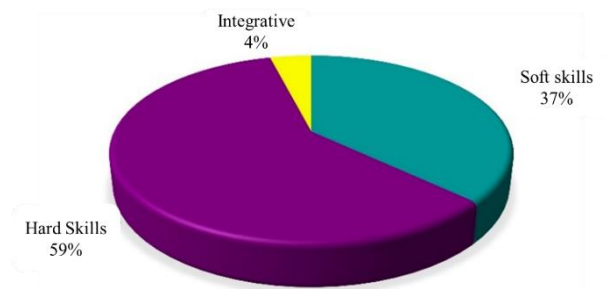
Graphic 8 Development of soft and hard skills in the Industrial Maintenance Engineering program
Source: Own elaboration

Importance of formative, administrative and technical subjects

The graduates were asked about the importance that soft skills represent for them in their work performance, 74% considered them important, 20% had only heard of them, but were unaware of their application in their professional performance, 3% were unaware of the concept, and another 3% did not consider them important for their profession. Figure 9 shows the results.
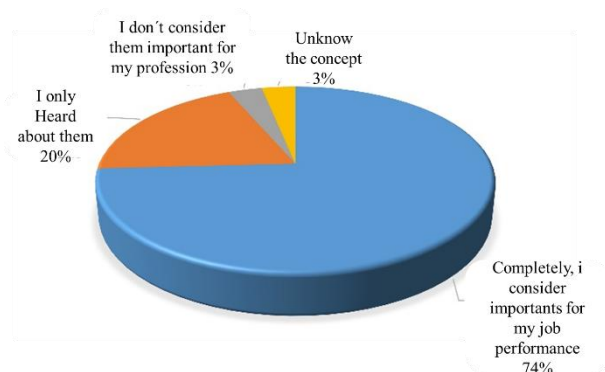
Graphic 9 Importance of soft skills in the work performance of graduates
Source: Own elaboration

If the responses are filtered taking into account only the opinion of those who are currently working, the figures change slightly; the percentage of those who consider soft skills to be important for their professional and work performance increases from 74% to 76%.

The percentage of those who have only heard of the concept but do not know its application remains at 20% and those who do not know the term soft skills is 4% as shown in Graph 10.

AGUILAR-DUARTE, Gladys Melissa, CASTILLO-SALCIDO, Paola Fernanda, CASTILLO-PÉREZ, Martha Lina and ROGELIO-RUIZ, Janeth Margarita. Didactic strategies to strengthen soft skills in the graduate profile of the Industrial Maintenance engineer. Journal University Management. 2023
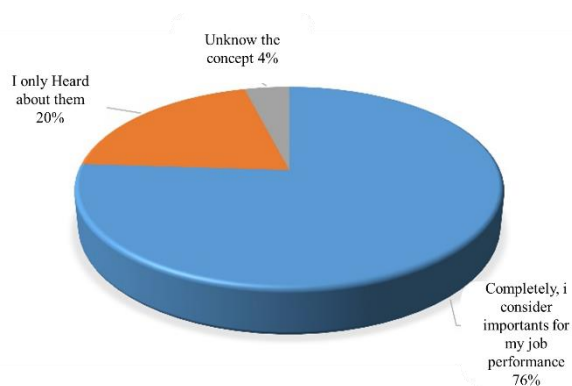
Graphic 10 Importance of soft skills in the labor performance of employed graduates
Source: Own elaboration

Determining didactic strategies to strengthen the soft skills

The results of the surveys applied to students, graduates and professors show the importance given by students to soft skills, as well as the need to apply them in the work environment at the time of graduation from Industrial Maintenance Engineering. It is shown that marital status and work situation influence the perception of the subjects that strengthen this type of skills, as well as the four-month period they are studying, since in the tenth four-month period students begin to value the topics offered by the formative and administrative subjects.

Graduates give greater importance to soft skills than students who are still studying engineering, because they realize firsthand how necessary it is to have them developed.

A program is planned to raise awareness about the importance of soft skills in the professional performance of Industrial Maintenance graduates and the implementation of extracurricular activities to develop them is proposed.

Didactic strategies for the development of soft skills in Industrial Maintenance engineering students

For the implementation of the inverted classroom strategy, there is a Moodle platform, through which the teacher can share content such as videos or access to interactive platforms to promote learning.

The Technological University of Chihuahua is an educational institution that seeks to foster values in the university community by strengthening and promoting values such as respect for others and the environment, responsibility, honesty, tolerance, loyalty, punctuality, friendship, justice, solidarity, order and cleanliness. In addition, it has several programs that allow its strengthening, such as the inclusion area, the values program and the smoke-free school program.

To strengthen the social work in the Industrial Maintenance career, social work has been carried out in the depressurized shift for approximately 2 years, this consists of visiting a farm home, taking food and living with the children who live there. We have also delivered cleaning supplies and gifts through a program of "adoption" of a child, where each student chooses a child to sponsor and bring him/her a gift, as shown in Figure 2.

Figure 2 Example of a social work activity

Acknowledgements

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Conclusions

Soft and hard skills complement each other; it cannot be said that soft skills are more important than hard skills, nor vice versa, because a graduate must have both skills.

The development of soft skills allows to perform more effectively the technical activities related to the Industrial Maintenance career. It is necessary to emphasize that according to several studies it is easier for a company to train personnel in technical subjects than to change the way of being of those who are part of their organizations, for that reason it is that they value to a great extent that a graduate mainly of engineering, apart from the knowledge related to the studies carried out, is a person who bases his behavior on values, who has the capacity to make decisions, plan, organize his time, work in team and communicate ideas in an effective way, as well as an attentive listening.

Companies also require people who are emotionally intelligent, creative and good leaders.

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Ludic didactic strategies for meaningful learning in undergraduate students

Estrategias didácticas lúdicas para el aprendizaje significativo en estudiantes de pregrado

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Abstract

The interest in achieving meaningful learning in undergraduate science students, as well as the emergence of new teaching-learning theories, inevitably lead teachers to generate various strategies that allow them to transfer and create knowledge in undergraduates. In this sense, the objective of this article was to evaluate the implementation of ludic didactic strategies in the learning of chemical nomenclature in undergraduate students, that is, how both variables are related. This research was quantitative and qualitative, descriptive and correlational, cross-sectional and the sample population by convenience of 104 students of the Bachelor's Degree in Pharmaceutical Chemistry and Biology. A measuring instrument with 15 items was used, validated by expert judgment and by means of Cronbach's Alpha Index. Data were analyzed with descriptive statistics and hypothesis testing. The findings show that the implementation of ludic didactic strategies by teachers favors learning in chemical nomenclature in undergraduate students. This contributes directly to the state of the art, although there is an evolution in the teaching-learning theories, there are still knowledge gaps in their applicability for educational benefit.

Resumen

El interés por lograr un aprendizaje significativo en los estudiantes de pregrado en ciencias, así como el surgimiento de nuevas teorías de enseñanza-aprendizaje, llevan inevitablemente a los docentes a generar diversas estrategias que les permitan transferir y crear conocimiento en los universitarios. En este sentido, el objetivo del presente artículo, consistió en evaluar la implementación de estrategias didácticas lúdicas en el aprendizaje de nomenclatura química en estudiantes de pregrado, es decir, cómo se relacionan ambas variables. Esta investigación fue de tipo cuantitativa y cualitativa, descriptiva y correlacional, de corte transversal y la muestra de la población por conveniencia de 104 estudiantes de la Licenciatura en Químico Farmacéutico Biólogo. Se utilizó un instrumento de medición con 15 ítems, validados por jueceo de expertos y mediante el Índice del Alfa de Cronbach. Con estadística descriptiva se analizaron los datos y la prueba de hipótesis. Los hallazgos muestran que la implementación de estrategias didácticas lúdicas de parte de los docentes favorece el aprendizaje en nomenclatura química en los estudiantes de pregrado. Lo anterior aporta directamente al estado del arte, si bien existe una evolución en las teorías de enseñanza-aprendizaje, aún hay brechas de conocimiento, en su aplicabilidad para el beneficio educacional.

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Introduction

The search for didactic strategies to improve learning in undergraduate students is a constant task for the teaching activity, given the prevalence of lack of knowledge in basic conceptualizations of chemical science, such as chemical nomenclature. These deficiencies are detected from the initial levels of academic training: secondary school, high school and even in their first approaches to this science during the learning units of the university career.

Therefore, learning in undergraduate students continues to be a novel research topic, as an important factor for both the teacher and the student to join in educational innovation, contemplating the new teaching-learning theories, whose main objective should focus on meaningful learning, starting from the identification of previous knowledge as a starting point for the generation of new knowledge, that is, to make sense of the knowledge acquired and above all to achieve self-learning.

Among the obstacles detected by some researchers on the subject of learning chemical nomenclature, it is worth mentioning the confusion of rules after a memorized learning, short term and little reflexive about what is learned. As well as the disconnection between the concepts studied and the belief that this learning is complicated. Also, it is found that the subject taught is isolated from the context of the student, limiting the relationship with the environment and particular interests.

In addition to the above, from the basic educational levels, students are unaware of the reason for using a special language of chemical nomenclature, which is justifiable given the number of existing chemical compounds (Gómez-Moliné et al., 2008). Hence the importance of mastering the essential concepts, not simply memorizing (Hernández, 2008). Another obstacle is the tendency of teachers to replicate the techniques and teaching methods with which they were educated (Maila-Alvarez et al., 2020), which limits their ability to meet the new needs of the teaching-learning process, due to changes in society and in the understanding of human beings themselves.

Accordingly, the importance of this research stands out, where the creation of meaningful learning in students is fundamental for their performance not only academically, but also in their professional life. In addition, this study contributes to the state of the art, theoretically to the teaching-learning theories and empirically by measuring quantitatively the prior and subsequent learning and knowledge of the students, after the implementation of the didactic ludic strategies, identifying the relationship between the variables studied. In this same order of ideas, the different didactic and ludic strategies play an important role, by allowing learning through play in a fun and effective way.

The technique used in this research is both quantitative and qualitative, whose approach is mixed, has an added value with respect to other techniques, on the one hand, a numerical analysis is carried out that allows for generalizable results for the population studied from the sample and, on the other hand, the qualitative analysis allows for complementing the explanation of the problem that occupies this study.

Consequently, in order to clarify the problem to be solved, the research question is formulated as follows: What is the relationship between the implementation of ludic didactic strategies by teachers with the significant learning of chemical nomenclature in undergraduate students? In order to influence the problem, the central hypothesis is established as follows:

H_0: The implementation of ludic didactic strategies by teachers does not have a significant relationship with the meaningful learning of chemical nomenclature of undergraduate students.

H_a: The implementation of ludic didactic strategies by teachers has a significant relationship with the meaningful learning of chemical nomenclature of undergraduate students.

This article is composed of nine sections, which are described below, in order to clarify the content of each one of them. In the first section, there is an introduction to the research topic, the problem to be solved, the hypothesis, the added value of the technique used and the generalities of the research.

SOLTERO-SÁNCHEZ, Jazmín del Rocío, HUERTA-CHÁVEZ, Irma Alicia, GONZÁLEZ-QUEZADA, Esperanza and FIGUEROA-OCHOA, Edgar Benjamín. Ludic didactic strategies for meaningful learning in undergraduate students. Journal University Management. 2023

In the second section, the literature review is presented, including an overview of the theory supporting the research, which includes teaching-learning and ludic didactic. In this same sense, the third section details the method used, the type and design of the research, the description of the variables, the measurement instrument, the participants, the procedure and the data analysis. The fourth section includes the results and discussion, with descriptive statistics, as well as the discussion in the light of the supporting theory. The fifth section includes the annexes, where the instrument used is included.

The sixth section includes the acknowledgements to the participating teachers and students, as well as to the institution of origin. The seventh section shows the source of financing for the research work. The eighth section presents the conclusions and recommendations, where the main findings, limitations and future work are presented. Finally, the ninth section lists the references of the authors who contribute directly to this study according to the literature review of teaching-learning in university environments.

Literature review

Teaching-learning

Teaching-learning process is conceived not only as a mere transmission of knowledge, but as a process of reconstruction, involving the accumulation of different learning experiences (Piaget, 1950). The techniques used are active cooperative learning as opposed to traditional passive learning.

Now, teaching-learning theory is mainly divided into two major models. The first one refers to teaching, where the teacher is in charge of transmitting knowledge in an expository way, that is, in a master class, where the student only listens. The second model refers to learning, where the student is at the center and the teacher is only a facilitator of learning (Gargallo-López, et al., 2011).

Traditional teaching

Teaching-centered model defines knowledge as an external construction based on the scientific knowledge of a discipline shared by the teacher in an organized manner, who is an expert, understands, dominates, explains and is updated on the topics.

For this, learning is interpreted as the way of acquiring or increasing knowledge in some area to be applied later (Gargallo-López et al., 2011), without considering the students' previous knowledge (Morales et al., 2015).

Accordingly, the teacher with the teaching model uses the lecture and expository lesson, unidirectional communication and eventually changes to bidirectional in the space of questions and answers. In addition, the material used are the teacher's notes based on books and the evaluation of the students consists of repeating what they have learned. Likewise, the teacher performs the tutoring task voluntarily and at a certain time (Gargallo-López et al., 2011). Therefore, teaching is the process by which knowledge about a subject is transmitted (Cabrera-Medina et al., 2016).

Constructivist learning

A very important event in pedagogy is the so-called Copernican revolution, where the focus shifts from teaching processes to learning processes, that is, on the learner. This does not mean that the role of the teacher is unknown, but rather that the figure of the teacher changes to being a guide, a tutor, a facilitator of learning (Tünnermann, 2011). So, the acquisition of knowledge is a process that is incorporated into pre-existing knowledge in the mind of the learner that can be modified or reorganized according to each individual (Piaget, 1950).

Constructivism is a theory of Harré (1986) and Osborne (1996), which has five objectives, the first one refers to the comprehension and expression of scientific messages both orally and in writing. The second refers to interpreting and representing science concepts adequately. The third refers to applying strategies in problem solving. The fourth refers to planning and carrying out scientific activities in teams. Finally, the fifth refers to reasoning based on personal criteria contemplating the era in which one lives (Insausti & Merino, 2000). Constructivist paradigm seeks that students build scientific knowledge for the development of scientific competencies, promoting greater autonomy and participation (Espinosa-Ríos et al., 2016). That is why, the teaching-learning process in universities has changed, it seeks to focus learning strategies on the student and the teacher is cataloged as a guide or mediator for problem solving and application of knowledge (Fernández & Aguado, 2017).

The constructivism approach conceives the student as responsible for his or her own learning and competencies, which requires the identification of the problem, as well as the knowledge that is available and the knowledge that is desired to investigate for the solution of the problem, with critical and creative thinking. While the teacher is responsible for facilitating the didactic strategy (Lozano-Ramírez 2020). This approach emphasizes the student with his or her knowledge, skills, abilities, expectations, attitudes and conditions to acquire new knowledge (González-Zambrano et al., 2022).

For the construction of knowledge, the establishment of innovative processes of learning environments should be considered, including motivation and co-instructional strategies. Stimulation of the memory of previous learning to develop competencies. Respect for the learner and autonomy. The presentation of pedagogical material and the use of technologies. The ease of appropriation of knowledge; and the linking of previous learning with new learning to be applied in reality (Salgado, 2022).

The learning model based on constructivism focuses on the student and the teacher as facilitator of learning. To this end, knowledge is defined as a social and negotiated construction, it is created and changing. In addition, learning is personally constructed and shared to give meaning to concepts and reality (Gargallo-López, et al., 2011). With this learning theory according to constructivism, the student reaches a significant level of understanding, achieves a conceptual and personal change, with an approach to reality, in addition to passing the subjects (Morales et al., 2015).

In this sense, teaching is understood as an interactive process for the construction of knowledge, where the teacher, in addition to mastering certain topics, must have didactic pedagogical tools to facilitate learning. Interaction with students is bidirectional, and the use of various bibliographic resources is essential to generate critical thinking, dialogue, discussion and teamwork (Gargallo-López et al., 2011). That is why, to facilitate learning, the teacher uses various interactive methods, dialogues or group techniques (Morales et al., 2015).

As a result, learning is the appropriation of knowledge in a critical way (Cabrera-Medina et al., 2016) and evaluation includes case studies, self-assessments, problem solving, rather than exams where knowledge is repeated (Gargallo-López et al., 2011). Now, at the higher education level, the student as the center of the teaching-learning process, it is essential to involve him/her so that learning is created and applied in his/her context (Soltero-Sánchez et al., 2021), in order to meet the new demands in the academic training of the next professionals (Huerta-Chávez et al., 2022).

Meaningful learning

Currently, in educational teaching, the concepts of stimulus, response and positive reinforcement have been replaced by meaningful learning, conceptual change and constructivism. At this time, quality teaching, considered as good, should contribute to conceptual change that facilitates meaningful learning (Moreira et al., 1997). This theory is a response to behaviorism, where activism and learning by discovery were strong (Ordóñez & Mohedano, 2019).

The teacher must contemplate the intellectual capacities of the students for the development and implementation of new didactic strategies. Also, he must socialize and review the current contents and link them with the knowledge generated. The most important thing is to achieve students' motivation to learn, search, collect and create knowledge (Guamán & Venet, 2019).

Consequently, to speak of meaningful learning goes beyond traditional learning, since it not only requires a change in behavior, but also a change in the meaning of the learner's experience. To this end, several elements have an impact on student learning, such as the teachers and the teaching method. Also, the curriculum and the way it is produced. In addition, the social context in which knowledge is developed (Ausubel, 1983).

In this type of learning, the student has a primordial role in generating his or her own knowledge and achieving a balanced cognitive change with individual and social meaning. There must be a willingness to learn, therefore, there must be suitable subsumers in the cognitive structure (Rodríguez, 2004).

Therefore, it is of great importance to use the knowledge that the student has, so that new learning is generated and becomes meaningful, not memoristic or mechanical (González, 2019).

Thus, the student will learn from the cognitive structure he has, that is, from the concepts and ideas and the way they are organized, which will affect learning in a beneficial way. Therefore, meaningful learning is achieved when a subject is taught in a way that is not arbitrary to what the student knows. Rather, based on what the student knows, a relevant aspect of the cognitive structure is identified and the teaching is carried out (Ausubel, 1983). Therefore, there are two important elements of meaningful learning, non-arbitrariness and substance, i.e., knowledge is not related to any concept but to the most relevant cognitive structure (Moreira et al., 1997).

Then, meaningful learning will occur when new information is connected with a relevant concept that the student possesses, therefore, an anchoring of previous knowledge with the new one is achieved. Not only is an association between knowledge achieved, but new knowledge is created in the cognitive structure, and the student is able to identify the difference, growth and development of knowledge in the subjects he learns (Ausubel, 1983).

Meaningful learning is divided into two types: representational learning and propositional learning. The first refers to individual symbols, such as knowledge of concepts, which leads to generic or categorical representations. The second refers to learning the meaning of ideas expressed by groups of words (Moreira et al.,1997; Ordóñez & Mohedano, 2019). The application of meaningful learning makes students more responsible for their learning, through the construction of knowledge by participating in various interaction activities in which they share their experiences and opinions in groups (Intriago-Cedeño et al., 2022).

Ludic didactic

The aspects of didactic strategies are united in ludic learning, both teaching, learning and evaluation. This turns the teacher's work into an interactive and reflective practice that impacts on teaching innovation. The student is the center of learning and the teacher the driver to achieve the desired learning (Gutiérrez-Delgado et al., 2018).

Gamification

Classic teaching model has been modified by the new educational trends of active student participation, where students actively influence their learning and gamification arises from these trends (Corchuelo, 2018). Gamification is an emerging methodology (Parra-González & Segura-Robles, 2019), it uses the game in contexts different from it (Lozada-Ávila & Betancur-Gómez, 2017), that is, in nonludic contexts (Zaragoza et al., 2016).

Digital games foster creativity, spontaneous learning, abstract thinking and skills development (Zaragoza et al., 2016). In higher education, games will have to be used according to the knowledge to be generated to ensure success (Lozada-Ávila & Betancur-Gómez, 2017). For quality education (Leyva, 2018) it is necessary to incorporate information and communication technologies (ICT) for the development of competencies and skills of both students and teachers.

The purpose of gamification is to ensure that the student meets the learning objectives and the teacher encourages such learning with gamified means, which achieve a link with the expected learning. It is also a mechanism for the understanding of academic content and active student participation. Therefore, it is an opportunity for students to be actively involved in their own learning, motivation, group dynamics, critical reflection and meaningful learning (Oliva, 2016). Gamification incorporates strategies, dynamics, mechanics and specific game content to influence the teaching and learning process in students (Pegalar, 2021).

Then, gamifying is a complex activity, more than a game design, since it involves analyzing the objectives to be achieved and a detailed planning and involvement of the participants (Ortiz-Colón, et al., 2018). Added to this, students play video games, they are gamers by nature, since it is part of their identity. So, using gamification didactic strategies, provoke an interest as motivation for greater and better learning (González-Moreno & Cortés-Montalvo, 2018). Gamification in higher education has an impact on providing better learning opportunities for students, by developing engagement skills, increasing motivation and interest in what is learned (Prieto, 2020), not only because society demands it, but also because schools demand it to facilitate learning (Sánchez-Domínguez, 2023).

Ludic

Ludic refers to the pleasurable and fun action, which is free and voluntary, it may or may not have rules, if there are rules it is a game. Therefore, the game in education has two functions: ludic and educational. The ludic function of games refers to fun and pleasure. While the educational function of games includes understanding, constructing and appropriating knowledge. Games foster motivation, participation, joy and improvement of academic performance, which positively affect the teaching-learning process. These ludic activities do not replace traditional teaching, but optimize the process (Gutierrez & Barajas, 2019).

Play or ludic activity is universal, but changes depending on the cultural environment. However, most people have participated at some time. In communities, through play, they have expressed life situations (Farias & Rojas, 2010). In addition, the game is a learning alternative, didactic games allow the development of skills, combining teaching and fun, being the necessary motivation to achieve meaningful learning, by encouraging critical capacity and self-learning (Martínez & Ríos, 2019).

Games can be classified as: function games, fiction games, construction games, grouping games or games representing the environment. They can also be cooperative, free or spontaneous, with rules or structured, strategy, simulation, popular or traditional, and adaptive structures. The latter are those in which the structure can be modified or redesigned, that is, a new game can be created on the basis of an already known game. This type of game is used for instructional purposes, because it helps to develop a diversity of games based on existing ones such as dominoes, cards or lottery (Farias & Rojas, 2010).

The development of diverse didactic and ludic strategies generates meaningful learning, theoretical knowledge is captured, and recreation, fun, conceptual reflection, debate, commitment and evaluation are made possible. These strategies, different from lectures, eliminate monotony in classes and allow students to be creative and to live new experiences that generate a taste for learning new things. It is noteworthy that these ludic strategies go beyond a simple listening to the lecture by the students, but contemplate the interrelation of previous knowledge with new knowledge, in a dynamic and motivational way (Caicedo, 2019).

The effectiveness of games in educational spaces lies in the fact that it is an activity that is part of the individual, since in addition to being considered as a leisure or entertainment activity, it is now a didactic resource and, therefore, favors learning (López & García, 2020). Consequently, play should be in the whole life of the human being as a fundamental activity for integral development (Caballero-Calderón, 2021). This type of ludic didactic strategies are supported by motivational theories to reinforce the student's performance (Manzano-León, 2021). In addition, by modifying traditional teaching models, they increase students' motivation for learning (Godoy, 2020).

Conectivism

The vertiginous changes since the middle of the previous century in relation to science and technology have caused movements in educational systems (Guamán & Venet, 2019).

Due to these changes, education faces new challenges that imply the generation of new pedagogical and educational perspectives to interrelate technology, communication and education (Bernal-Garzón, 2020).

Connectivism is a new theory of the digital era (Siemens, 2004), with new technologies such as: wikis, social networks, blogs, among others. In addition to having unlimited access to the computer world at the moment, students can control their own learning path (Hernández, 2008). The use of technologies for education improves its quality (Matute et al., 2009). This creates a new scenario for learning, where the role of information technologies becomes relevant (Gutiérrez, 2012). It also highlights the importance of the good use of learning resources such as mind and concept maps, as well as technological tools to design strategies and methodologies to generate interest and motivation in students (González-Zambrano et al., 2022).

In this same sense, the use of technology such as video games, web and social spaces, in teaching-learning with the combination of didactic and recreational situations, help to make learning easier and more fun (Guerrero & Flores, 2019). Now, the theory of connectivism, arises from technology and its impact on learning, part of the chaos and points out the impossibility of predicting, since reality depends on a myriad of uncertain events, one has an impact on another, being the challenge of learning to identify the hidden patterns of existing meanings. It also integrates the theory of self-organization, which depends on the learner's ability to create his or her own connections between information, people or social environments that interest him or her (Siemens, 2004).

This theory states that knowledge and the learning process reside at the same time inside and outside the individual, who is the starting point. Therefore, knowledge is composed of a network connected with others, which by interacting and collaborating feed back the knowledge of the networks generating new and updated learning (Altamirano et al., 2016). Connectivism, then, applies network principles to both knowledge and learning. Knowledge is a pattern of relationships and learning is the creation of new connections and their manipulation (Siemens, 2004).

The principles of connectivism point out that learning and knowledge result from diverse opinions. Therefore, learning is a process of connecting diverse sources of information and may be in non-human artifacts. Likewise, the ability to create more knowledge is important, as facilitating continuous learning and the ability to identify connections between concepts, ideas and topics is paramount. In addition, decision making is a learning process in itself, so what is learned and its meaning has to be seen in a changing reality (Gutierrez, 2012; Siemens, 2004).

For connectivism, all ideas come from other inherited ideas and everything has a root, each concept, thus knowledge networks are formed (Ovalles, 2014). Learning occurs with the condition that the nodes achieve interconnections between the same information needs in order to feed, update and purify the knowledge networks (López & Escobedo, 2021). However, the person responsible for learning is the learner, given that, in the current digital era, the choice of content and its structuring in the learning process plays an important role, where an attempt is made to organize the chaos of knowledge (Sánchez-Cabrero, 2019).

Notwithstanding, this theory, being emergent, faces the challenge of facilitating students to "learn to learn", which implies identifying networks, nodes and self-organization not only according to their interests, but also according to the academic objectives of each subject (Bernal-Garzón, 2020).

Method

Type and design of research

The current research presents a quantitative and qualitative approach, of a non-experimental type with cross-sectional cut (Bernal, 2016; Hernández et al., 2014).

Variables

Ludic didactic strategies variable

Didactic strategies focused on undergraduate student learning, contemplate the ludic activity as a tool for the development and strengthening of the student's cognitive structure, specifically in the subject of chemical nomenclature. It is based on the theory of ludic didactics, gamification and connectivism.

Meaningful learning variable

Teaching-learning strategy that mainly contemplates the student as the center of learning and the teacher as facilitator or guide with the implementation of new didactic methodologies to achieve meaningful learning in students with the topic of chemical nomenclature under the constructivist model.

Measuring instrument

The instrument used to measure the implementation of ludic didactic strategies in the meaningful learning of undergraduate students consisted of 15 items, of which 9 were evaluated on a 10-point Likert scale. The remaining 6 items evaluated qualitative variables, of which, 1 was evaluated in terms of time, 1 was evaluated in terms of knowledge of the three types of nomenclature, 2 evaluated the perception of the games and the preference of these, and the last 2 were open-ended questions regarding the opinion of the didactic strategy in which they participated. This instrument was validated by means of the expert judgment technique and the reliability test was carried out by calculating Cronbach's Alpha.

Participants

The sample was non-probabilistic by convenience (Bernal, 2016; Hernández et al., 2014), which consisted of 104 students of the Bachelor's Degree in Pharmaceutical Chemical Biologist, who voluntarily agreed to participate in the "Chemical Nomenclature Workshop Course", within the scientific and cultural event called "Week of the Pharmaceutical Chemical Biologist".

Procedure

Within the program of the scientific and cultural event called "Week of the Pharmaceutical Chemist and Biologist", we offered the "Chemical Nomenclature Workshop Course" with a duration of 2 hours, which was enough time to implement the didactic and ludic strategies. First, an explanation of chemical nomenclature was given, which included: nomenclature of elements, ancient and current nomenclature, types of nomenclature (systematic, stock and traditional). At the same time, the games portal Cerebriti (https://www.cerebriti.com/) and Aula of Red (https://aulaenred.fundacionibercaja.es/) were used, which are virtual platforms originating in Spain, where free access to ludic didactic tools, i.e., different games as a fun way to learn, is available.

From the Cerebriti platform, the following science games were used: 1) nomenclature of acids and salts, 2) recognize the chemical element, 3) the salts game, 4) playing with hydroxides and oxides, salts, 5) inorganic chemistry formulas, 6) inorganic nomenclature best game ever. While from the Aula of Red platform, inorganic chemistry nomenclature formulation exercises were used for binary and tertiary compounds, relating the formula with the type of stock, systematic or traditional nomenclature.

Likewise, the traditional games catalogued by the theory as adaptable structures were used: Memorama, on the concepts of oxide, hydroxide, anhydride, etc., and review of the endings of hydracid acids, metals with 2, 3 and 4 oxidation states. Dominoes were also used to review the formation of various compounds in molecular form. And as an integrating game, the virtual platform Kahoot (https://kahoot.it/) was used to review what was learned.

Additionally, undergraduate students were recommended some applications to install on their cell phones to continue improving their learning (https://www.quimitube.com/aplicaciones-moviles-para-formulacion-quimica/, https://www.yoformulo.com/, https://play.google.com/store/apps/details?id=com.chemist&hl=es_MX). As well as the book of Chemical Nomenclature by Solis Correa, 2009, published by Patria, which contains an interactive CD for practice.

At the end of the workshop course, after the implementation of the ludic didactic strategies for meaningful learning, the measurement instrument with 15 items was applied virtually, using the Google Forms virtual platform (https://docs.google.com/forms/u/0/), from which the databases were obtained for subsequent analysis.

Data analysis

Data were processed with the statistical program SPSS (Statistical Package for the Social Sciences) version 25 and Microsoft Excel spreadsheet software. Descriptive statistics were used for data analysis, measures of central tendency, graphs and hypothesis testing.

Results and discussion

The measurement instrument used, in addition to having been evaluated by expert judgment, the Cronbach's Alpha Index was calculated and presented values above .700 as indicated by Nunnally (1978) and Hair et al. (1999). This proved that the scale is valid and reliable (see Table 1).

Variables	Cronbach's Alpha > .700 (Nunnally, 1978)
LCNSS1, LCNHS2, LCNGC3, KSCE6, KTCN7, KSCN8, KSCN9, ACNC10, ACNLSC11	0.790

Table 1 Calculation of Cronbach's alpha index
Source: Own elaboration, (2023)

Of the 15 items that made up the measurement instrument, 6 of these correspond to qualitative variables, i.e., for their analysis, the responses issued by the students had to be categorized, for subsequent counting and quantitative analysis (Bernal, 2016; Hernández et al., 2014).

In the case of the item referring to the time dedicated to the study of chemical nomenclature in the learning unit General Chemistry 1, 49% of the students thought that 2-6 days were dedicated to it, but less than a week. Likewise, 23% thought that only 1 day was dedicated to study the topic of chemical nomenclature and 22% thought that the topic was studied in 7 days, equivalent to one week. However, only 6% thought that they saw the subject during the whole semester (see Graph 1).

Legend: 1 day ■ 2-6 day ■ 7 day ■ All semester
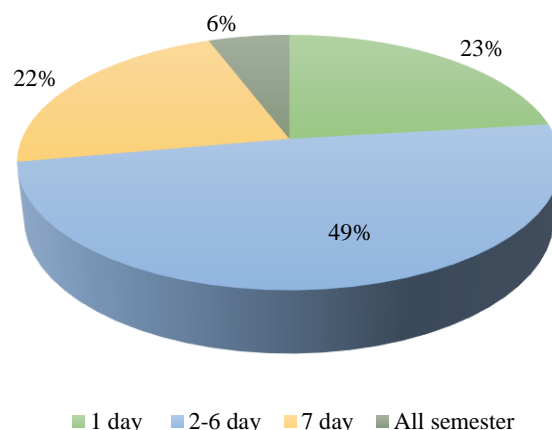
Graphic 1 Time devoted to the study of chemical nomenclature in the learning unit General Chemistry 1
Source: Own elaboration (2023)

In this sense, the teaching theory stands out, where the teacher is given all the responsibility for transmitting knowledge (Gargallo-López et al., 2011). Therefore, by not devoting enough time to the study of the subject during class hours, it causes a deficiency in student learning. That is why the approach in the learning theory based on constructivism (Harré, 1986; Osborne, 1996) takes great relevance by giving the responsibility for learning to the student.

In relation to the item referring to the knowledge of the types of nomenclature: traditional, systematic and stock. 76% of the students thought that they had knowledge about the types of nomenclature, 15% thought that they did not have knowledge on this subject and only 9% showed an attitude of doubt, answering with maybe (see Graph 2).

Legend: ■ Yes ■ No ■ Maybe
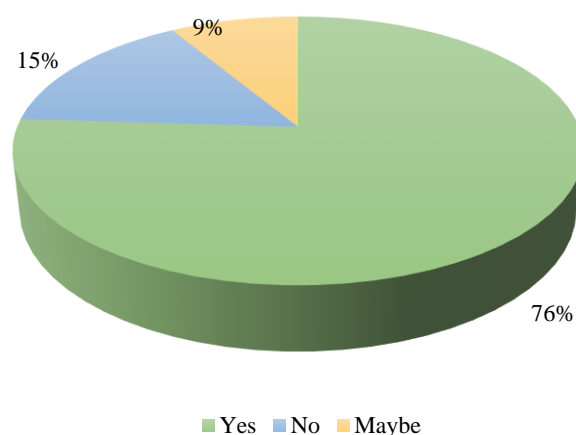
Graphic 2 Knowledge of the types of traditional, systematic and stock nomenclature
Source: Own elaboration (2023)

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Due to the above, it is important to identify prior knowledge (Morales et al., 2015) and understand that it can be modified or reorganized (Piaget, 1950) for the development of competencies (Espinosa-Ríos et al., 2016). Thus, skills, abilities and attitudes will influence the creation of new knowledge (González-Zambrano et al., 2022).

The item referring to the perception of the didactic games used. 64% of the students responded that they achieved learning and also reviewed what they already knew. While 32% of the students thought that the didactic games used during the chemical nomenclature workshop course were fun, 3% thought that they only had fun and did not learn anything. Finally, 1% thought that the games were boring (see Graph 3).
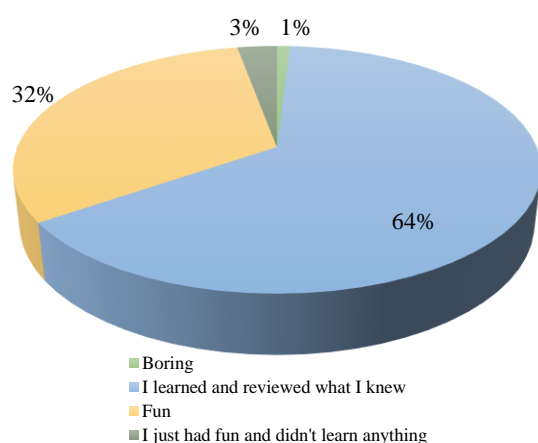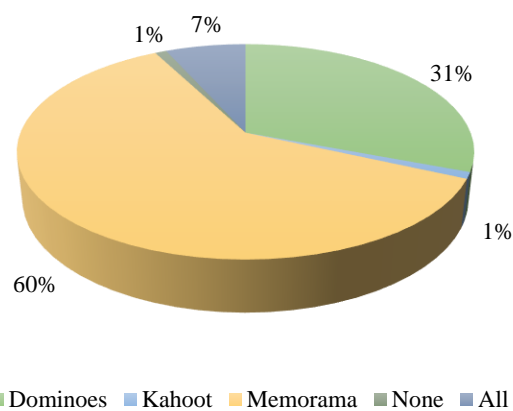

Graphic 3 Perception of the didactic games used
Source: Own elaboration (2023)

In this regard, in order to build knowledge it is extremely necessary to create pleasant learning environments (Salgado, 2022). This becomes a constant task of the teacher by generating interactive and reflective practices (Gutiérrez-Delgado et al., 2018) so that the student achieves his or her own learning.

Now, in relation to the item that refers to the effectiveness of the didactic games for learning used during the chemical nomenclature workshop course. The game that most pleased them and helped them to learn was the Memorama, of which 60% agreed with their answer. Next, the Dominoes game obtained 31% of favorable response and 7% of the students thought that all the games were effective. However, 1% leaned towards the Kahoot game, and only the remaining 1% thought that none of them were effective (see Graph 4).

Graphic 4 Effectiveness of didactic games used for learning
Source: Own elaboration (2023)

For the evaluation of the effectiveness of games it is possible to understand that this activity is an important part of the individual, since in addition to being an entertainment activity, in the educational context it becomes a didactic resource that helps favorably in learning (López & García, 2020).

The general perception of the didactic games used for learning in the chemical nomenclature workshop course was also obtained. To this end, 52% of the students thought that they are a practical tool for easy and fun learning. 18% were of the opinion that didactic games serve as motivation for learning and 17% considered them as a form of innovation in teaching. While 12% thought that didactic games are good and excellent. However, 1% thought that more complex didactic games could be implemented compared to those used in the workshop course (see Graph 5).
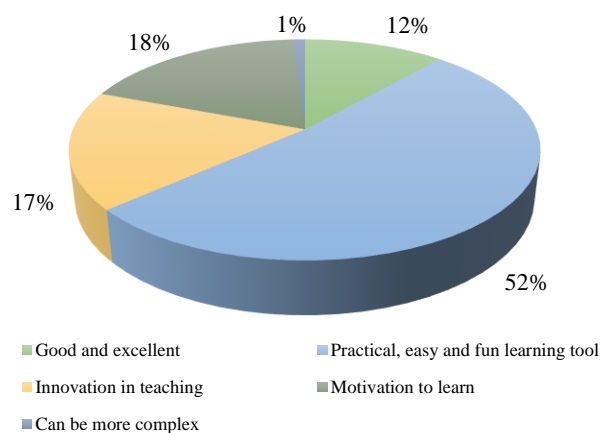
Graphic 5 General perception of the didactic games for learning used
Source: Own elaboration (2023)

It is here where the importance of the implementation of didactic games for learning becomes relevant. Since games provoke fun and pleasure due to their ludic function. In addition, they promote motivation, participation and joy (Gutierrez & Barajas, 2019), as they are based on motivational theories (Manzano-León, 2021).

The variable related to the general perception of the chemical nomenclature workshop course was measured through the categorization of responses. For this, 61% of the students thought that the workshop course was important, interesting and pleasant. Additionally, 23% thought it was excellent. While 9% thought that this type of workshop course should be held more consistently and for a longer duration. 6% thought that this workshop course, because of the way it was approached, contributes to innovation in teaching. However, 1% mentioned that more in-depth, non-basic teaching should be included (see Graph 6).
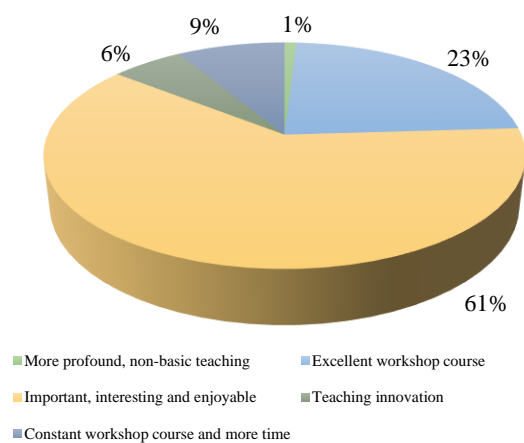
Graphic 6 General perception of the chemical nomenclature workshop course
Source: Own elaboration, (2023)

In this sense, the development of the workshop course, as a response to changes in educational systems and technology (Guamán & Venet, 2019), made it possible to interrelate technology, education and communication (Bernal-Garzón, 2020), as a strategy for generating student interest and motivation in a learning environment (González-Zambrano et al., 2022).

On the other hand, for the analysis and interpretation of the 9 quantitative variables of the instrument, measures of central tendency were used. The variables that refer to previous learning of the topic of chemical nomenclature from the educational levels of secondary school (LCNSS1), high school (LCNHS2) and in the learning unit of General Chemistry 1 (LCNGC3), presented values from 1 as minimum and 10 as maximum and the standard deviation obtained values $2 > 3$. However, the mean scores were 3.56 for the LCNSS1 variable, 4.52 for the LCNHS2 variable and 6.27 for the LCNGC3. Which demonstrates low levels of prior learning in the subject (see Table 2).

Variable	N	Min	Max	Mean	Standard deviation
LCNSS1	104	1	10	3.56	2.584
LCNHS2	104	1	10	4.52	2.569
LCNGC3	104	1	10	6.27	2.358
KSCE6	103	3	10	7.34	1.432
KTCN7	104	1	10	6.32	1.907
KSCN8	104	1	10	7.01	2.152
KSCN9	104	1	10	6.66	1.831
ACNC10	104	6	10	9.62	0.828
ACNLSC11	104	3	10	9.59	1.094

Table 2 Central tendency measures
Source: Own elaboration (2023)

Regarding the variables that measured the knowledge of the general types of nomenclature (KSCE6) and individualized that includes the traditional (KTCN7), systematic (KSCN8) and stock (KSCN9), only the variable KSCE6 obtained minimum scores of 3 and maximum of 10, and individually in the rest of the variables, the minimum value obtained was 1 and maximum of 10 and the standard deviation values were $1 > 3$. The mean values for the variable KSCE6 were 7.34, for KTCN7 were 6.32, for KSCN8 were 7.01 and for KSCN9 were 6.66 (see Table 2).

For the evaluation variables of the workshop course in general (ACNC10) and of the ludic didactic strategies for learning chemical nomenclature (ACNLSC11). For the variable ACNC10, the rating ranges are between 6 and 10, the mean is 9.62 and the standard deviation is 0.828. While for the variable ACNLSC11, the values obtained vary between 3 and 10, the mean is 9.59 and the standard deviation is 1.094 (see Table 2).

Regarding the initial learning (MLI) the minimum value obtained was 1 and the maximum was 10, the mean was 5.98 and the standard deviation was 1.481. For the final learning and knowledge achieved, that is, meaningful learning (MLF) the minimum value was 6 and the maximum was 10, the mean was 9. 62 and the standard deviation was $0 > 1$. Finally, the effectiveness of the didactic ludic strategies (EDLS) in the students' meaningful learning had values between 3 and 10 as maximum, the mean was 9.59 and the deviation between $1 > 2$ (see Table 3).

Variable	N	Min	Max	Mean	Standard deviation
MLI	104	1	10	5.98	1.481
MLF	104	6	10	9.62	0.828
EDLS	104	3	10	9.59	1.094

Table 3 Central tendency measures
Source: Own elaboration (2023)

To perform the hypothesis test to find the relationship between the variables MLF and EDLS, Pearson's correlation coefficient was calculated. The existence of a very strong relationship between both was detected, thus testing the central hypothesis, where the null hypothesis is rejected and the alternative hypothesis is accepted, i.e., the implementation of ludic teaching strategies by teachers has a significant relationship with the meaningful learning of chemical nomenclature of undergraduate students (see Table 4).

		MLF	EDLS
MLF	Pearson´s correlation	1	.466**
	Sig. (bilateral)		0.000
	N	104	104
EDLS	Pearson´s correlation	.466**	1
	Sig. (bilateral)	0.000	
	N	104	104

Table 4 Cronbach's alpha index calculation
Source: Own elaboration (2023)
** The correlation is significant at the 0.01 level (bilateral).

The above shows that, at present, it is necessary that in the different educational levels, ludic didactic strategies for learning the subject of chemical nomenclature are implemented, especially in higher education levels, where this subject is fundamental in the formation of future professionals, who will go out into the world, to avoid deficiencies in basic conceptualizations, promoting a successful development of their profession.

Without leaving aside the commitment that the educational institution has with society to form better professionals.

The teacher's work is also relevant, since it must take into account the intellectual capacities of students, in order to generate new didactic strategies for learning and encourage students to be motivated to learn, seek and create their own knowledge (Guamán & Venet, 2019). Learning will be meaningful, as long as it is possible to connect a relevant concept that the student already has with new knowledge, i.e., an anchorage between knowledge must be achieved (Ausubel, 1983).

Finally, ludic didactic strategies for learning are relevant to develop skills in students, resulting from the combination of teaching and fun, as well as motivation to achieve meaningful learning (Martínez & Ríos, 2019).

Annexes

The items evaluated in the instrument are shown below (see Table 5).

Variable	Item
LCNSS1	Learning in chemical nomenclature in secondary school.
LCNHS2	Learning in chemistry nomenclature in high school.
LCNGC3	Learning chemical nomenclature in General Chemistry 1.
TIMECN4	Study time of chemical nomenclature in General Chemistry 1.
TYPECN5	Knowledge of chemical nomenclature types: traditional, systematic and stock.
KSCE6	Knowledge of the symbols of chemical elements.
KTCN7	Knowledge of traditional chemical nomenclature.
KSCN8	Knowledge of systematic chemical nomenclature.
KSCN9	Knowledge of stock chemical nomenclature.
ACNC10	Assessment of the chemical nomenclature workshop course.
ACNLSC11	Assessment of chemical nomenclature learning ludic strategies.
PDGL12	Perception of didactic games for learning used.
EDGL13	Effectiveness of didactic games for learning used.
PDGL14	General perception of the didactic games for learning used.
GPCNC15	General perception of the chemical nomenclature workshop course.

Table 5 Items and variables of the instrument applied
Source: Own elaboration (2023)

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Conclusions and recommendations

The evolution of the teaching-learning theory, the emergence of new theories such as constructivism, meaningful learning, ludic, gamification and connectivism. In which the student is increasingly made responsible for his own learning and the role of facilitator or guide is given to the teacher. It is possible to conclude that it is imperative to design new didactic strategies that include both information technology tools and face-to-face activities, in order to involve students in their learning and make it meaningful.

The purpose of this is that the student is the one who manages his or her own learning. By reviewing the constructivist theory, it is possible to conclude that learning must be created by the student himself and at the same time achieve meaningful learning, which starts from previous knowledge and integrates the new one. Without losing sight of the fact that the ludic theory, gamification and connectivism, which contemplates the game and technology as a ludic didactic tool, is extremely necessary in the digital era.

A great challenge facing educational research is to teach students to "learn to learn". That is why the role of the teacher has not been distorted; on the contrary, now, in addition to being knowledgeable about the subjects, he must have pedagogical didactic skills to promote learning. This does not detract from the fact that learning is found in each individual, who is responsible for selecting the learning content, which must be linked to the objectives of each subject.

The main limitations faced by this research were the selection of the sample, since it was non-probabilistic and by convenience, so that the generalization of results is exclusively to explain the behavior of the variables studied in the context described. The data analysis was limited to the use of descriptive statistics. Therefore, as future work, it is recommended to use a probabilistic sample and to incorporate inferential statistics in the analysis of the information, which will have an impact on the reduction of the knowledge gaps in the topic of study of this research.

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Design and validation of an instrument to assess the quality of life of university students in the state of Sonora

Diseño y validación de un instrumento para evaluar la calidad de vida de estudiantes universitarios del estado de Sonora

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Abstract

The design and validation of an instrument to assess the quality of life of university students in the state of Sonora is shown. Made up of 32 items, on a Likert scale, divided into three dimensions: Quality of student life, university identity and academic performance, which was validated with a sample of 531 randomly selected subjects. With a non-probabilistic sample, since the information is collected at the convenience of the study based on previously established selection parameters, of a quantitative type, with a non-experimental design and descriptive scope. Validity was carried out through three types of: content, criteria and construct. Where the first refers to the development of the instrument capable of measuring the quality of university life, to develop a focus group of specialist teachers in the area of research, experts in the subject to assign and request their validation with respect to the clarity of content, making reference to the accuracy of each item. For construct validity, an exploratory factor analysis type evaluation was used, with simple Varimax rotation, with the KMO Test. The general Cronbach's α value was 0.957, validating the internal consistency of the instrument.

Resumen

Se muestra el diseño y validación de un instrumento para evaluar la calidad de vida de estudiantes universitarios del estado de Sonora. Conformado por 32 ítems, por una escala de Likert, divido en tres dimensiones: Calidad de vida estudiantil, identidad universitaria y desempeño académico, el cual fue validado con una muestra de 531 sujetos, seleccionados de forma aleatoria. Con una muestra no probabilística ya que la información es recabada a conveniencia del estudio en base a los parámetros de selección previamente establecidos, de tipo cuantitativo, con diseño no experimental y alcance descriptivo. La validez se realizó mediante tres tipos de: contenido, criterio y constructo. Donde la primera hace referencia al desarrollo del instrumento capaz de medir la calidad de vida universitaria, para desarrollar un grupo focal de docentes especialistas en el área de investigación expertos en el tema para asignar y solicitar su validación con respecto a la claridad de contenido, haciendo referencia a la exactitud de cada uno del ítem. Para la validez de constructo se utilizó una evaluación de tipo análisis factorial exploratorio, con rotación simple Varimax, con la Prueba de KMO. El valor del α de Cronbach general fue de 0,957 validando la consistencia interna del instrumento.

Validation, Probabilistics, Validity   **Validación, Probabilístico, Validez**

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Introduction

This paper designs and validates an instrument to evaluate the quality of work life of university students, addressing the issue of quality of life. According to Carrera Calderón & Bonilla (2022), it is very important to know the student's current situation for their formative process. The QOL is a conceptualization that has to do with different areas of daily life in individuals, oriented to the evaluation of people in terms of their health, material things they possess, economic situation they present and feeling of the same in relation to the environment in which they develop (Agramón et. al, 2019).

Quality of life is the perception based on the person's feelings about the opportunities presented by the environment where he/she develops in order to satisfy his/her own needs, whether personal and/or work-related, in addition to considering financial variables (Félix & Acosta, 2019).

Having said the above, the most important factors in the quality of life of university students are: having a comfortable place to live, daily food, good health, the possibility of recreation and pleasant educational conditions (Hernández, et. al, 2017).

Nowadays the concept of quality of life is more used as an indicator of human welfare, this relationship is due to the influence it has on the health of the individual and the achievement of good functioning that allows to continue with the realization of all those activities necessary in life and that may somehow affect their state of well-being (Pacheco, et. al, 2014).

For this reason, the purpose of this research is the design and validation of an instrument to evaluate the quality of work life of university students in the state of Sonora through a descriptive statistical analysis that allows the detection of areas of opportunity that can be used as mechanisms and/or tools for improvement, considering critical success factors (Gastelum et al., 2023).

Factors that can be determinants of quality of life are health, economy, love, emotional stability, body image and social relationships (Medina et al., 2022).

According to the World Health Organization (2017) quality of life is defined as the perception that each individual has of their own position in life in a context of culture and value systems in which they live and also in relation to their goals, expectations, standards and concerns considering health a fundamental pillar, as part of sports management (Carrión, 2023).

In this sense the evaluation of the quality of life is vital in the different stages of life, since it is considered an integral indicator of health promotion and support (Veramendi, et. al, 2020), with this contributes to the knowledge of the educational area (Ponce & Arriga, 2021).

In this sense, the United Nations (UN) as an international organization establishes that the concept of QOL is directly linked to sustainability, since it has to do with economic issues such as work, remuneration and equality, but also with the availability of possessions and services such as public spaces, educational institutions, among others. With the objective of channeling these elements, the UN in its Habitat version founded the indicator in a multidimensional way with the purpose of measuring the VC in the areas and it is known as Urban Prosperity Index (Escobar, 2018).

Currently there are no instruments with specific validity and reliability for university students; since, if they exist in a general way in other areas managed to know the level of quality of work life of students, but there is not one in particular that has the variables of student quality of life, University Identity and academic performance, which is the proposal of the present research, to design and validate an instrument according to these variables.

In this little studied line of research there are undoubtedly some instruments that are validated and are good to know certain related information, but there is not one specifically designed in terms of the mentioned indicators, to know the level of quality of life in the respective situations of university students in the state of Sonora.

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The design and validation of this instrument provides the opportunity to evaluate and know the existing levels of quality of life in university students in the state of Sonora, since it analyzes in a specific way the satisfaction that the members have with life, their happiness, stress, or important affectations and this information has the capacity to analyze and obtain results that allow detecting areas of opportunity to improve professional and personal development.

Methodology

Methodology

A Design and validation of an instrument to evaluate the quality of life of university students in the state of Sonora was carried out, quantitative type, with non-experimental design and descriptive scope, since, according to Hernandez et al., 2014, it seeks to specify the properties, characteristics and profiles of people or groups, which is subjected to analysis. Espinoza 2019 states that it is of utmost importance to be able to measure a research methodology in order to have better results.

Participants

The subject of study for this research is constituted by 531 students, randomly selected with those who showed acceptance to answer the instrument, where a population of 34,176 enrolled in 2022 was considered. The university is a study, taking as a basis for the application to undergraduate students, with a confidence level of 95.5% (Stevenson, 1981).

It is a non-probabilistic sample since the information is collected at the convenience of the study based on the previously established selection parameters; 54% are female, 40% are male and 6% are non-binary. Marital status 83% were single and 17% married. In terms of age, 8% were under 18 years of age, 43% between 18 and 20 years of age, 37% between 21 and 23 years of age, 9% between 24 and 26 years of age and 3% over 27 years of age.

Procedure

The procedure was carried out in the following phases (Soriano, 2014).

Phase 1. Objectives, theory and construct

An investigation of the existing scientific literature was carried out, with the aim of learning about the research that has already been carried out, and to be able to consider relevant information.

Once the bibliographic citations were analyzed, a description of the operationalization of the variables was elaborated, under an exhaustive review of the theory (Arias, 2022).

Once the previous topics had been studied, we proceeded to the elaboration of the instrument and selection of the elements it contains, composed of initial instructions, sociodemographic information, three perspectives, a comment section to select according to four classifications and finally a section for a free-text comment, where an instrument of 32 items was obtained.

Phase 2. Selected validation and expert judgment

Validity of the instrument: after the design, the validity was carried out by means of three types, content, criterion and construct, where the validation of the content data was obtained with respect to clarity (in each item), pertinence (in the placement of the dimension) and, finally, the relevance of this to highlight the information obtained.

Reliability of the instrument: in order to measure the reliability of the instrument, it was measured using Cronbach's Alpha coefficient and a confidence level of 95.5% was obtained, considered excellent.

Phase 3. Pilot test

Application of the instrument: it was applied to students of the universities of the State of Sonora where quantitative data were obtained for their interpretation and achievement of the objectives of this study.

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Conducting the focus group. The focus group is of utmost importance to validate the contents of this instrument, since it is a technique that presents great versatility (Bonilla & Escobar, 2017). The focus group is made up of 7 experts in the design and validation of instruments in the educational sector. In a study conducted by Pacheco & Salazar (2020) in relation to focus groups concluded that the average number of participants in order to have greater benefits is between six to ten participants. Campas et al. (2021) affirms that in order to validate an instrument it is vital to define the type of experts to invite in order to obtain better results within the process (Campas et al. 2022).

Phase 4. Validation

Analysis and interpretation of the results: the qualitative and quantitative data obtained were processed in order to obtain a report of the results.

Results and discussion

The design and validation of the instrument for the collection of specific data with the objective of analyzing and knowing the standard of living of university students in the state of Sonora was elaborated, which begins with the objective of the survey and instructions for answering each of the questions, once completed it was submitted to the Institutional Research Ethics Committee of the University under study where the research protocol was reviewed, including the informed consent.

The design of this instrument was developed by the authors and is based on the information gathered in this research.

These elements provide the opportunity to know all those factors that in some way have an impact on the quality of life present in university students in order to carry out corrective measures capable of creating improvements in the institutions and student development.

After the objective and instructions, the instrument begins with questions of nominal variable type which show the qualities of the students analyzed, such as sociodemographic data, i.e., educational program, sex, type of student, age and marital status.

It is made up of 32 questions which are divided into three dimensions:

Quality of student life, which is made up of 10 questions; then the second variable, university identity, made up of 10 questions; and finally the third variable, academic performance, which, unlike the previous ones, is made up of 12 questions.

For the selection of the answers, each of the questions can be answered according to the case on a Likert scale with values from 1 to 5, these categories were grouped as follows.

Scale 1: Strongly Disagree

Scale 2: Disagree

Scale 3: Neutral

Scale 4: Agree

Scale 5: Strongly Agree

Validity and reliability of the instrument

Validity was carried out by means of three types: content, criterion and construct. The first refers to the development of an instrument capable of measuring three dimensions: quality of student life, university identity and academic performance.

The design and validation of an instrument is a basis on which to base a defined structure as a research tool (Sann et al., 2023).

Once the instrument was designed, a focus group was held with a group of seven teachers specialized in the area of research, experts in the subject, to assign and request its validation with respect to the clarity of content, referring to the accuracy of each item, the relevance it has in terms of its placement in the dimension and finally its relevance to highlight the information obtained.

The criterion validity was determined by comparing the proposed scale of the quality of life in university students exclusively from the state of Sonora with other instruments that measure the quality of student life in the same way.

For construct validity, an exploratory factor analysis type evaluation was used, with simple Varimax rotation, with the KMO and Bartlett's Test, since it is a data analysis technique to analyze and validate a test or other types of tests that evaluate dimensional constructs (López & Gutiérrez, 2019).

Kaiser-Meyer-Olkin measure of sampling adequacy		.958
Bartlett's test for sphericity	Approx. chi-square	9872.158
	gl	496
	Sig.	.000

Table 1 Factor analysis KMO and Bartlett's test

In Table 1, the Kaiser-Meyer-Olkin test for the scale administered to the 531 subjects shows a value close to 1, making a factor analysis feasible. In addition to this, Bartlett's test of sphericity shows a significance level of less than .05, which also confirms that a factor analysis is feasible.

To carry out this analysis, first of all, the Kaiser method (Kaiser, 1958) is used, which determines as many factors as self-values greater than 1 using the SPSS version 26 statistical package, derived from the results obtained, two items were eliminated from the instrument.

Table 2 shows the total number of questions that remained after the validation of the principal component analysis, with a % variance of 78,206. According to Moliner et al., (2017) the design, validation and exploratory factor analysis gives a research a support for future research in the field of academic productivity.

Factor	Autovalores iniciales			Sumas de cargas al cuadrado de la extracción			Sumas de cargas al cuadrado de la rotación		
	Total	% de varianza	% acumulado	Total	% de varianza	% acumulado	Total	% de varianza	% acumulado
1	14.343	44.821	44.821	5.044	15.764	15.764	5.562	17.382	17.382
2	1.554	4.857	49.678	9.933	31.041	46.805	4.124	12.886	30.268
3	1.250	3.905	53.583	1.002	3.133	49.937	3.277	10.239	40.508
4	1.110	3.468	57.051	.658	2.056	51.994	2.619	8.185	48.692
5	1.039	3.248	60.298	.574	1.795	53.788	1.631	5.096	53.788
6	.933	2.917	63.215						
7	.888	2.776	65.991						
8	.792	2.475	68.467						
9	.762	2.380	70.846						
10	.717	2.242	73.088						
11	.647	2.023	75.112						
12	.602	1.880	76.991						
13	.578	1.807	78.798						
14	.561	1.754	80.553						
15	.521	1.628	82.181						
16	.485	1.516	83.697						
17	.454	1.419	85.116						
18	.441	1.380	86.496						
19	.412	1.289	87.785						
20	.399	1.246	89.031						
21	.378	1.181	90.212						
22	.372	1.164	91.376						
23	.340	1.062	92.438						
24	.333	1.040	93.478						
25	.325	1.016	94.494						
26	.293	.915	95.409						
27	.283	.885	96.294						
28	.258	.807	97.101						
29	.251	.784	97.885						
30	.248	.776	98.661						
31	.222	.692	99.353						
32	.207	.647	100.000						

Método de extracción: máxima verosimilitud.

Table 2 Total variance explained with the Extraction method: principal component analysis

Figure 1 shows the sedimentation by number of components, since the Kaiser-Meyer-Olkin and Barlett test was performed, another test is performed to ensure that it is feasible to perform a factor analysis with the existing sample of subjects; where the results show how the confirmatory factor analysis has corroborated the hypothesis that the scale was unidimensional.
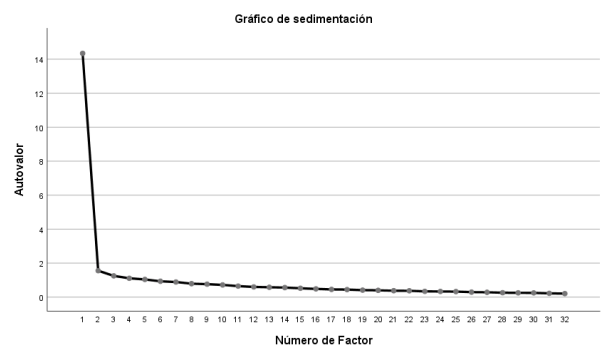

Figure 1 Sedimentation graph

Chi-square	gl	Sig.
1098.733	346	.000

Table 3 Goodness-of-fit test

Table 3 shows a bilateral significance of .000. This figure is a probability and signifies the good relationship between the variables of the instrument.

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Cronbach's alpha	N of items
.957	32

Table 4 Cronbach's alpha coefficient of the instrument to measure the quality of life of university students
Source: Own elaboration

Table 4 shows the result Cronbach's Alpha Coefficient, according to George and Mallery (2003), $\alpha \geq .90$ is excellent.

Variable	Cronbach's alpha
Quality of student life	.853
University Identity	.891
Academic performance	.929

Table 5 Cronbach's alpha coefficient by variable

Rodríguez & Reguant (2020) mention that it is essential to conduct research with an acceptable level of rigor. Cronbach's alpha is useful to determine internal consistency (Oviedo & Campo, 2005). As shown in Table 5, where an analysis of the Cronbach's alpha coefficient by variable was performed.

In general, a high Cronbach's Alpha Coefficient is obtained in all variables and in general, as a fundamental element for the design and validation of an instrument (Domínguez & Merino, 2015). This type of research is a reference (Ortega et al., 2023) to promote self-knowledge.

Acknowledgments

Funding

Conclusions

This research met the objective of Design and validation of an instrument to evaluate the quality of life of university students in the state of Sonora, where 83.09% of the level of quality of life in students was obtained as a general result, applied to 531 subjects, since the sample used must be defined (Creswell, 2012).

The strengths of the study are centered on the best evaluated results: I am proud of the work I do as a student with an average of 4.34, I have the opportunities to improve my skills within my educational program 4.35, I consider that I have the support of my professors to solve doubts and/or problems that arise 4.36 and I am clear about my responsibilities at the University 4.42.

Regarding the areas of opportunity found in the study is the item my work at the university allows me to maintain a balance between my student and personal life responsibilities with a mean of 3.8 and I have enough time to do my current semester assignments within each day with a mean of 3.7.

Another research by Veramendi, Portocarero & Espinoza (2020) found that there is a good quality of life of students, in general, an average value of lifestyles of 81.5 was obtained. A study by Lara et al., (2015) found that 84.1% were satisfied with their studies, it is appreciated that having favorable aspects of the university environment have a positive impact on the perception of the quality of life of students; In addition that with these results can be promoted theses at different levels (Washko, S. (2023).

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Measurement of the management skills of academic directors in a higher education institution

Medición de las habilidades directivas de los directores académicos en una Institución de Educación Superior

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Abstract

The evaluation and the teaching practice are subjects of great importance in the educational field, and objects of study of research centers and higher education institutions. In this sense, this article shows some reflections as a product of the first phase of research, currently under development, about teacher evaluation in higher education, closely linked to the practices developed by academic staff at this level. educational. The first point that we present is made up of the latest reforms to Article 3 of the Constitution, the maximum normative reference for education in Mexico. Next, a brief overview of the recent history of the evaluation of education is made and its relationship with the much-touted quality is analyzed. A third section is made up of a series of discussions and analysis on teacher evaluation, opening the debate about whether it is worth reconsidering the concept, given that the original purpose of this has been perverted, as we establish in the following subtopic. The conclusive lines call for the urgency of recovering the essence of evaluation, as a means for the improvement and transformation of ourselves, as educators, and of our world, based on our contexts. We accept that if, as a result of the improvement of our practices, we achieve a salary or ladder promotion, welcome; but we make a call to uphold the original meaning of the evaluation.

Resumen

La evaluación y la práctica docente son temas de gran trascendencia en el ámbito educativo, y objetos de estudio de centros de investigación e instituciones de educación superior. En este sentido, en el presente artículo se muestran algunas reflexiones como producto de la primera fase de una investigación, actualmente en desarrollo, en torno a la evaluación docente en la educación superior, estrechamente vinculadas a las prácticas que desarrolla el personal académico en este nivel educativo. El primer punto que presentamos lo constituyen las últimas reformas al artículo 3° Constitucional, máximo referente normativo de la educación en México. En seguida, se hace un somero recorrido por la historia -reciente- de la evaluación de la educación y se analiza su relación con la tan traída calidad. Un tercer apartado queda conformado por una serie de discusiones y análisis sobre la evaluación docente, abriendo el debate acerca de si vale la pena reconsiderar el concepto, dado que el original fin de esta se ha pervertido, como lo establecemos en el subtema siguiente. Las líneas conclusivas llaman a la urgencia de recuperar la esencia de la evaluación, como medio para la mejora y la transformación nuestra, como educadores, y de nuestro mundo, a partir de nuestros contextos. Aceptamos que si, como producto de la superación de nuestras prácticas, logramos un ascenso salarial o escalafonario, bienvenida; pero hacemos un llamado a sostener el sentido original de la evaluación.

Teacher evaluation, Teaching practice, Higher Education

Evaluación docente, Práctica docente, Educación Superior

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Introduction

Management is a vital function of the organisation and according to David and Newstrom (1995), Cañeque (2017) and Moreno (2022), the managerial role takes on a humanistic nuance as, in the current uncertainty, leaders are needed who foster transparency, sociability and integration.

Managerial skills are a key factor for success in organisations, as they allow synergy to be achieved by integrating all other resources. According to Whetten & Cameron (2011), they are the building blocks of effective management. Based on Naranjo (2016), Lechuga (2007) and Madrigal (2009), management skills are the set of knowledge, skills, attitudes, behaviours and abilities learned and acquired through practice and training, which allow the functions and roles of management to be exercised effectively.

As Davis and Newstrom (1995), Daft (2007), García and Brás-Dos-Santos (2020) and Nahoul (2020) argue, management skills contribute to the generation of optimal, functional and productive work environments, boosting the potential of human talent, directing efforts towards achieving organisational objectives and achieving motivated staff with a high degree of commitment and a sense of belonging to the organisation; in short, they enable competitive advantages to be achieved, generating high levels of productivity and performance.

It is important to emphasise that management skills are cultivated, educated, taught and developed; but in order to perfect them it is necessary to start with a diagnosis of the current level of development. As García and Brás-Dos-Santos (2020) state, it is necessary to know what the current knowledge, skills and abilities are, in order to design strategies for strengthening them. The research topic is of great relevance given that higher education institutions (HEIs) have a great responsibility to train future managers and, therefore, must develop their managerial skills. But there is no better way to teach than by example, so strengthening the managerial skills of academic authorities will have a positive impact on the educational service they offer.

In the last two decades, several research studies have been carried out on management skills and their correlation with different variables; a search in various academic search engines revealed fifteen recent academic productions related to the topic of study. Most of them were carried out abroad, mainly in Peru, Spain and Cuba. At the national level, the research by Pérez et al. (2008) stands out, in which they carry out a measurement of managerial skills in the Technological Institutes of southeast Mexico; the research work by Moreno (2022), in which he analyses organisational change and the managerial skills that were required in times of Covid-19 and the research by Nahoul (2020), entitled "Managerial skills as a factor of influence in the organisational climate of a Higher Education Institution in Xalapa, Veracruz". But there is no research on the subject for the technological university subsystem.

The general objective of this research is to measure the managerial skills possessed by the academic directors of the institution, so that based on the diagnosis they can design a training programme to strengthen them; and the specific objectives are: to detect the management skills required by academic directors to carry out their functions effectively and efficiently at present; to identify the most critical problems faced by academic directors and the reasons why academic directors fail; to identify the level of development of the management skills of academic directors, based on the perception of subordinates (teaching staff and administrative staff) and the directors' own self-assessment; and to analyse the relationship between the perception of subordinates with respect to the self-perception of academic directors.

Management

"Since ancient times, the management of people has been an activity inherent to the social structure developed by human beings. From the primitive tribes that organised themselves to hunt, to the large corporations that dominate today's economic orb, the activity of management has always been present" (Ortega, 2015, p.22).

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"The objective of management is to organise group members and to coordinate, direct, lead and supervise their activities in order to obtain the desired results and goals" (Madrigal, 2009, p. 23). Management consists of directing operations through the cooperative effort of subordinates to obtain high levels of productivity through motivation and supervision.

Based on the above definitions, three common aspects of management can be identified: the human element, the supervision of effort and the cooperation of subordinates' effort. It is important to recognise that the qualities of managers have changed over time, as the current landscape of competitiveness and globalisation has forged new managerial schemes. In the words of Lechuga (2007): "Thousands of managers were high level in the boom, but in the crisis they collapsed; they were excellent navigators in calm waters, but in turbulent waters they failed" (p. 15).

Key points of a manager today

According to Warren Bennis (1989), quoted by Payeras and Ronco (2002), and after studying 80 successful entrepreneurs, he identified 5 key points that a leader must have today, which I summarise below:

- Be clear about where you want to go "guiding vision".

- Ability to transmit love and commitment in what they do, "passion".

- Generate trust, based on integrity and honesty.

- Be empathetic, open to new things and attentive to opportunities "open-mindedness".

- Show boldness to learn, even from times of adversity and mistakes.

Lechuga (2007) states that some high-performance managers are born, but they are also made; and that the profile of such managers is made up of three elements: knowledge, skills and attitudes. Similar reasoning is held by García and Brás-Dos-Santos (2020), who state that, through training, coaching, experience and continuous effort, we can all develop managerial skills.

García and Brás-Dos-Santos (2020), manage to define the relevance of the managerial function today:

The manager must act as a transforming element that empowers people and guides them towards the objectives and manages to count on the support of each of the participants and the organisation. On the other hand, the manager also has the responsibility to contribute to the generation of optimal, functional and productive work climates based on the practices of his or her actions. (p. 58).

Managerial skills

The word skill refers to the capacity or ability to execute something. "Managerial skills are those necessary to be able to exercise the functions and roles of management, therefore, they are a set of skills that would be desirable in a manager" (Naranjo, 2016, p. 84).

Whetten & Cameron (2011) define managerial skills by identifying their characteristics that differentiate them from other skills, which are summarised below:

- They are behavioural, as they lead to a certain outcome and are tangible and observable by other individuals.

- They are controllable: Their performance can be self-regulated by the manager him/herself; therefore the skills can be demonstrated, practised, improved or consciously curbed.

- They can be developed: Practice and feedback allow them to be improved.

- They are interrelated and overlapping: The skills do not manifest themselves individually, but are an integrated whole; the manager uses them in combination.

- They are sometimes contradictory or paradoxical: An effective manager must be flexible and creative and at the same time controlling, stable and rational; both encouraging and competitive, both participative and driving.

According to Madrigal (2009) "Skill is the ability of the individual acquired by learning to produce expected results with the maximum of certainty, with the minimum of time and economy and with the maximum of security" (p.1).

I take this definition as a reference, as it shows that skills can be acquired or developed; the same happens in the management skills themselves, the executive may possess some of them naturally and can develop the ones he/she needs and needs, everything can be improved.

Management Skills in Higher Education Institutions (HEIs)

Ascón et al (2019), identifies that the international organisations that direct educational policies in Latin America emphasise that despite the important efforts in the training of managers in management skills that allow their development in highly vulnerable environments, there is still much work to be done in relation to the existing potentials in HEIs, which is why a climate of excellence must be created that encourages the spirit of self-improvement and keeps professionals committed.

Whetten and Cameron (2011), for their part, consider the importance of the development of essential management skills in HEIs as a technique that facilitates the interrelation of theoretical and practical components in the holistic strategic management of personal management functions in their projection towards other subjects, which determines their high complexity.

For Ascón et al (2019), the development of managerial skills in higher education enables the achievement of the formulated objectives, in an interrelated manner with personal and organisational goals; they can be learned through the teaching-learning process or through self-development acquired in practice and demonstrated in experience when executing tasks or strategic actions indicated, which facilitate the achievement of the pre-established objectives.

The development of HEIs is also conditioned by the ever-changing environment, which constantly requires managers to take on challenges and be at the forefront of globalisation, technology and new ideologies; therefore, it is necessary to strengthen managerial skills to guide the staff in their charge towards the achievement of the institutional vision and mission through the application of methods, techniques and instruments of efficiency and quality that contribute to the full flourishing of human potentialities and raise their competitiveness and increase their quality of life (Pérez et al, 2008).

Ascón et al (2019), emphasises the importance of managerial skills in HEIs, as the decisions and actions taken by managers have a direct effect on society and companies, through the training of future leaders. According to Ascón et al (2019) the impacts of globalisation involve the flow of technology, ideas and values that transcend borders; therefore, internationalisation processes constitute a response to the globalised world. Based on this idea, Ascón et al (2019) propose that HEIs should integrate a global, an international and an intercultural dimension into the substantive functions of their educational processes, as well as institutional strategies for strengthening objectives through the improvement of educational policies.

Therefore, management skills are the theoretical and practical components necessary to face the challenges of HEIs, the fundamental information and knowledge such as mastering relevant data and timely professional knowledge, sensitivity to knowledge and facilities for social development. Thus, meta-skills relate to those that enable managers to develop specific skills needed in particular circumstances.

Referential framework

The present research work seeks to measure managerial skills in a public organisation in the educational sector. The institution under study is a university belonging to the subsystem of technological and polytechnic universities, located in the centre of the country, with more than two decades of operation.

Twenty-two educational programmes are offered in this institution, 11 of which are university technical courses and 11 of which are continuing studies (bachelor's degree level); its total enrolment ranges between 4,500 and 6,700 students, depending on the four-month period of the year, with the highest demand in September/December; 65% of these students are studying university technical courses and the remaining 35% are studying bachelor's degrees. The educational programmes are grouped for administration into 5 academic divisions, each headed by a division director and led by the academic secretary. Something that distinguishes the governing body of this institution is that all the directors before holding this position were part of its teaching staff and 4 of them have more than 20 years of seniority.

According to Provencio (2020), the SARS-CoV-2 coronavirus pandemic (COVID 19), "is a multiple and global crisis, unprecedented in its health origins and its abrupt irruption; unique in its characteristics and speed of spread" (p. 202).
Due to the increase in contagions and given that on 11 March 2020 the World Health Organisation (WHO) declared it a pandemic, on 16 March of the same year, the Secretary of Public Education of the Federal Government of the United Mexican States, Esteban Moctezuma Barragán, published in the Official Gazette of the Federation the agreement 02/03/20 suspending classes at all educational levels from 23 March of the same year; This forced an abrupt migration from face-to-face to virtual education; each institution faced this reality from different perspectives and with the resources available to them. The university that is the subject of this research received this provision 5 weeks before the end of the term and without a Learning Management System (LMS).

If managing staff and gaining their commitment is a difficult challenge, it is even more so when working remotely, with social distance as a barrier. The home office requires management skills to lead remote teams, new time management schemes, the use of technological platforms to enhance communication and manage organisational operations, as well as maintaining focus on the organisational mission and vision.

Methodology

Research paradigm

The first was qualitative in nature and sought to identify the skills required to exercise academic leadership in an HEI efficiently and effectively; the research instrument used was a structured interview with division directors, consisting of 7 questions and an evaluation of the degree of use of twenty-two skills or behaviours during the working day of an academic director; The second phase was quantitative in nature, and sought to measure the managerial skills possessed by the academic directors of the institution, based on the perception of subordinates (teaching staff and administrative personnel) of the level of development of the academic directors' managerial skills, as well as on the self-assessment of the division directors themselves. In order to obtain the information, a survey was applied on the Google platform to a representative sample of teaching staff and division directors to find out their assessment of the level of competence of the management skills of each division director.

By its nature it is a basic research, since it is based on the theoretical framework and existing state of the art on the subject; through field research, information was obtained which, through statistical analysis, made it possible to understand the relationship between the study variables and provide specific knowledge about the study phenomenon in the institution under study.

Population and sample

In order to identify the managerial skills of divisional managers and to measure their effectiveness, the assessment was carried out from two perspectives:

a) The self-assessment of the division heads.

b) The perception of a representative sample of teaching staff in each academic division.

The top management in the academic area is made up of only 6 people (academic secretary and 5 division directors), both the self-evaluation survey form and the structured interview were answered by 4 division directors, only one did not answer the form and did not attend the personal interview.

As for the teaching staff, for practical purposes and to save time and resources, a representative sample was determined, considering the following parameters: 99% confidence interval, 1% degree of error and a finite population of 139 full-time teachers (FTEs). Table 1 shows the total number of FTEs per academic division.

ACADEMIC DIVISION	TOTAL DE PTC′S
Economic-Administrative Division (DEA)	51
Industrial Electromechanics Division (DEI)	23
Division of Chemical Biology (DQB)	25
Division of Information and Communication Technologies (DTIC)	22
Division of Industrial Processes (DPI)	18

Table 1 PTC's by academic division,
Source: Own elaboration, with information provided by the Academic Secretariat

Sample and sampling

Considering a confidence interval of 99%, a degree of error of 1% and the number of PTC's in each academic division, the sample was determined as follows:

Academic division	Ptc's to survey
DEA	28
DEI	17
DQB	18
DTIC	17
DPI	14

Table 2 Sample of PTC's to be surveyed by academic division
Source: Own elaboration, calculation of the sample with finite population formula

With the authorisation by official letter from the academic secretary to apply the surveys and conduct the interviews with the academic directors, an official letter was sent to each division director with the links to the two survey forms, indicating the deadline for answering them; the day and time of the structured interview was also scheduled, which was carried out personally with the division directors.

Instruments

Information on the study variables was collected through field research, using the structured interview and the Google platform survey as instruments.

Survey form

The "Personal Assessment of Managerial Skills (PAMS)" survey, designed by Whetten and Cameron, which consists of 85 items, was used. This survey was completed by each academic director as a self-assessment exercise of his or her managerial skills, and was also completed by a representative sample of subordinates as a heteroassessment exercise.

The 85 items of the questionnaire group managerial skills into three categories: personal, interpersonal and group.

Personal managerial skills are subdivided into three subcategories: developing self-awareness, managing personal stress, and analytical and creative problem solving.

Interpersonal management skills are subdivided into four subcategories: leading, guiding and supportive communication, gaining power and influence, motivating others, and managing conflict.

Group management skills are subdivided into three subcategories: empowerment and delegation, effective team building and teamwork, and leading positive change.

Structured interview

Academic managers were interviewed to identify which attributes they associate with managerial effectiveness, following the interview format used by Whetten and Cameron.

Results

Identification of the managerial skills required by the academic heads to perform their duties effectively and efficiently

During the interview, the academic managers assessed the frequency with which they used the following 22 skills during their working day, which made it possible to identify essential activities.

Motivate others	20
Active listening	20
Creative problem solving	20
Conflict management	19
Analytical decision-making	19
Interpersonal communication	19
Setting specific goals and objectives	19
Managing personal time and stress	18
Promote continuous improvement and quality	18
Defining or solving complex problems	18
Team building and teamwork	17
Capitalise on personal awareness	17
Negotiate	17
Facilitate organisational change	16
Facilitate group decision making	15
Articulate and energise a vision	15
Delegating	15
Holding meetings	14
Empowering others	14
Giving speeches or presentations	13
Conduct interviews	12
Gaining and using power	11

Table 3 Skills or behaviours used during their working day
Source: Own elaboration, based on the assessment made by the academic managers

The skills most used in their working day coincide with most of those identified by Nahoul (2020): communication, motivation, conflict management, analytical and creative problem solving, team building. These are included in the classification of the nine fundamental management skills, which Whetten & Cameron (2011) organised into three categories: personal, interpersonal and group.

They then inquired about the skills they considered most important and necessary to be a successful manager in their line of work. Eight essential skills were identified, which include group skills (empowerment and delegation, integration of effective work teams and adaptation to change), interpersonal skills (emotional intelligence, effective communication and leadership) and technical skills, which refer to having mastery of the technical area of the educational programmes they manage.

Managers with professional maturity have the ability to recognise the talent and good practices of other managers, so they were asked about the extraordinary practices or skills they have identified in other effective managers.

1. Emotional intelligence.
2. Teaching, professional and managerial experience.
3. Ability to integrate effective work teams.
4. Effective communication skills.
5. Leadership.
6. Time management.
7. Adapting to change

Table 4 Extraordinary practices and/or skills of an effective manager
Source: Own elaboration, based on interview

The information provided on this subject confirms what García and Bras-Dos-Santos (2020) affirm, highlighting that the participative group management style is the one that enables high levels of productivity to be achieved, as it allows the experience and expertise of the collaborators to be used, while at the same time encouraging autonomy and the development of the collaborators' skills.

Identification of the most critical problems faced by an academic director and the reasons why academic managers fail

They were also asked about the reasons why academic managers fail, highlighting the lack of knowledge of the institution's regulations, guidelines and operating procedures, communication problems, the lack of strategic planning aligned with the organisational philosophy, the absence of resilience and adaptability, egocentrism and the lack of concern for strengthening their management training.

When asked about the most critical problems they face, all principals agreed that the main challenges they face are: the inefficient performance of some teachers; student conflicts; limited resources, mainly equipment, laboratories and software, which undermine the practical training of students; and achieving and maintaining accredited academic programmes.

Training plan for an academic director

Based on the information obtained and confirming with the academic directors the points on which an academic director should be trained, 6 essential aspects were identified:

- Processes carried out by the academic director, based on the quality management system and the applicable regulations.

–   Leadership and effective communication

–   Time management and adaptation to change.

–   Processes of accreditation and evaluation of educational programmes by bodies recognised by COPAES.

–   Strategic planning and management.

–   Development of the cognitive skill of divided attention (multitask).

Subordinates' perception of the level of development of the managerial skills of their division manager

With the weighted average of each category of managerial skills per academic director, the institutional rating of the level of development of the academic directors' managerial skills was concentrated in a matrix, obtaining a very similar level of performance in the three groups of managerial skills and at the academic division level. As can be seen in table 5, no category is close to performance level 6; the three groups are close to level 5, which is an acceptable result but not ideal, so it is necessary to strengthen the skills of the division directors.

CATEGORY	DEA	DTIC	DEI	DPI	MEDIA
AVERAGE PERSONAL SKILLS	4.93	4.76	5.04	4.90	4.91
AVERAGE INTERPERSONAL SKILLS	5.04	4.82	5.32	4.69	4.97
AVERAGE GROUP SKILLS	5.14	4.86	5.19	4.76	4.99
OVERALL AVERAGE	5.00	4.80	5.16	4.81	4.94

Table 5 Concentrated assessment of subordinates
Source: Own elaboration, based on the results of the subordinate survey.

Academic managers' perception of their own development of managerial skills

Table 6 shows the self-assessment of the 10 categories of management skills of the four divisional directors, as well as the average per group of management skills and per category at institutional level. The main areas of opportunity are personal stress management, conflict management and supportive leadership and communication. The manager with the lowest self-assessment is the ECD manager, followed by DTIC, which is congruent with the assessment of subordinates.

In relation to the director with the highest self-evaluation, the director of DEA, followed by the director of DEI; in the evaluation of the subordinates the result was the opposite, i.e. the director with the highest evaluation was the director of DEI, followed by the director of DEA.

CATEGORY	DEA	DTIC	DEI	DPI	MEDIA
AVERAGE PERSONAL SKILLS	5.49	5.00	5.34	4.39	5.06
AVERAGE INTERPERSONAL SKILLS	5.63	5.00	5.74	4.44	5.20
AVERAGE GROUP SKILLS	5.78	4.71	5.75	5.58	5.45
OVERALL AVERAGE	5.59	4.95	5.54	4.61	5.17

Table 6 Concentrated self-assessment of academic directors
Source: Own elaboration, based on the results of the academic managers' self-assessment survey

Relationship between the perception of subordinates and the self-perception of academic managers

The survey consists of 85 items, with 6 levels of performance on a Likert scale, making a maximum possible score of 510 points. The first 40 items assess personal management skills and give a maximum possible score of 240 points; the next 27 items assess the level of development of interpersonal management skills and have a maximum possible score of 162 points and the last 18 items assess group management skills, with a maximum possible score of 108 points.

Tables 7, 8 and 9 present the total results of the surveys, both of the self-evaluation of the academic directors and of the evaluation of their subordinates, in which they are broken down by each group of management skills (personal, interpersonal and group). The results obtained are acceptable in the first two skill groups and high in the self-assessment of group skills.

In all three skill groups the correlation is positive, which means that the higher the manager's self-assessment, the higher the subordinates' perception of the development of their academic director's skills. However, the correlation is more significant in the interpersonal skills group.

ACADEMIC DIVISION	PERSONAL SKILLS	
	Self-assessment	Subordinate assessment
DEA	219	198
DTIC	200	191
DEI	219	202
DPI	176	196
Average	203.5	197
Maximum value	240	240
Likert scale	ACCEPTABLE	ACCEPTABLE
Correlation	0.473812715	

Table 7 Correlation of personal skills.
Source: Own elaboration based on the results of the survey of managers and subordinates.

ACADEMIC DIVISION	PERSONAL SKILLS	
	Self-assessment	Subordinate assessment
DEA	152	136.0
DTIC	135	130.2
DEI	155	143.7
DPI	120	126.8
Average	140.5	134.2
Maximum value	162	162.0
Likert scale	ACCEPTABLE	ACCEPTABLE
Correlation	0.919757484	

Table 8 Correlation of interpersonal skills.
Source: Own elaboration based on the results of the survey to managers and subordinates

ACADEMIC DIVISION	GROUP SKILLS	
	Self-assessment	Subordinate assessment
DEA	104	93
DTIC	85	88
DEI	104	94
DPI	101	86
Average	98.5	90
Maximum value	108	108
Likert scale	ALTO	ACEPTABLE
Correlation	0.514410769	

Table 9 Correlation of group skills
Source: Own elaboration based on the results of the survey to managers and subordinates.

Conclusions

The general objective of this research was to identify the essential management skills for efficiently and effectively leading the educational institution under study, and to measure their level of development through the evaluation of the perception of a representative sample of subordinates (teaching and administrative staff) in each academic division and the self-evaluation of the academic directors themselves. The instruments used were the structured and personal interview with the academic directors and the application of two surveys through Google forms.

The research topic is very relevant, as it has been proven that management skills contribute to the generation of optimal, functional and productive work climates, which generate high levels of productivity, commitment and a sense of belonging to the organisation; furthermore, these skills can be developed, i.e. they can be perfected, but to strengthen them, a diagnosis of their current level of development must be made. Identifying the essential management skills to effectively and efficiently lead a HEI is of utmost importance, since future managers and/or leaders are trained in them; in addition to the fact that the decisions and actions taken by managers have a direct effect on society and companies. The identification of these essential management skills serves as a reference for other HEIs, and their strengthening has a favourable impact on the educational service offered.

The following conclusions can be drawn from the results:

1. The essential management skills are the motivation of others, effective communication, analytical and creative problem solving, conflict management, time management, strategic planning and management, team building, adaptation to change, resilience, empowerment and delegation, emotional intelligence, participative leadership, management and decision-making capacity, skills in the technical area of educational programmes, and mastery of the frame of reference (regulations, guidelines and operating procedures).

2. It is recommended to use the systematisation of information to speed up decision-making and to have the ability to be present with students and teachers.

3. It is noted that if the aforementioned management skills are not strengthened, there is a high probability of failing in the management function and not being able to face the most critical challenges.

4. From the analysis of the perception of the subordinates, it is concluded that the level of performance is very similar in the three groups of management skills (personal, interpersonal and group). In none of the 10 subcategories is the level of performance perceived as ideal (6), but there is an acceptable level of performance (5). In all three groups of managerial skills, managers in the DEI and DEA divisions scored the highest and managers in the DPI and DTIC divisions scored the lowest. The best performing subcategories are: developing self-awareness, leading, coaching and supportive communication, and empowering and delegating. The lowest scoring subcategories are: managing personal stress, gaining power and influence, motivating others and managing personal stress.

5. From the analysis of the academic managers' self-assessment it was identified that personal stress management and leadership towards positive change need to be strengthened. The academic managers with the highest self-assessment are those in the DEA and DEI division, which is consistent with the assessment of the subordinates.

6. When analysing the results of both the self-assessment and the subordinates' assessment together, it is concluded that the level of development of the managerial skills is acceptable and the only category that was perceived as having a high level of development is group skills, from the perspective of the academic managers. In all three groups of managerial skills the correlation is positive, which means that the higher the manager's self-assessment, the higher the subordinates' perception of the development of their academic manager's skills. However, the correlation is most significant in the interpersonal skills group.

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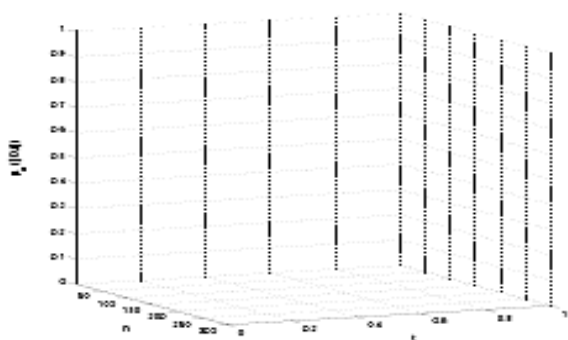
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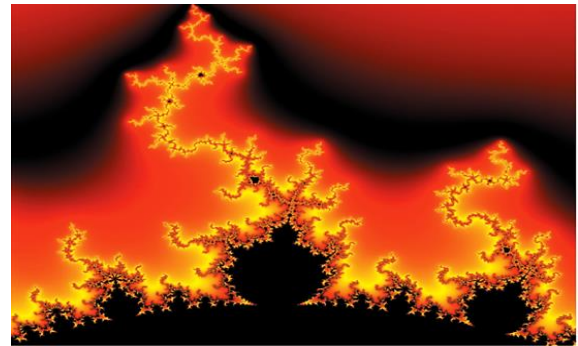
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