Handbook T-II

TECNM academic research collaboration synergies

González-Flores, Adalberto. PhD
Santos-García, Adrián. PhD
Hernández-Sánchez, Josefina. PhD
Ricardo-Vargas Moreno. PhD

Coordinators

15th ANNIVERSARY
ECORFAN
Special Edition

ECORFAN®

ISBN: 978-607-8948-55-0
ECORFAN Publishing Label: 607-8948
HSCIA Control Number: 2024-017
HSCIA Classification (2024): 301224-0117

Park Pedregal Business 3580 – Adolfo Ruiz Cortines Boulevar, CP-01900. San Jeronimo Aculco Álvaro Obregón - Mexico City.

Handbooks

Definition of Handbooks

Scientific Objectives

To support the International Scientific Community in its written production of Science, Technology and Innovation in the CONAHCYT and PRODEP research areas.

ECORFAN-Mexico, S.C. is a Scientific and Technological Company in contribution to the formation of Human Resources focused on the continuity in the critical analysis of International Research and is attached to the RENIECYT of CONAHCYT with number 1702902, its commitment is to disseminate research and contributions of the International Scientific Community, academic institutions, agencies and entities of the public and private sectors and contribute to the linkage of researchers who perform scientific activities, technological developments and training of specialized human resources with governments, businesses and social organizations.

To encourage the interlocution of the International Scientific Community with other study centres in Mexico and abroad and to promote a wide incorporation of academics, specialists and researchers to the serial publication in Science Niches of Autonomous Universities - State Public Universities - Federal IES - Polytechnic Universities - Technological Universities - Federal Technological Institutes - Teacher Training Colleges - Decentralised Technological Institutes - Intercultural Universities - S&T Councils - CONAHCYT Research Centres.

Scope, Coverage and Audience

Handbooks is a product edited by ECORFAN-Mexico S.C. in its Holding with repository in Mexico, it is a refereed and indexed scientific publication. It admits a wide range of contents that are evaluated by academic peers by the double-blind method, on topics related to the theory and practice of the CONAHCYT and PRODEP research areas respectively with diverse approaches and perspectives, which contribute to the dissemination of the development of Science, Technology and Innovation that allow arguments related to decision-making and influence the formulation of international policies in the field of Science. The editorial horizon of ECORFAN-Mexico® extends beyond academia and integrates other segments of research and analysis outside that field, as long as they meet the requirements of argumentative and scientific rigour, in addition to addressing issues of general and current interest of the International Scientific Society.

Editorial Board

Arbitration Committee

Assignment of Rights

By submitting a Scientific Work to ECORFAN Handbooks, the author undertakes not to submit it simultaneously to other scientific publications for consideration. To do so, the author must complete the Originality Form for his or her Scientific Work.

The authors sign the Authorisation Form for their Scientific Work to be disseminated by the means that ECORFAN-Mexico, S.C. in its Holding Mexico considers pertinent for the dissemination and diffusion of their Scientific Work, ceding their Scientific Work Rights.

Declaration of Authorship

Indicate the name of 1 Author and a maximum of 3 Co-authors in the participation of the Scientific Work and indicate in full the Institutional Affiliation indicating the Unit.

Identify the name of 1 author and a maximum of 3 co-authors with the CVU number - PNPC or SNI-CONAHCYT - indicating the level of researcher and their Google Scholar profile to verify their citation level and H index.

Identify the Name of 1 Author and 3 Co-authors maximum in the Science and Technology Profiles widely accepted by the International Scientific Community ORC ID - Researcher ID Thomson - arXiv Author ID - PubMed Author ID - Open ID respectively.

Indicate the contact for correspondence to the Author (Mail and Telephone) and indicate the Contributing Researcher as the first Author of the Scientific Work.

Plagiarism Detection

All Scientific Works will be tested by the PLAGSCAN plagiarism software. If a Positive plagiarism level is detected, the Scientific Work will not be sent to arbitration and the receipt of the Scientific Work will be rescinded, notifying the responsible Authors, claiming that academic plagiarism is typified as a crime in the Penal Code.

Refereeing Process

All Scientific Works will be evaluated by academic peers using the Double-Blind method. Approved refereeing is a requirement for the Editorial Board to make a final decision which will be final in all cases. MARVID® is a spin-off brand of ECORFAN® specialised in providing expert reviewers all of them with PhD degree and distinction of International Researchers in the respective Councils of Science and Technology and the counterpart of CONAHCYT for the chapters of America-Europe-Asia-Africa and Oceania. The identification of authorship should only appear on a first page, which can be removed, in order to ensure that the refereeing process is anonymous and covers the following stages: Identification of ECORFAN Handbooks with their author occupancy rate - Identification of Authors and Co-authors - PLAGSCAN Plagiarism Detection - Review of Authorisation and Originality Forms-Assignment to the Editorial Board - Assignment of the pair of Expert Referees - Notification of Opinion - Statement of Observations to the Author - Modified Scientific Work Package for Editing - Publication.

ECORFAN TECNM academic research collaboration synergies

Volumen II

The Handbook will offer volumes of selected contributions from researchers who contribute to the scientific dissemination activity of the Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo in its research areas of Education, Sustainability and Planning. In addition to having a full evaluation, in the hands of the coordinators of the Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo, quality and punctuality in its chapters, each individual contribution was refereed to international standards [V|LEX, RESEARCH GATE, MENDELEY, GOOGLE SCHOLAR and REDIB], the Handbook thus proposes to the academic community, recent reports on new developments in the most interesting and promising areas of research in Education, Sustainability and Planning.

For future volumes:
http://www.ecorfan.org/handbooks/

TECNM academic research collaboration synergies

Handbooks T-II

Coordinators
González-Flores, Adalberto. PhD
Santos-García, Adrián. PhD
Hernández-Sánchez, Josefina. PhD
Ricardo-Vargas Moreno. PhD

Tecnológico de Estudios Superiores de Valle de Bravo December 2024

DOI: https://doi.org/10.35429/H.2024.17.1.97

Abstract

The Tecnológico Nacional de México (TecNM) has established various strategies that take advantage of the synergies that are generated between higher education institutions, with the intention of promoting technological and academic development in the country. A recent example is the result of the collaborative work shown in this publication, which seeks to promote joint research projects, human resources training and the development of technological programs among some of the sister technology institutions in the State of Mexico. This effort is aligned with TecNM's strategy to address specific labor needs, such as the relocation of technology companies in the region. In addition, TecNM promotes collaboration among its campuses in the State of Mexico, facilitating the exchange of knowledge and resources among academics and researchers. This initiative reflects TecNM's commitment to be a reference in innovation and development in Mexico, disseminating knowledge in the State of Mexico.

Resumen

El Tecnológico Nacional de México (TecNM) tiene establecidas diversas estrategias que aprovechan las sinergias que se generan entre las instituciones educativas de nivel superior, con la intención de potenciar el desarrollo tecnológico y académico en el país. Un ejemplo reciente es el resultado del trabajo colaborativo que se manifiesta en esta publicación que busca impulsar proyectos de investigación conjunta, formación de recursos humanos y desarrollo de programas tecnológicos entre algunos Tecnológicos hermanos en el Estado de Méxic . Este esfuerzo se alinea con la estrategia del TecNM para abordar necesidades laborales específicas, como la relocalización de empresas tecnológicas en la región. Además, el TecNM promueve la colaboración entre sus campus en el Estado de México, facilitando el intercambio de conocimientos y recursos entre académicos e investigadores. Esta iniciativa, refleja un compromiso del TecNM para ser un referente en innovación y desarrollo en México, divulgando el conocimiento en la región mexiquense.

González-Flores, Adalberto. PhD
Santos-García, Adrián. PhD
Hernández-Sánchez, Josefina. PhD
Ricardo-Vargas Moreno. PhD
December 2024

Content

Soft skills in the age of artificial intelligence for Bachelor of Management students

Las habilidades blandas en la era de la inteligencia artificial para los estudiantes de la Licenciatura de Administración

Vargas-Moreno, Ricardo*[a] & González-Flores, Adalberto[b]

[a] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • KVB-3842-2024 • 0009-0007-5071-6284 • 1346751

[a] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • KVB-3506-2024 • 0000-0002-8045-295X • 950822

CONAHCYT classification

DOI: https://doi.org/10.35429/H.2024.17.1.10

Area: Social Sciences
Field: Economic Sciences
Discipline: Economics in technological change
Sub-discipline: Technology and social change

Key Handbooks

This research examines how leading companies in the local industry of Valle de Bravo have integrated AI into their operations and which soft skills have been determinant for the success of their employees. It also identifies the soft skills most in demand in management-related roles involving AI (e.g., leadership in AI projects, effective communication in multidisciplinary teams, ethical decision making in AI contexts) in order to develop a curricular model that integrates the development of soft skills in all stages of the undergraduate degree in management, It includes recommendations for strengthening students' digital competencies, such as critical thinking, problem solving and adapting to change, which are fundamental for working with AI. It reviews the various tools and platforms available for the development of soft skills (e.g., simulators, role-playing games, coaching) and evaluates their effectiveness. the author of this paper is a research professor with professional and teaching experience. All the authors of this research work are assigned to the Tecnológico Nacional de México, campus Valle de Bravo, being this a public Higher Education Institution of the Government of the State of Mexico. The keywords used are: Technology in Education, Digital Transformation, Educational Simulations.

Citation: Vargas-Moreno, Ricardo & González-Flores, Adalberto. Soft skills in the age of artificial intelligence for Bachelor of Management students. 1-10. ECORFAN.

* ✉ ricardo.vm@vbravo.tecnm.mx

Handbook shelf URL: https://www.ecorfan.org/handbooks.php

Abstract

This study explores the growing importance of soft skills in the field of management, especially in a context marked by increasing automation driven by artificial intelligence. Despite the fact that routine tasks are increasingly performed by machines, interpersonal skills, effective communication, and critical thinking skills remain critical for professional success. The research focuses on identifying the soft skills most relevant to management students and developing strategies to strengthen them. Through a systematic review of the literature and a student survey, it seeks to determine which skills are most valued by the labor market and how these are developed in academic programs. The results of this research will serve to design educational programs that are better adapted to the current demands of the labor market, ensuring that future management professionals are prepared to face the challenges of a constantly evolving work environment.

Soft skills in the age of artificial intelligence for undergraduate business students		
Objective	**Methodology**	**Contribution**
		
Define strategies to be implemented in the classroom that will allow graduates in Administration to have better tools to face not only work challenges but also personal challenges, obtaining ways and learning environments that allow them to acquire and integrate cognitive skills, strengthening the business structure of companies and organizations.	Exploratory and descriptive methodology, developing a series of questionnaires in Google forms validated by Cronbach's alpha, which was applied to a sample establishing a confidence interval that allowed us to know the proportion of students who feel identified with the Bachelor's degree in administration through a statistical instrument with the following formula: $$N = \frac{NZ^2Pq}{(N-1)E^2 + z^2pq}$$ $$P1\text{-}P2 = P1 - P2 \pm \sqrt{\frac{P_1q_1}{N_1} + \frac{P2q2}{N2}}$$	Development of a curriculum model that effectively integrates soft skills and AI, creating a conceptual framework that clarifies the relationship between AI and soft skills in the context of management, developing a reliable and valid soft skills assessment tool.

Tecnología en Educación, Transformación digital, Simulaciones educativas

Resumen

Este estudio explora la importancia creciente de las habilidades blandas en el campo de la administración, especialmente en un contexto marcado por la creciente automatización impulsada por la inteligencia artificial. A pesar de que las tareas rutinarias son cada vez más realizadas por máquinas, las habilidades interpersonales, la comunicación efectiva y la capacidad de pensamiento crítico siguen siendo fundamentales para el éxito profesional. La investigación se centra en identificar las habilidades blandas más relevantes para los estudiantes de administración y en desarrollar estrategias para fortalecerlas. A través de una revisión sistemática de la literatura y una encuesta a estudiantes, se busca determinar qué habilidades son más valoradas por el mercado laboral y cómo estas se desarrollan en los programas académicos. Los resultados de esta investigación servirán para diseñar programas educativos más adaptados a las demandas actuales del mundo laboral, asegurando que los futuros profesionales de la administración estén preparados para enfrentar los desafíos de un entorno laboral en constante evolución.

Las habilidades blandas en la era de la inteligencia artificial para los estudiantes de La licenciatura de administración		
Objetivo	**Metodología**	**Contribución**
		
Definir estrategias a implementar en el aula que permitan a los Licenciado en Administración tener mejores herramientas para afrontar desafíos no solo laborales si no también personales, obteniendo maneras y ambientes de aprendizaje que permitan adquirir e integrar habilidades cognitivas fortaleciendo la estructura empresarial de las empresas y organizaciones.	Metodología exploratoria y descriptiva, elaborando una serie de cuestionario en Google forms validados por Alfa de Cronbach la cual se aplicó un muestreo estableciendo un intervalo de confianza que nos permitió conocer la proporción de alumnos que se sienten identificados con la Licenciatura en administración a través de un instrumento estadístico con la siguientes formula: $$N = \frac{NZ^2Pq}{(N-1)E^2 + z^2pq}$$ $$P1\text{-}P2 = P1 - P2 \pm \sqrt{\frac{P_1q_1}{N_1} + \frac{P2q2}{N2}}$$	Desarrollo de un modelo curricular que integra de manera efectiva las habilidades blandas y la IA, creando un marco conceptual que clarifica la relación entre la IA y las habilidades blandas en el contexto de la administración, desarrollando una herramienta de evaluación de habilidades blandas que sea confiable y válida.

Tecnología en Educación, Transformación digital, Simulaciones educativas

Introduction

AI transforms the nature of work, eliminating routine and repetitive tasks, however, soft skills become more relevant in this context, as machines cannot fully replicate empathy, creativity and conflict resolution skills (Laker & Powell, 2011). It is therefore an important factor in the development of a professional, which is where the strategies to be implemented in the TESVB become important, as these are the competences that need to be strengthened in education. A study conducted by the economist mentions that soft skills increase up to 16% the income of workers, it is also mentioned that artificial intelligence has triggered new challenges to improve adaptation to change, flexibility, creativity, innovation, communication and teamwork (Guativa, 2020).

This research was based on a documentary analysis in academic, scientific and research topics that support the methodology proposed in order to characterise this phenomenon, conducting a mixed analysis, from the application of role-playing instrument, applied in a matrix of assessment applied by teachers of some subjects selected for a joint application to the evaluation of 25% of the subject, whose tabulation is done following a quantitative analysis of cross-sectional.

The universe and sample was selected from the Bachelor's Degree in Administration using the sample size formula together with a correlation study of variables. Complementing this research, meetings were held with employers in the Valle de Bravo region to find out which skills are most in demand in their employees.

The objective is to define strategies to be implemented in the classroom that will allow graduates in Administration to have better tools to face challenges not only at work but also personal, obtaining ways and learning environments that allow them to acquire and integrate cognitive skills, strengthening the business structure of companies and organisations.

The expected result of this project corresponded to the implementation of a process of strengthening soft skills that will be maintained over time in the study programmes of the Tecnológico de Estudios Superiores de Valle de Bravo, which will also be recognised by the recently graduated students in its impact on their work performance and development. With the increasing integration of artificial intelligence in business processes, it is imperative that management students develop not only technical competences, but also interpersonal skills that allow them to work effectively in diverse teams and lead in changing environments.

Rationale

AI transforms the nature of work, eliminating routine and repetitive tasks, however, soft skills become more relevant in this context, as machines cannot fully replicate empathy, creativity and conflict resolution skills.

A study by the economist mentions that soft skills increase workers' earnings by up to 16%, also mentioning that artificial intelligence has triggered new challenges to improve adaptation to change, flexibility, creativity, innovation, communication and teamwork.

The increasing integration of artificial intelligence into business processes has become a challenge as management students must develop not only technical competencies, but also interpersonal skills that enable them to work effectively in diverse teams and lead in changing environments.

Objective

To define strategies and implement them in the classroom that will allow Management graduates to have better tools to face challenges not only at work but also personally, obtaining learning environments that allow them to acquire and integrate cognitive skills, strengthening the business structure of companies and organisations.

Methodology

Ricoeur (2000) defines phenomenology as a hermeneutic variable of reflexive philosophy that favours the analysis of reality, ideal for qualitative approaches, where an understanding of human behaviour is required. In this case, the phenomenon to be studied refers to the soft skills required in management students. For the development of the theoretical foundation, a qualitative and descriptive approach was applied with the use of the systematic review methodology, in such a way that the preliminary result was guaranteed in the categorisation of variables that define the soft skills.

For the characterisation and assessment of the soft skills, a mixed analysis is carried out, based on the application of the role-playing instrument, applied in an assessment matrix that was given to the teachers, the tabulation of which is carried out following a cross-sectional quantitative analysis (Díaz, 2006). Description of the unit of analysis: The students of the Bachelor's Degree in Management and the labour market.

The variables Soft skills, characterised at three levels: systematic review, in students. Population and sample. The population of the present investigation is constituted by the students enrolled during the period 2023-2024, in which they were classified by means of the instrument of data collection.

where:
N= Total population
Z= Level of confidence 95%-1.96
Pq= Proportion allowed.5
E= Error allowed 5%

This instrument was validated with Cronbach's Alpha tool, within this methodological scope, the design of the present research was descriptive transactional, as it is carried out in a specific and unique period of time. The data is collected at a single moment and time for the purpose of describing the soft skills variable.

Based on the analysis developed, the research question was posed:

How to strengthen the soft skills of the student of the Bachelor's Degree in Administration of the Tecnológico de Estudios Superiores de Valle de Bravo?

Thus the hypotheses that support the thematic approach of the research and guide the methodological development are:

– Ho: Bachelor of Management students require the implementation of strategies to strengthen their soft skills in a new environment created by artificial intelligence.

– H1: Bachelor of Management students do not require the implementation of strategies to strengthen their soft skills in a new environment created by artificial intelligence.

Development of the theme

The results indicate that management students are aware of the importance of soft skills in their education. Some 85% of respondents consider these skills essential for their future career, especially in roles that require human interaction (Management Student Survey, 2023).

Furthermore, programmes that integrate soft skills training along with the use of AI tools tend to produce graduates who are more prepared for the labour market. This correlates with an increase in employability rates (Veorecol, 2024).

The classification of soft skills applied in the Mathematics and Statistics subjects for management in the Bachelor of Management curriculum was categorised into three aspects as shown in the following table:

Table 1 Classification of Soft Skills

Cognitivas	Emotional	Social
– Critical thinking – Creative thinking – Self-awareness – Decision-making	– Empathy – Managing emotions and feelings – Tension and stress management	– Assertive communication – Interpersonal relationships – Problem and conflict management

Source: Own elaboration

Once categorised, a rubric was developed that allowed students to be assessed during a unit per subject according to the topics and exercises seen in each session of the unit.

Table 2 Soft skills assessment rubric

Habilidad	1 - Mala	2 - Regular	3 - Bueno	4 - Excelente
Pensamiento crítico	No intenta comprender el tema	Intenta comprender el tema, pero no obtiene resultados positivos	Analiza y obtiene en su mayoría resultados esperado	Analiza e identifica la solución de manera correcta
Pensamiento creativo	No genera ideas ni muestra interés	Trata de generar nuevas ideas, pero no son las más adecuadas	Genera ideas el mayor tiempo posible	Genera ideas innovadoras y creativas para la solución del tema
Autoconocimiento	Reconoce e identifica áreas de mejora	Trabaja las áreas de mejora identificadas	Comprende los temas y aclara sus dudas	Ni tiene dudas en los temas vistos
Toma de decisiones	No considera opciones o lo hace de manera muy limitada	Menciona algunas opciones, pero el análisis es superficial	Considera varias opciones, pero podría profundizar más.	Examina múltiples opciones de manera exhaustiva y objetiva
Empatía	Es indiferente las emociones de sus compañeros	Comprende las emociones de sus compañeros, pero no muestra apoyo	Comprende y apoya en medida que le piden ayuda	Comprende y comparte los sentimientos y emociones de sus compañeros
Manejo de emociones y sentimientos	Sus emociones son intensas y no logra concentrarse en clase	Identifica sus emociones, pero le cuesta concentrarse	Identifica sus emociones y logra concentrarse en clase	Identifica y controla sus emociones
Manejo de tensiones y estrés	No se adapta a situaciones estresantes y se siente abrumador.	Tiene dificultad para adaptarse y rara vez encuentra soluciones.	Se adapta, pero con dificultad y sin soluciones efectivas.	Se adapta bien a situaciones estresantes y encuentra soluciones.
Relaciones interpersonales	La comunicación es confusa o inadecuada	La comunicación es limitada o poco clara en algunas situaciones	Se comunica bien, pero a veces puede ser poco asertivo	Se comunica de manera clara, asertiva y respetuosa
Manejo de problemas y conflictos	No analiza el problema y no muestra interés	Analiza el problema, pero no muestra interés en solucionarlo	Sugiere algunas soluciones	Propone soluciones creativas

Source: Own Elaboration

Table 3 Analysis of the results of the soft skills of students studying mathematics and statistics on the Bachelor's Degree in Management

Ability	Results
Critical thinking	The students showed mostly good critical thinking with 57%, as they analyse and get a good result once they try, however, 41% of the students try to understand the topic, but do not reach the right result.
Creative thinking	In this area, the majority of students show a good level, however, only 7% manage to generate innovative and creative ideas for the solution of a problem.
Self-awareness	For this skill, 43% were recorded as good and fair, reflecting that students identify and work on areas for improvement.
Decision-making	Most students consider several options when solving a problem but could still go a little deeper.
Empathy	5% are indifferent to the emotions of their peers, while 22% understand the emotions of their peers, but do not show support, with the highest percentage being good with 58%, which means that if they are asked for help they are able to provide it, and only 15% are overly concerned about others.
Managing emotions and feelings	This is the skill where the lowest margin between the different items was recorded, with an excellent level of 24%, a fair level of 31% and a good level of 45%, which reflects that none of the students identify and control their emotions, highlighting that they know how to control their emotions and concentrate in class.
Tension and stress management	50% adapt with difficulty, but fail to have solutions that allow them to make the right decisions in a stressful situation in the classroom.
Interpersonal relations	For this item most of the students are assertive in their relationships with their peers, but they could improve when it comes to working in a team.
Problem and conflict management	49% only suggest proposals to conflicts, but show no interest in solving them, which leads to misunderstandings between them.

Source: Own elaboration

Once the analysis by category was completed, we proceeded to the evaluation of the impact of emotions on academic performance, with which we can identify a direct relationship between the emotions they experience and their academic performance, as well as the perception of how these emotions influence aspects such as concentration, productivity and social interactions. As for the most frequent emotion experienced by students during the semester, stress stands out with 26.5%. This is not surprising, as the academic environment can be demanding. However, it is also observed that a significant group of students experience happiness with 24.5% as the predominant emotion, suggesting that, despite the challenges, some find positive moments in their academic experience.

Academic performance in the presence of negative emotions, such as stress, is mostly assessed as good or fair. This reflects the ability of some students to maintain acceptable performance even when facing adverse emotions. However, this performance is not optimal, highlighting the fact that negative emotions exert a negative influence on the quality of academic performance. 30.6% of the respondents consider that managing their emotions has a direct influence on their ability to concentrate, stating that it is of great importance. This highlights the relevance of emotional management in the learning process, as concentration is key to assimilating information and meeting academic demands. In terms of exam preparation and performance, it is observed that stress affects the majority of students moderately, with a percentage of 32.7%, while a smaller group of 24.5% report that it does so slightly.

This suggests that, although stress is a factor, its impact is not always severe, although it is still a barrier to achieving full academic performance. On the other hand, 34.7% of students state that positive emotions such as joy and motivation are a driving force that significantly increases their academic productivity. This evidences the importance of fostering an environment where positive emotions prevail, as these enhance students' ability to complete their tasks and face academic challenges. In relation to social interactions, 39.5% of students report that their emotions worsen the quality of their relationships with peers and teachers. The 39.5% of students who experience positive emotions tend to improve their interactions, while those who experience negative emotions report a deterioration in the quality of their relationships.

This finding is relevant, as social support within the academic environment can influence students' emotional well-being. Among the emotional coping strategies, physical exercise scored 25.2% while talking to friends or family stood out with 27.2% and they stand out as the most used methods. This indicates that students resort to activities that allow them to disconnect momentarily from academic pressure and get external support, which helps them to regain emotional balance. In addition, 34.7% believe that adequate emotional support would improve their academic performance to a great extent. This suggests the need to implement psychological or emotional support programmes in institutions, as students perceive that this type of intervention could be key to improving their performance.

The general perception that emotional intelligence is fundamental to the management of academic challenges. Students recognise that the ability to identify, understand and manage their emotions enables them to better cope with the demands of the academic environment. In this part, the majority also consider that receiving counselling would be very or moderately effective in improving both their emotional well-being and their academic performance. On the other hand, students believe that teachers do influence their emotional well-being and academic performance either positively or negatively, and this is due to the way in which they teach their classes.

Students recommend meditation for a correct management of emotions, as this technique helps you to relax and get rid of bad thoughts, helps you to have better ideas and to feel better about yourself. Subjects also influence their academic performance, as each student has a favourite subject which makes them perform better and this can be reflected in their grades. Finally, they suggest that classes should be more practical and not so much theoretical, as this would allow students to apply the knowledge acquired more effectively in real situations. In addition, more interactive and dynamic teaching would encourage greater interest and participation in the learning process, which in turn would contribute to better understanding and retention of content.

An important part of this research is to link soft skills as well as the impact of emotions with the new AI-based environment.

AI has the potential to transform the educational experience of undergraduate management students, especially in terms of academic performance. As institutions adopt these technologies, it is critical to continue to research and evaluate their effectiveness to ensure that their positive impact on higher education is maximised.

The impact of AI on Bachelor of Management students is significant, promoting more dynamic learning tailored to individual needs. However, it is crucial to address the challenges and ethical considerations that arise in its implementation to ensure equitable and effective education.

Table 4 Axes of impact of artificial intelligence on Bachelor of Management students

Axes of impact of Artificial Intelligence (AI)	
Personalisation of learning	AI enables the creation of personalised learning experiences, tailoring content and speed to the individual needs of each learner. Intelligent tutoring systems can provide instant feedback and help students identify their strengths and weaknesses.
Task automation	Many routine administrative tasks, such as data collection and report generation, can be automated through AI, freeing up time for students to focus on more strategic and creative tasks.
New skills	AI requires a new set of skills, such as critical thinking, complex problem solving and the ability to work with data. Management programmes must adapt to develop these skills in their students.

Source: Own Elaboration

The survey showed that the majority of respondents were female (61.7%) and male (38.3%). The semesters with the highest participation were the first semester with 40.8%, the fifth semester with 23.9% and the third semester with 18.3%. The AI they use the most is CHAT GPT and GEMENI, stating that they are easy to use and very practical. However, they are aware of the importance of knowing how to use them correctly, as they sometimes provide erroneous information. The frequency with which students use AI in their tasks based on the data collection instrument is 2 to 3 times per week with 69%, with 23.2% using it 4 times per week and 7.7% not using it. The areas where they use artificial intelligence the most are research and data analysis with 62.7%, content creation (essays, presentations, etc.) with 19%.

Students stated that their concerns about the use of AI in their careers are over-dependence on technology (46.2%) and lack of critical skills (32.2%).

As a result, students responded that the areas of management where AI will have the greatest impact were marketing (51.7%) and human resources (24.5%).

When questioned about how prepared they felt to use AI in their future career, the results were as follows: Modernly prepared with 55.6% and not very prepared with 32.4%. Students who have premium AI services said it is very affordable and worth the cost (53.5%) and not very affordable (26.1%). Students also reported that the use of AI affects the dynamic management of teamwork as neutral (71.3%) and positive (21.7%). It was concluded that most of the students who carry out academic projects with these tools purify the information with 85.9% while 14.1% only copy the text directly.

Conclusions

This study has explored the importance of soft skills in the training of Management students, as well as the impact of artificial intelligence on their professional development. The results obtained reveal a significant correlation between the development of soft skills and academic and professional success.

The students surveyed recognise the importance of soft skills, especially those related to cognition, emotions and interpersonal relationships. However, the results of the assessment rubric indicate that there are still areas of opportunity to strengthen these skills, particularly in creative thinking, decision-making, and stress and tension management.

The integration of artificial intelligence tools into learning processes has proven to be beneficial by personalising the learning experience and automating routine tasks. However, it is critical that students develop the critical skills necessary to use these tools effectively and ethically.

Analysis of the impact of emotions on academic performance has revealed that stress is a predominant emotion among students, affecting their concentration and performance. On the other hand, positive emotions such as joy and motivation are associated with better academic performance and interpersonal relationships.

Regarding artificial intelligence, students show a great interest and an increasing use of these tools in their academic tasks. However, they also express concerns about over-reliance on technology and lack of critical skills.

In conclusion, this study highlights the need to integrate soft skills development more deeply into management programmes. Furthermore, it underlines the importance of accompanying the implementation of artificial intelligence with strategies that promote critical thinking, problem solving and ethics in the use of these technologies.

Statements

Artificial intelligence is redefining the employment landscape and, with it, the importance of soft skills in management education. The combination of technical training and interpersonal skills is essential to prepare students for the future of work. It is recommended that educational institutions evaluate and reform their curricula to include a balanced focus on both areas. On the one hand, AI offers opportunities to improve the quality of management education, such as personalisation of learning, access to high quality resources and improved learning efficiency. However, it also poses significant challenges, such as the need to develop non-technical skills, the digital divide and the ethics of automated decision-making.

Today, the institution faces the challenge of not only ensuring the academic success of its students, but also promoting their holistic well-being. Despite using different teaching methods, it can be noted that students often face various pressures, these pressures come not only from academic demands, but also from emotional and personal factors that can influence their academic performance and development.By providing a data-driven analysis of the impact of emotions, this study can offer the TESVB valuable tools to develop support programmes that help management students manage their emotions more effectively, striking a balance between their emotional well-being and their academic success.

Conflict of interest

The authors declare that they have no conflicts of interest. They have no financial interests or personal relationships that could have influenced this book.

Authors' contribution

Vargas-Moreno, Ricardo: Contributed to the formulation of the research project and the design of the methodology.

González-Flores, Adalberto: Selected the main sources of information from which the information used in this work was compiled.

Availability of data and materials

All data and information presented in this research are available in the references.

Funding

This research did not require funding.

Acknowledgements

The authors declare that no funding was received for this research from any public or private institution.

Abbreviations

AI Artificial Intelligence

References

Background.

Guativa, J. A. (2020). Twenty-first century challenges and trends in higher education. Social Science Journal. Retrieved from https://www.redalyc.org/journal/280/28064146010/html/

Discussions

Diaz, G. Z. (2006). ethics, phenomenology and hermeneutics in paul ricœur. Philosophica University. doi:0120-5323

Laker, D., & Powell, J. (2011). The Differences Between Hard and Soft Skills and Their Relative Impact on Training Transfer. doi:10.1002/hrdq.20063

Veorecol. (28 August 2024). Verecol. Retrieved from https://psico-smart.com/articulos/articulo-la-influencia-de-la-inteligencia-artificial-en-el-desarrollo-de-habilidades-digitales-170026

Management and Burnout Syndrome: Leadership and Engagement as a Strategy

Gestión y Síndrome de Burnout: Liderazgo y compromiso como estrategia

Fragoso-Díaz, Maribel*[a], Plascencia-Rodríguez, Jhovann Alonso[b] and Fragoso-Díaz, Socorro[c]

[a] Tecnológico Nacional de México, Tecnológico de Estudios Superiores de Coacalco • LMM-8427-2024 • 0009-0005-1186-8870
[b] Tecnológico Nacional de México, Tecnológico de Estudios Superiores de Coacalco • LKN-8444-2024 • 0009-0008-5842-9738
[c] Tecnológico Nacional de México, Tecnológico de Estudios Superiores de Coacalco • LBH-5538-2024 • 0009-0004-4754-4184

CONAHCYT classification **DOI:** https://doi.org/10.35429/H.2024.17.11.18

Area: Administration
Field: Business
Discipline: Administration and management
Sub-discipline: Business Administration

Key Handbooks

The main contributions to the generation of Science and Technology written in this research are the identification of strategies for the integration of a work team creating a positive work environment. For the understanding of the key aspects to understand to apply to the generation of universal knowledge is the identification of burnout, establish a proper diagnosis and propose strategies for the application of engagement. It is concluded that it is important for organizations not to neglect the human factor, which should be motivated to be more productive, starting from integration activities for a healthy work environment as well as encouraging employees to become more professional for a better performance of their activities.

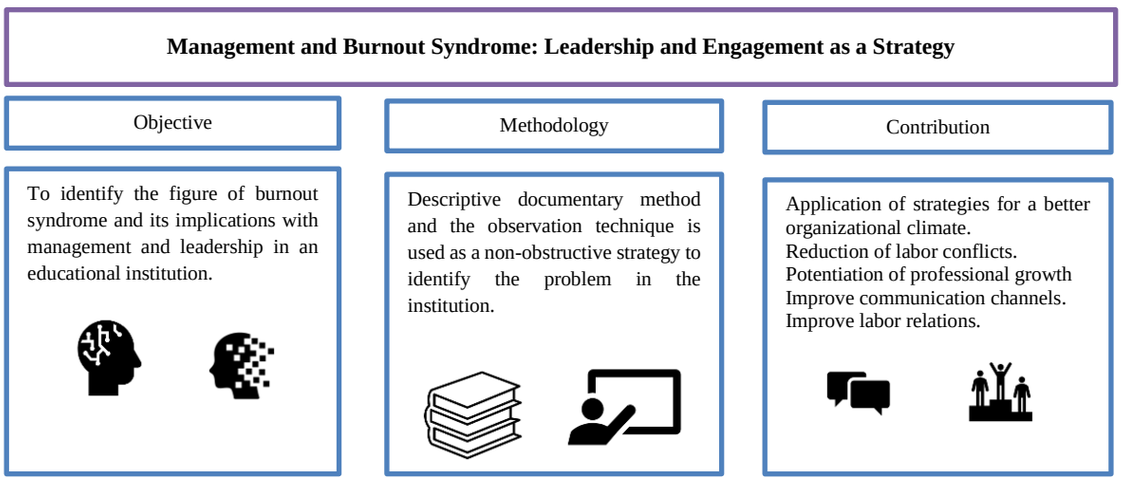
Citation: Fragoso-Díaz, Maribel, Plascencia-Rodríguez, Jhovann Alonso and Fragoso-Díaz, Socorro. Management and Burnout Syndrome: Leadership and Engagement as a Strategy. 11-18. ECORFAN.

* ✉

Handbook shelf URL: https://www.ecorfan.org/handbooks.php

Abstract

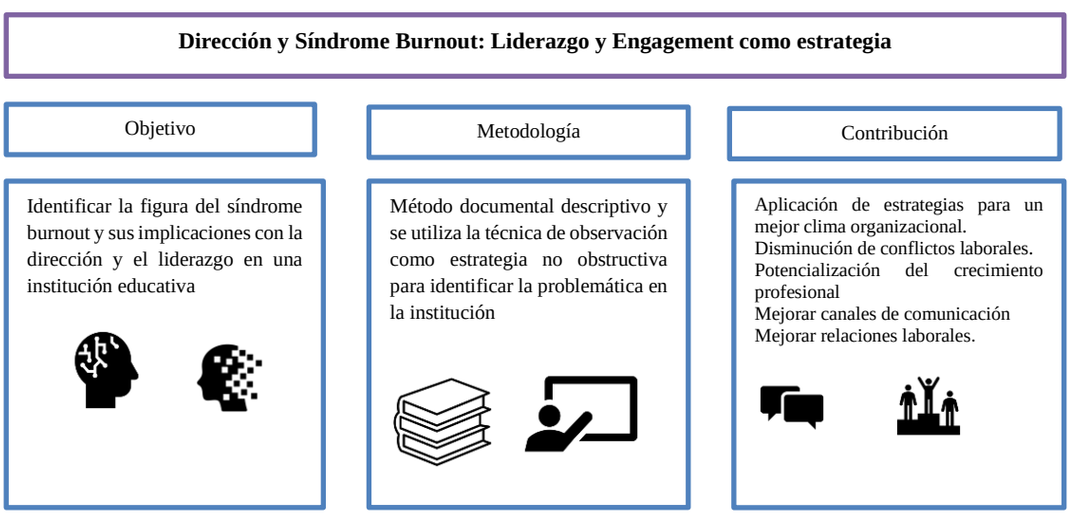
The objective of this study is to identify the figure of the burnout syndrome and its implications with the management and leadership in an educational institution using a descriptive documentary method and the observation technique is used as a non-obstructive strategy to identify the problems in the institution, the concepts of management and leadership are described with the intention of verifying the causes that originated the burnout syndrome, the new management, concerned about improving the work center, accepts proposals that, according to the research carried out, suggest the application of engagement with the intention of improving the organizational climate, as well as seeking that the personnel be more participative with the organization's projects, that they express their ideas and opinions actively, that they show enthusiasm and are motivated, identify their talents and relocate them for the achievement of objectives. The aim is to motivate workers to professional and personal growth.



Burnout, Management, Leadership, Engagement, Engagement

Resumen

Este estudio tiene como objetivo identificar la figura del síndrome burnout y sus implicaciones con la dirección y el liderazgo en una institución educativa utilizando un método documental descriptivo y se utiliza la técnica de observación como estrategia no obstructiva para identificar la problemática en la institución, se describen los conceptos de dirección y liderazgo con la intensión de verificar las causas que originaron el síndrome burnout, la nueva dirección preocupada por mejorar el centro de trabajo acepta propuestas que de acuerdo con la investigación realizada se sugiere aplicar el *engagement* con la intención de mejorar el clima organizacional además se busca que el personal sea más participativo con los proyectos de la organización, que expresen sus ideas y opiniones activamente que muestren entusiasmo y estén motivados, identificar sus talentos y reubicarlos para el logro de objetivos. Se trata de motivar a los trabajadores a un crecimiento profesional y personal.



Bournout, Dirección, Liderazgo, Engagement

Introduction

Work demands, misinformation about the requirements of the job position in organizations, poor administrative and personnel management are causing problems that are gradually growing, usually not observed, if not until it reaches the limit of the members of the institution. In this project we talk about burnout syndrome, according to Fernandez *et. al*. (2010), it is also known as professional burnout syndrome, PDS is also called work-related stress syndrome or job burnout syndrome. The term in English is burnout, which translated into Spanish means to be burned out, worn out, exhausted and losing enthusiasm for work.

In the institution where the study is being carried out, the situation is present; the personnel is tired, feels irritated and presents health problems, high absenteeism has been generated, in this project the concept of management and leadership has been studied with the intention of demonstrating to the new leader the difference for a new management model, also the proposal of engagement is made as a strategy to improve the organizational climate.

The purpose of this article is to show the difference between leadership and management, concepts used in organizations that the application of one and the lack of the other can generate or not the bournout syndrome in the company, a review of the literature is made to define the main concepts and demonstrate the need to maintain a balance between management and leadership to reduce or avoid bournout in the organization.

The methodology used is descriptive documentary since it makes use of different researches to integrate the concepts mentioned above, in addition, the observation technique is used to describe the situation in the company.

Administrative Aspects

Leadership

Garcia (2015), relies on Weibler and Rosenstiel to establish leadership; it consists of influencing others, through a socially accepted behavior, influence that orients towards a behavior focused on objectives (Weibler (2001), likewise (Rosenstiel 2000), indicates that the determinants of behavior are found within the factors of capacity (training), will (motivation), values and norms, as well as situational conditions (circumstances). In this aspect, leadership can be defined as the influence that will obviously be exerted by the members of an organization to achieve institutional objectives.

Transformational leadership is a leadership style that enhances the awareness of the collective interest among the members of the organization and helps them to achieve their collective goals (García 2012, quoted by Roque and Arriaga 2020).

Delgado (2003), shares what Peter Drucker (n.d.) states “the task of the leader is to develop leaders. This is increasingly relevant at a time when many people know more than their boss. The boss must learn to build a team in which specialists take the lead in the areas they dominate with superiority.” But he also points out that, “In crises there is no shared leadership. When the ship is sinking, the captain cannot bring people together to hear them. He has to give orders. That's the secret of shared leadership: knowing in which situations to act as boss and in which to act as partner.”

The organization where the subject of this article is being studied is an elementary school. According to the concepts presented, the problem arose due to the absence of a leader because the person in charge of administrative management did not have clear objectives, the universal values and norms that should be followed and respected in any institution or social environment were exceeded, there was no teamwork and the collective interest was lost. The institution's collaborators require a more efficient administrative management that maintains an adequate organizational climate and fosters personal development.

The organization in charge of an administrator who establishes what is done, how it is done, when it is done, according to the position given is known as director, that is why it is required to know theoretically the concept and capabilities of this.

Organizational climate

Coda (1992), on the other hand, considers the organizational climate to be the indicator of the degree of satisfaction of the members of a company, in relation to different aspects of the culture or apparent reality of the organization, such as: human resources policy, management model, company mission, communication process, professional valorization and identification with the company.

The institution under study is managed by a person who has no experience in the management of human capital, does not carry out its activities under a procedures manual where the members of the institution can base themselves to perform their functions, in relation to the resources there is no adequate use of them: the responsibility of managing an educational institution has is relevant since it has connotations of social character.

For the institution the human capital, referring to the teachers, help the leader to achieve objectives, the leader is not alone his team is the one that strengthens him with the various activities in the institution to teach a class, participate in competitions, develop learning strategies in the classroom, civic events within the institution, as well as the participation of teachers in courses, workshops and other activities that have with other institutions of the same level periodically.

In the educational organizational environment, it will allow the development of a set of informative, implementation and control mechanisms, which can be used by the management to increase the probability that the behavior of the people who are part of the institution is consistent with its objectives (Majad 2016).

Management

A manager takes responsibility for the organization to facilitate the achievement of objectives through the group of people who make up the organization by managing resources.

Sanchez (2007), task-oriented managers are understood as those who are defining quantitative objectives, insisting on their achievement, exploring new means of efficiency, or adopting new methods to manage the knowledge, skills, information and understanding used by their collaborators to achieve the proposed results, some of the characteristics they present are the following:

Box 1

Table 1

Director's characteristics.

Characteristic	Description
Norms, Objectives and Standards Performance	The degree to which the leader is concerned with the definition and detailed or itemized description of the tasks, objectives and activities to be performed, as well as with the establishment of the norms and standards within which such tasks, objectives and activities are to be accomplished.
Control	It is the degree to which the leader is concerned with exercising control, as well as the means and forms used by the leader to exercise that control.
Performance	The degree to which the leader is concerned with knowing the success or failure of the achievement of the objectives and tasks assigned to his or her employees, as well as the nature or use of performance information in the management process.
Orders	It is the form or manner in which the leader issues orders to his collaborators, as well as the character of such orders. Responsibilities: The responsibilities that the leader assigns to his collaborators in terms of planning, programming, execution and presentation of results.
Power	It is the type of power that the leader has, whether formal or informal, as well as its possible uses in the solution of individual, group and organizational conflicts.

Source: Sanchez 2007

This is generated with good management where the leader studies the structure of the organization and establishes objectives to be achieved, which will be based on a procedure manual that establishes responsibilities, must value the staff and create work teams that are committed and work towards the goals of the organization. This study supports the need for a transformational leader because there is no adequate work environment in the organization.

The origin of the burnout syndrome in the institution under study.

The organization has been suffering for nine years a deterioration with the teaching staff, the management far from setting goals, following manuals and/or integrating the staff, has been responsible for causing discomfort among employees, giving preferences to some employees not to deliver forms, not to do certain activities, among some other situations, which has led to major problems in the organization.

Burnout Syndrome

The symptoms of burnout syndrome are very similar to the symptoms associated with work stress in general, however, in the case of burnout they can increase in intensity, especially in relation to changes in behavior or character, among which can be found:

Box 2

Table 2

Burnout symptoms

Symptoms	Typology
Symptoms at the emotional level;	Changes in mood Demotivation Mental exhaustion Lack of energy and lower performance
Symptoms at the physical level;	Affections of the locomotor system Other psychosomatic alterations

Source: Balladares,2017

.

Burnout syndrome is a response to chronic stress at work (long-term and cumulative), with negative consequences at the individual and organizational level, and which has very specific peculiarities in certain areas of work, professional, volunteer, (Martinez 2010).

Factors conducive to burnout

Martínez (2019), talks about the factors that favor the presence of burnout syndrome, among which he mentions:

1. At the individual level, the counter-transference or getting excessively involved in the needs and problems of users, increases the level of demand and takes problem solving as a personal challenge.

2. Interpersonal relationships at work, either with users or with other co-workers, where conflict situations, quarrels and other adverse situations, can generate a climate of tension and discomfort, which is increased by the lack of support or situations of harassment and bullying.

3. The organizational level characterized by bureaucracy or situations of inequity among workers, favoritism or coordination problems that prevent the proper recognition of the work of each professional.

4. The social environment where the profession is executed, not being the favorite of the worker, accessing this by mere labor necessity, thus existing an internal pressure to carry the economic sustenance, rather than by institutional identity; which generates that the professional does not feel committed to his work and therefore is more susceptible to feel dissatisfied with the functions to be performed.

Consequences of burnout

The consequences of suffering from burnout syndrome are diverse, among which are described suicides, separations or divorces, absenteeism, undesired rotation, sabotage, work accidents, deterioration of quality, abandonment, demotivation, negativism, passivity, "passivity", indifference, errors, indecision, increase of drug addictions, low performance and productivity, poor quality and job dissatisfaction, (Aranda 2013).

In the institution of study, the observation technique has been carried out: for (Matos 2008), observation techniques; it consists of the valid and reliable systematic recording of behavior or manifest conduct. It is the act in which the spirit captures an internal (perception) or external phenomenon and, registers it with objectivity. This perception allows the development of behaviors of contemplation, curiosity, reflection, research, visualization of events of the external and internal world. Based on the previous concept, it can be defined that observation makes it possible to obtain data without interfering in the environment or behavior of the observed subjects, with the legitimacy of the situations.

However, the observation technique in the institution revealed: people with little desire to go to work, absenteeism, accidents at work, constant incapacity due to stress, lack of respect among colleagues and from bosses to subordinates, fear of losing their job due to labor demands; identifying these situations allows us to confirm that the staff is indeed burned out, that they have been abused in such a way that has generated burnout syndrome.

Engagement

For Sandoval (2008), engagement is a psychological link with work, being psychologically linked to work is something more than not being 'burned out' by work. Certain behaviors that we call 'extra-role' (e.g., organizational altruism, group cooperation) require employees to be more than 'not' burned out; they need to be excited. Psychological bonding is the theoretical opposite construct to burnout. In contrast to burned-out employees, engaged employees are able to cope with the new demands that arise in everyday work, and they manifest an energetic and effective connection to their jobs.

Proposal

As a proposal it is intended to apply engagement strategies, with the intention of recognizing the staff as it is important to be interested in their welfare and psychological health, which will allow better performance and loyalty to the institution, the objective of the strategies is the direct relationship with the occupational health of human resources and management.

Establishing strategies to apply engagement aims to improve different aspects with employees, it should have an impact on communication, employee recognition, motivate professional development, including maintaining a balance between work and personal life, the strategies should be applied whenever: clear goals and objectives are established, thus identifying what needs to be improved, feedback is given to the employee, always being cautious and not going overboard with any comment that may affect professionally or personally, then identify strategies to use, design them, plan their implementation and implement them, seek the active participation of workers and finally at all times to follow up on the implementation of engagement.

Conclusions

Working with human resources is an art, it depends on the leader with the commitment to establish organizational goals and objectives, which can be met with the staff of the institution, when the person who is in charge of the institution does not have the profile of leader and is only in charge of directing the organization then problems arise that limit the performance of activities in the organization, the objectives are not achieved; coupled with this problems arise between colleagues and there is no communication.

The leaders of the institution seek to make a change by promoting the improvement of the organizational climate, in addition to promoting a change in the personnel to commit themselves to new challenges and a professional and personal change, engagement is a tool that can be useful if it is properly applied.

Authors' contributions

Fragoso Díaz - Maribel Fragoso Díaz; contributes the problem statement, proposes the subject to be studied and develops the research tool.

Plascencia Rodríguez - Jhovann Alonso; proposes the research topic and develops part of the theoretical framework.

Fragoso Díaz- Socorro; proposes engagment as a strategy and develops part of the theoretical framework.

Availability of data and materials

The availability of data and materials of this research work are available according to the sources consulted.

Financiación

The present research work did not receive financial support from any institution.

Acknowledgement

To the Tecnológico de Estudios Superiores de Coacalco, for the general support provided to professors committed to their mission in the context of research.

Abbreviations

TECNM/TESCo

References

Aranda Beltrán, C., López Gónzalez, JL., & Barraza Salas, JH (2013). Factores psicosociales y síndrome de burnout en trabajadores de la industria de la transformación de la masa, Tepic, México. Revista Colombiana de Psiquiatría, 42 (2), 167-172.

Balladares Ponguillo, Karen Andrea; Hablick Sánchez, Félix Cristobal Burnout: el síndrome laboral Journal of business and entrepreneurial studies, vol. 1, núm. 1, 2017

Delgado Torres, N. A., & Delgado Torres, D. El líder y el liderazgo: reflexiones. *Revista Interamericana de Bibliotecología, 26*(2), 75-88. (2003).

Fernández Cantillo, A., Hernández Fernández, A., Hernández Fernández, E., & Cañizares Carmenate, I. (2010). SINDROME DE DESGASTE PROFESIONAL: HISTORIA, ETIOLOGIA Y CONSECUENCIAS. *Revista Información Científica, 65*(1),

García-Solarte, M., (2015). Formulación de un modelo de liderazgo desde las teorías organizacionales. *Entramado*, *11*(1), 60-79.

Majad Rondón, M. A., (2016). Gestión del talento humano en organizaciones educativas. *Revista de Investigación*, *40*(88), 148-165.

Martínez Pérez, A., (2010). El síndrome de burnout. evolución conceptual y estado actual de la cuestión. Vivat Academia, (112), 42-80.

Martínez,P. (2019). Una revisión bibliográfica: el síndrome de "burnout".Revista Medicina Preventiva. Journal of business and entrepreneurial studies, vol. 1, núm. 1, 2017

Matos, Y., & Pasek, E. (2008). La observación, discusión y demostración: técnicas de investigación en el aula. *Laurus*, *14*(27), 33-52.

Roque López, Víctor Manuel, & Arriaga Martínez, Antonio Alejandro. (2019). El efecto del liderazgo, aprendizaje organizacional y administración del conocimiento en la percepción de la innovación del personal operativo en la Ciudad de México. *Contaduría y administración*, *64*(3), e109.

Salanova, M., & Llorens, S. (2008). Estado actual y retos futuros en el estudio del burnout. *Papeles del Psicólogo*, *29*(1), 59-67.

Sánchez Manchola, I. D., (2007). Los estilos de dirección y liderazgo en el área de gestión humana: Un proceso de caracterización. *Cuadernos de Administración,* (38), 103-116.

Low cost prototype for a room housing with basic automated services

Prototipo de bajo costo para una casa habitación con servicios básicos automatizados

Hernández-Vásquez, Juan Gabriel[a], León-Bañuelos, Luis Alberto[b]*, Avellaneda-Reyes, José Luis[c] and Hernández-Rodríguez, Cristian[d]

[a] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • 0000-0003-1335840X
[b] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • 0000-0003-0332-6228
[c] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • 0009-0007-5108-5218
[d] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • 0009-0000-4893-250X

CONAHCYT classification **DOI:** https://doi.org/10.35429/H.2024.17.19.30

Area: Engineering
Field: Engineering
Discipline: Engineering systems
Sub-discipline: Automation

Key Handbooks

The project focuses on generating contributions in the field of engineering and automation to develop low-cost proposals and give access to a greater number of the population to domotic technologies. The key aspects to understand to apply to the generation of universal knowledge stand out in the inclusion of technologies in the daily use to automate processes that adapt to the needs of people; the impact it has is the low cost proposal compared to the distributors of domotic technologies with complex automation and an extremely high cost for a large percentage of the population. The main conclusions of this research are that there are different technologies to generate low-cost automation proposal to suit homes with different characteristics; and therefore can be adapted to different economic strata. At the date of writing this research, the corresponding author is a member of the National System of Researchers of CONHACYT. Also, at the date of preparation of this manuscript, the author has the Desirable Profile designation granted by the Teacher Development Program (PRODEP), awarded by the Ministry of Public Education. In the previous year, the main author has a total of 18 citations. All the authors of this research work are assigned to the Tecnológico Nacional de México, campus Valle de Bravo, being this a public Higher Education Institution of the Government of the State of Mexico. The keywords used are: Domotics, Arduino, Sensor.

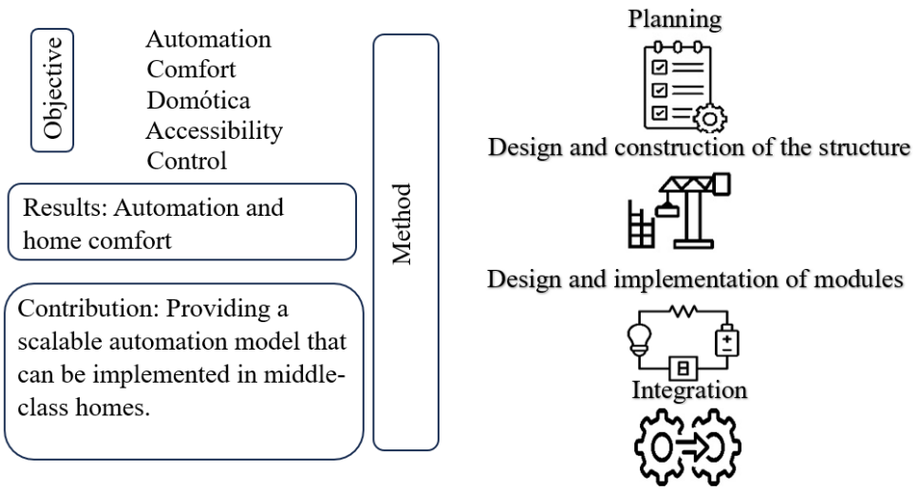
Citation: Hernández-Vásquez, Juan Gabriel, León-Bañuelos, Luis Alberto, Avellaneda-Reyes, José Luis and Hernández-Rodríguez, Cristian. Low cost prototype for a room housing with basic automated services. 19-30. ECORFAN.

* ✉ luis.lb@vbravo.tecnm.mx

Handbook shelf URL: https://www.ecorfan.org/handbooks.php

Abstract

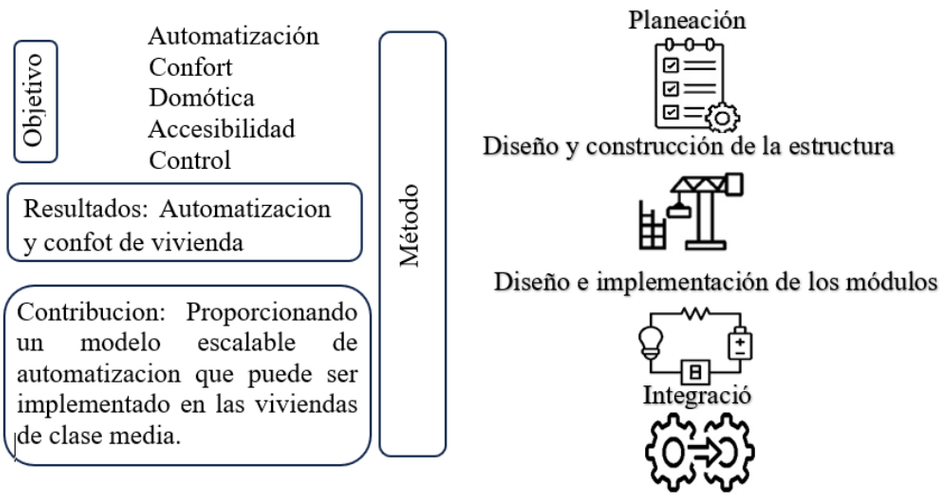
The continuous advancement in technology, telecommunications, and computing drives the development of more sophisticated systems to meet the increasing demands of society. The ability to provide comfort, control, supervision, automation, and optimization are key processes that significantly improve people's quality of life. This proposal addresses the design and development of an automated system using Arduino as a control interface for basic home services such as lighting, blinds control, and irrigation. Given the growing interest in improving quality of life through the use of advanced technologies, the project focuses on creating a prototype to gain a clearer understanding of home automation, with the aim of future implementation in residential homes. Likewise, the basic comfort services proposed aim to be accessible to a larger portion of the population. The results obtained demonstrated the feasibility of the prototype and its ability to enhance functionality and comfort in the home.



Domotic, Arduino, Sensors

Resumen

El avance continuo en tecnología, telecomunicaciones e informática impulsa el desarrollo de sistemas sofisticados para satisfacer las crecientes demandas de la sociedad. La capacidad de proporcionar confort, control, supervisión, automatización y optimización son procesos claves que mejoran significativamente el confort de las personas. Esta propuesta aborda el desarrollo de un sistema automatizado utilizando Arduino como interfaz de control en los servicios básicos en la vivienda: iluminación, control de persianas y riego. Ante el creciente interés por mejorar mediante el uso de tecnologías avanzadas, el proyecto se centra en la creación de un prototipo con automatización para que a futuro se implementen en casas habitaciones. Se proponen los servicios básicos de confort para que sea accesible a una mayor parte de la población considerando que la domótica es costosa. Los resultados que se obtuvieron demostraron la viabilidad del prototipo y su capacidad para mejorar la funcionalidad y comodidad en la vivienda.



Domótica, Arduino, Sensor

Introduction

The constant growth of electronics, telecommunications and computer technology leads to the development of increasingly complex computer systems to meet the needs that exist in society (Irwin *et al.*, 2011). Providing comfort, security, control, monitoring, automation and optimisation are processes that improve the quality of human life (Sanchez *et al*., 2014).

As an example, home automation is defined as the integration of technology in the intelligent design of an enclosed space (Cantalejo, 2016). And its name comes from the union of the words 'domus' (Latin for 'dwelling') and 'autonomous' (from the Greek: αὐτόνομος; 'governing itself') which refers to the ability to control and automate the installations of the home (Pérez-Lombard *et al*., 2008).

The services offered by home automation in everyday life undoubtedly seek comfort and security (Florez-Oviedo, 2021). Among its main objectives, they provide forms of communication that act on interaction through devices that perform an action in the home (Calderón and Marín, 2017).

Automated homes can reduce electricity consumption (Molano-Aguas & Álvarez-Rueda, 2020). By up to 30%, thanks to smart lighting and heating systems that automatically adjust according to occupancy and user preferences (Lasso-Vera, 2024).

57% of users consider that home automation systems increase their comfort and convenience (Guzman-Muñoz, 2023). It allows users to control devices and systems through voice commands or mobile applications (Cook & Das, 2004).

The implementation of artificial intelligence (AI) and machine learning algorithms in home automation has enabled the development of predictive systems that optimise energy use and improve home security (Mura-Montero *et al*., 2024). These systems can learn from usage patterns and adjust automatically (Cook *et al*., 2009).

Homes equipped with home automation technologies can increase their market value (Clericus, 2014). Buyers are willing to pay more for homes that offer greater efficiency and security (Balta-Ozkan, 2013).

Although it is known that home automation has several advantages in terms of comfort and security, it is expensive due to the current technologies that are implemented, which means that it is not accessible to most of the population; for this reason, automation by modules is proposed, with the aim of only considering the basic services (lighting, irrigation and shutter control), thus achieving a more accessible cost for the general population.

Due to the above, the objective of the project is to present a proposal to develop and evaluate a prototype of a dwelling that implements home automation for the automation of basic services.

Methodology

The methodology used is based on the home automation project of Sánchez and collaborators (2014), contemplating the phases shown in figure 1, which are focused on the automation of basic services.

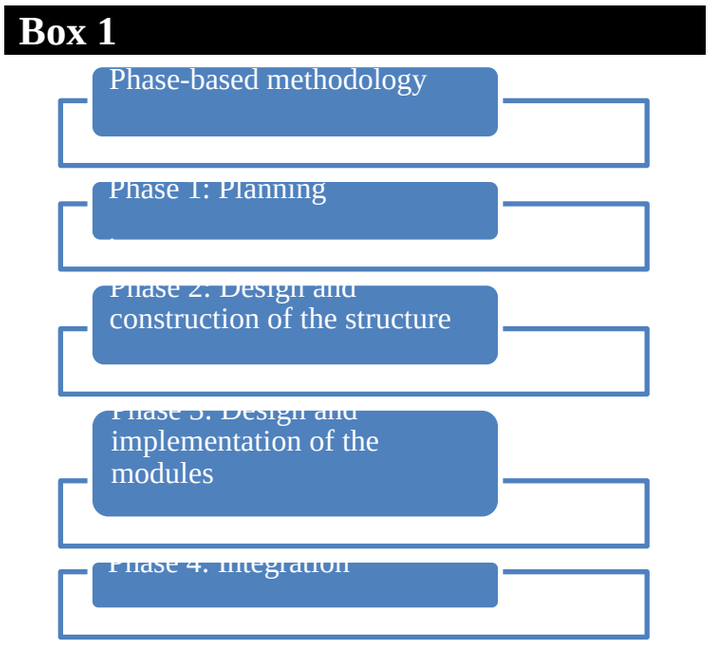


Figure 1
Diagram of the methodology

Phase 1: Planning

The planning phase is the process of setting objectives and determining the courses of action needed to achieve them. The following basic services were considered for the prototype: indoor and outdoor lighting, automation of window blinds and automated irrigation.

The prototype is proposed for an automated house with two floors, two bedrooms, a living room, study room, garden and swimming pool. It is intended that costs can be reduced by focusing on basic services to make it accessible to a larger percentage of the population.

At this stage, a lighting system was contemplated for the whole house through PIR type motion sensors which will send signals to the Arduino when movement is detected and this microcontroller will return the signal to the LEDs. In the case of the motors of the blinds, it was considered that they would be activated by an infrared sensor that would send a signal to the Arduino when a presence is detected and this microcontroller would return the signal to the motors, thus allowing the blinds to be rolled up and allowing natural light to enter. Finally, for the irrigation system, as well as the lighting of the pool, it was considered to be activated through photoresistors, which when detecting the absence of sunlight will send the signal to the Arduino and this microcontroller in turn will return the signal to the sprinklers and LEDs in the pool.

Planning the prototype design

A preliminary design of the interior and exterior of the prototype was made, with 3D plans of the prototype using AutoCAD software, as well as the common areas such as the garden and the pool, as shown in figure 2.

Box 2

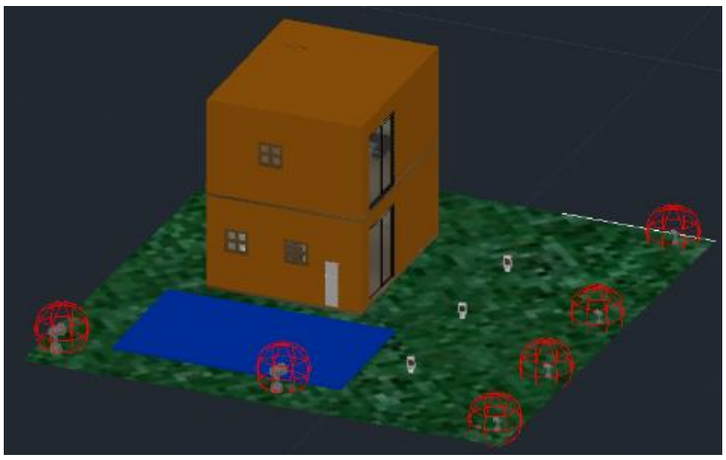


Figure 2
Exterior view of the prototype

Phase 2: Design and construction of the structure

2D design of a template

AutoCAD software was used to design a 2D template of the structure that was used in the assembly of the house, including measurements in centimetres and meticulous planning of each part as it was laser cut. This process involved several stages, from the initial conceptualisation to the creation of a complete dimensional model as can be seen in Figure 3.

Box 3

Figure 3
Template of the structure of the house made in AutoCAD

Phase 3: Design and implementation of the modules

Module design and implementation is a crucial process in the development of complex systems, allowing the creation of individual components that work together to form a complete solution. This modular approach facilitates system management, maintenance and scalability.

Smart light circuits with LEDs, photoresistors and PIR-type motion sensors connected to an Arduino Uno.

In the design of the smart light circuit with LEDs and photoresistors, during assembly the photoresistors were connected to pins A0, A1 and A2, which on detecting the absence of light send a digital signal to the microcontroller, which sends voltages to pins 11, 12 and 13 to the LEDs allowing them to be switched on in the garden, irrigation system and pool areas. The circuit shown in figure 4 shows the connection diagram.

Box 4

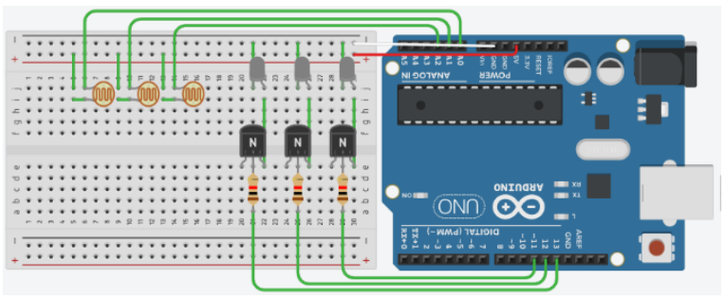


Figure 4

Diagram for garden lighting, pool and irrigation, edited in Tinkercad

In the design of the circuit with PIR type motion sensors, during assembly, 3 sensors from the top floor, ground floor and stairs were directly connected to pins 2, 3 and 4, which, when detecting motion, send a digital signal to the microcontroller, which in turn sends an output voltage through pins 8, 9 and 10 to the LEDs, allowing them to be switched on inside the prototype home. The circuit in figure 5 shows the connection diagram.

Box 5

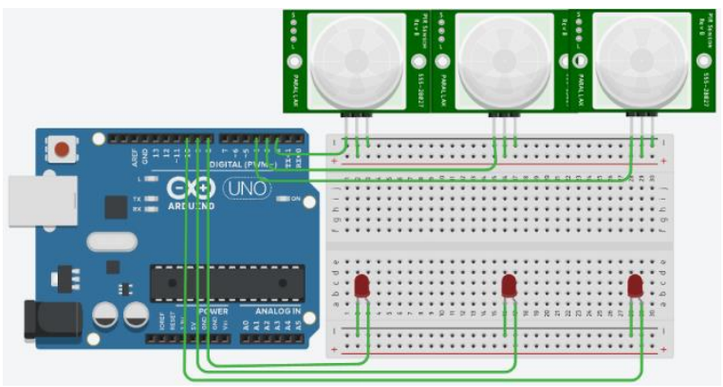


Figure 5

Diagram for the lighting of the interior of the prototype (Vvienda) edited in Tinkercad

Blinds opening and closing circuit

This circuit was designed and assembled using an Arduino Mega 2560, where an infrared sensor was connected to pin 7. When it detects a presence, it sends a digital signal to the microcontroller, which in turn returns a digital signal on pin 15 to the motors, allowing the opening and closing of the blinds in the ground floor and upper floor areas of the prototype. The circuit in figure 6 shows the connection diagram.

Box 6

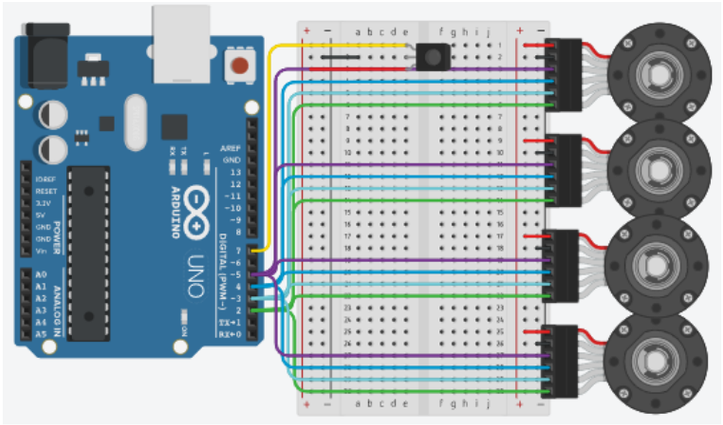


Figure 6

Diagram for opening and closing shutters, edited in Tinkercad.

Phase 4: Integration

Integration is a crucial phase that occurs after the different modules have been individually designed, implemented and tested. This phase focused on combining all system components into a cohesive and functional unit.

Functionality of the integrated modules

By executing the codes loaded in the microcontrollers, the operation of all the interconnected circuits was verified, where operating errors were identified, due to bad connections, detection of damaged elements or logical errors in the codes, which affected the sensitivity, speed and direction of rotation of the motors that control the blinds, movement sensors and photoresistors. Based on the above, corrections and modifications were made to the circuits, as well as to the codes that allowed the finished prototype to function optimally.

Results

Phase 2: Construction of the structure

2D design: Figure 7 shows the final 2D laser-cut design, detailing the layout and dimensions of each component of the prototype to ensure that all the pieces fit perfectly in the final prototype, as each piece of the design was prepared for cutting, a process that requires millimetric precision.

Box 7

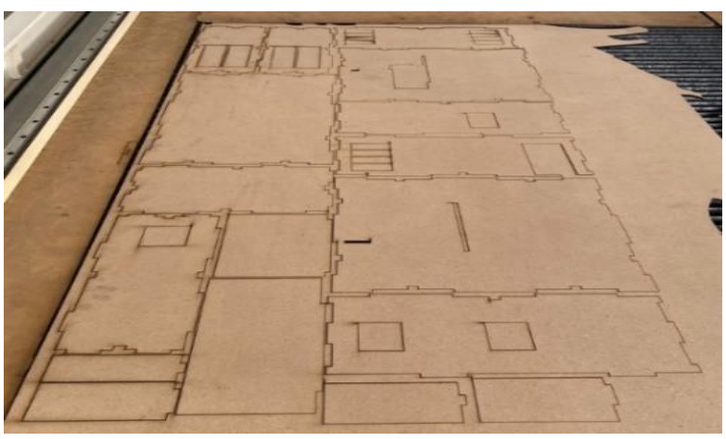


Figure 7

Laser cut MDF template.

Once all the parts were cut, they were assembled and glued together to form a solid structure. For the base of the whole structure a wooden plywood was used and painted with water-based paints in a variety of colours (green, brown, orange and blue) which provides an attractive visual finish as shown in figure 8.

Box 8

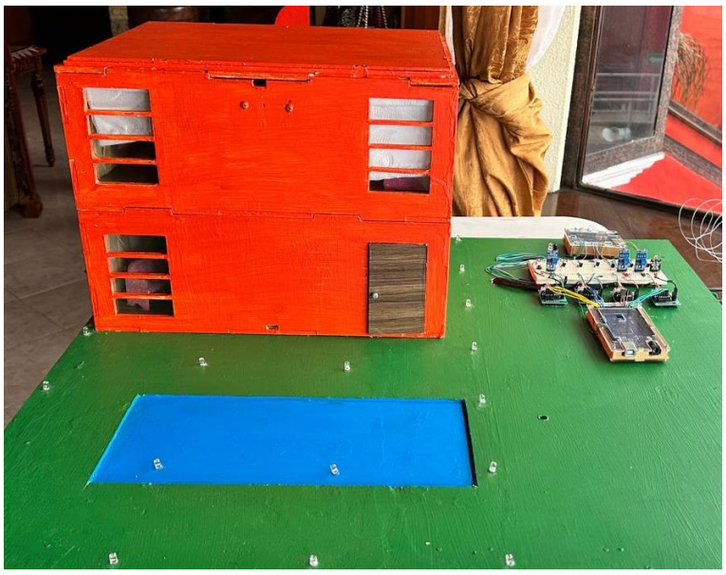


Figure 8

Diagram for the lighting of the interior of the prototype (Prototype house front view)

Phase 3: Implementation of the modules

Smart light circuit with LEDs and photoresistors: For the development of the smart light circuit, an Arduino Uno was used as the main controller, in this circuit 3 photoresistors were connected to pins A0, A1 and A2. The photoresistor detects the absence of light and sends a signal to the microcontroller; this signal is processed and through pins 11, 12 and 13, the Arduino emits a voltage to the LEDs, activating its ignition in specific areas such as the garden, the irrigation system and the pool, figure 9 illustrates the circuit configuration.

Box 9

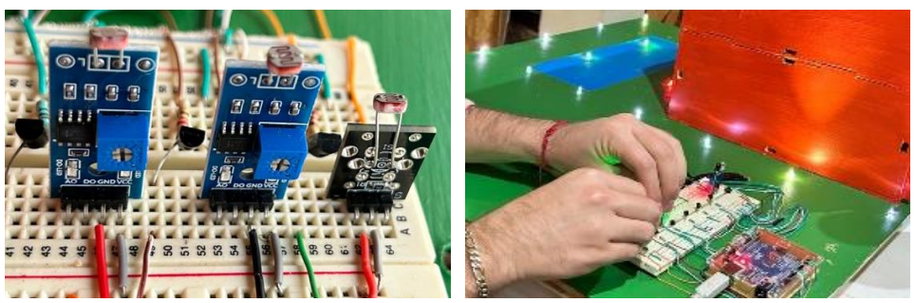


Figure 9

Connection of house control modules

This smart light circuit demonstrates how a modular approach and the use of simple electronic components can be effectively integrated to improve the functionality and automation of a home environment.

Blinds opening and closing circuit design: In terms of the development of the motor control circuit, an Arduino Mega was used as the main controller, in this circuit an infrared sensor was connected to pin 7 of the Arduino so, when it detects an approach, the sensor sends a signal to the microcontroller which is processed and through pin 15, the Arduino emits a voltage to the motors, activating their ignition in the ground and ground floor areas of the prototype. Figures 10a, 10b and 10c illustrate the circuit configuration.

Box 10

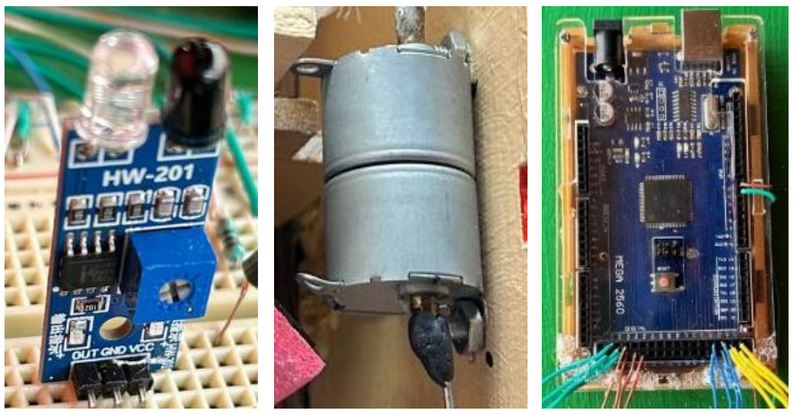


Figure 10

Blinds control circuit components

The control circuit used in the motors demonstrates how a modular approach and the use of simple electronic components can be effectively integrated to improve the functionality and automation of a home environment.

Lighting circuit with LEDs and motion sensors (PIR): In the development of the lights automation circuit through motion sensors, an Arduino Uno was used as the main controller, in this circuit, 3 motion sensors (PIR), were connected to pins 2,3 and 4 of the Arduino Uno, so when detecting a movement, the sensors send a signal to the microcontroller and this is processed through pins 8, 9 and 10 of the Arduino Uno, finally emitting a voltage to the leds, activating its ignition in the areas of the stairs, upstairs and downstairs of the prototype. Figure 11 illustrates the circuit configuration.

Box 11

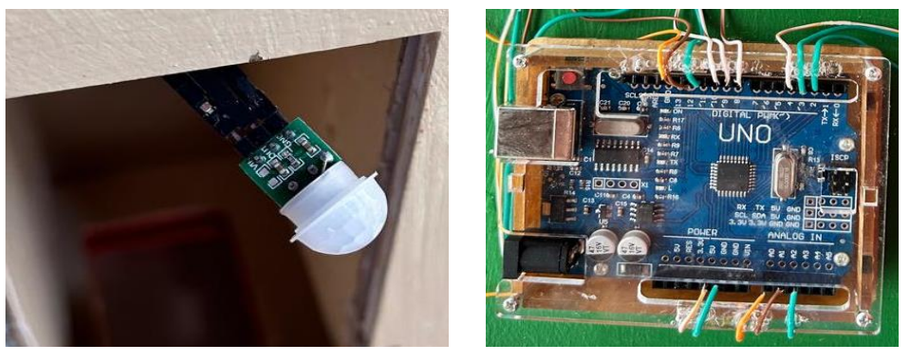


Figure 11

Components of the light circuit of the LED light and motion sensor system

Phase 4: Integration

Testing the Functionality of the Integrated Modules: In order to ensure the correct interaction between them, modifications were made to the control code, these adjustments were essential to improve the synchronisation and communication between the different components of the system. Figure 12a shows part of the code that controls the shutter motors, highlighting the line of code where the speed adjustment is carried out to improve the efficiency and response to the closing or opening of the shutters.

Figure 12b shows part of the code for the photoresistors, highlighting a comparison to determine whether the lighting level is in a range for switching on the LEDs. Finally, full tests were carried out with the defined codes to ensure that all the initial requirements and specifications were met.

Box 12

```
const int buttonPin = 6;
const int ledPin = 13;
int INFRARROJO = 7;
int valor = 0;

const int motorPin1 = 22;     // 28BYJ48 In1
const int motorPin2 = 23;     // 28BYJ48 In2
const int motorPin3 = 24;    // 28BYJ48 In3
const int motorPin4 = 25;    // 28BYJ48 In4
int motorSpeed = 1200;     // variable para fijar la velocidad
int stepCounter = 0;      // contador para los pasos
int stepsPerRev = 16384/2 ;   // pasos para una vuelta media
const int numSteps = 8; // 8 MEDIOS PASOS
```

```
void setup() {
  Serial.begin(9600);
  pinMode(2,INPUT);
  pinMode(3,INPUT);
  pinMode(4,INPUT);
}
void loop() {
//Primer sensor
  int analogValue = analogRead(LIGHT_SENSOR_PIN);
  Serial.print("Analog Value = ");
  Serial.print(analogValue);    // señal analogica cruda
  if (analogValue < 900) {
    Serial.println("LED1 OFF");
    digitalWrite(ledPin1, LOW);
  } else {
    Serial.println("LED1 ON");
    digitalWrite(ledPin1, HIGH);
```

Figure 12

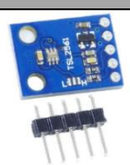
Codes used for circuit control

In case you want to implement the proposal in a real dwelling, the prototype sensors can be replaced by others with higher range, force, speed and sensitivity capabilities as shown in Table 1.

Box 13

Table 1

Equivalent sensors from prototype to living quarters

Prototype sensor	Illustrative image	Sensor for living quarters	Illustrative image
Photoresistance		Light sensors SL2561	
Sensor (PIR)		Sensor PIR HC-SR501	
Stepper motor 5v		Stepper motor 24v	

It is worth mentioning that the codes and the Arduino board are functional and compatible with both proposals.

Conclusions

This project addressed the design and construction of a prototype modular system, facilitating the management and scalability of the system, with a focus on making these technological advances accessible to a larger part of the population. The results obtained show that the integration of home automation technologies in homes increases the market value of properties.

During the prototype's operation tests, it was possible to verify its functioning and operation based on the basic services considered in the automation of a home, the feasibility of improving its functionality and comfort.

The implementation of sensors and control modules in a functional prototype validated its effectiveness, highlighting its potential based on what was worked on the prototype scale was automated lighting system, irrigation system and control of blinds, so that this can be implemented in a middle-class housing.

Statements

The project is scalable in the future by implementing green technologies to promote sustainability.

Conflict of interest

The authors declare that they have no conflicts of interest. They have no financial interests or personal relationships that could have influenced this book.

Authors' contribution

Hernández-Vasquez, Juan Gabriel: Contributed to the formulation of the research project and the design of the methodology.

Leon-Bañuelos, Luis Alberto: Carried out the literature search for the state of the art and supported the project methodologically.

Avellaneda-Reyes, José Luis: Carried out the design and simulation of the circuits and design of the template for the prototype.

Hernández-Rodríguez, Cristian: developed the source code for the automation of the circuit and made the physical circuits.

Availability of data and materials

All the data and information presented in this research are available in the references.

Funding

This research did not require funding

Acknowledgements

The Tecnológico de Estudios Superiores de Valle de Bravo is thanked for providing the facilities for the development of this project.

Abbreviations

AI Artificial Intelligence
PIR Passive Infra Red

References

Background.

Balta-Ozkan, N., Davidson, R., Bicket, M., & Whitmarsh, L. (2013). Barreras sociales a la adopción de hogares inteligentes. Energy policy, 63, 363-374.

Calderón, M., López, G., & Marín, G. (2017). Ciudades inteligentes en América Latina: Realidades y preparación técnica. En Computación ubicua e inteligencia ambiental: 11th International Conference, UCAmI 2017, Philadelphia, PA, USA, November 7-10, 2017, Proceedings (pp. 15-26). Springer International Publishing.

Clericus, S. P. R. (2014). ANÁLISIS Y DISEÑO DE UNA RED DOMÓTICA PARA VIVIENDAS SOCIALES (Tesis doctoral, UNIVERSIDAD AUSTRAL DE CHILE).

Cook, D. J., Augusto, J. C., & Jakkula, V. R. (2009). Ambient intelligence: Technologies, applications, and opportunities. Pervasive and mobile computing, 5(4), 277-298.

Cook, D., & Das, S. K. (2004). Smart environments: technology, protocols, and applications (Vol. 43). John Wiley & Sons.

Flórez-Oviedo, O. A. (2021). Diseño e implementación de una aplicación domótica para una vivienda familiar en la cuidad de barranquilla mediante la empresa Conarcaribe SAS.

Basics

Pérez-Lombard, L., Ortiz, J., & Pout, C. (2008). A review on buildings energy consumption information. Energy and buildings, 40(3), 394-398.

Irwin, D., Barker, S., Mishra, A., Shenoy, P., Wu, A., & Albrecht, J. (2011). Exploiting home automation protocols for load monitoring in smart buildings. In Proceedings of the third ACM workshop on embedded sensing systems for energy-efficiency in buildings (pp. 7-12).

Support

Martín Cantalejo, S. (2016). Scalable and manageable home automation control platform using mobile devices (Bachelor's thesis).

Sánchez, C., Mesa, A., Manrique, C., Calderón, H., Cobo, L., Vicente, R. D., & Moncayo, C. M. (2014). Design and implementation of a home automation prototype based on arduino and android platforms. Ontare Journal, 2(2), 115-132.

Differences

Molano Aguas, A. A., & Álvarez Rueda, A. M. (2020). Use of home automation and ICT in the control and saving of electrical energy in Colombian homes (Bachelor's thesis, Universidad EAN).

Mura Montero, R. A., Sánchez Vargas, N. I., & Mendoza Vera, M. (2024). Verde Iinteligente (Bachelor's thesis, Mechatronics Engineering, Universidad EAN).

Discussions

Guzmán Muñoz, W. B. (2023). Design of a domotic system and electrical energy consumption for a family home in the District of Pativilca, 2023.

LASSO VERA, D. N. (2024). MOBILE APPLICATION FOR INTELLIGENT LIGHTING WITH IOT IN COMPUTER ROOM 014 OF THE INFORMATION TECHNOLOGY CAREER (Bachelor's thesis, Jipijapa-Unesum).

Gastronomic Tourist Route: Regional food in the municipality of Valle de Bravo, State of Mexico, Mexico

Ruta Turística gastronómica: Comida regional en el municipio de Valle de Bravo, Estado de México, México

Mandujano-De Los Santos, Ariadna*[a], Echavarría-Gudiño, Héctor[b], Guerrero-Alonso, Araceli[c] and Santos-García, Adrián[d]

[a] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • 0009-0007-7605-3335.
[b] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • KVB-4738-2024 • 00009-0002-3356-1667
[c] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • DLVS-6887-2024 • 009-0006-8868-7442
[d] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • 0000-0002-8144-8346.

CONAHCYT classification **DOI:** https://doi.org/10.35429/H.2024.17.31.41

Area: Social Sciences
Field: Business and Administration
Discipline: Administration and management
Sub-discipline: Business Administration

Key Handbooks

The direct contribution is to the Social Sciences, in the economic field, since through the Critical-Sociocritical Paradigm, the individual is positioned as a central part of the event and reconstructs his reality. It is proposed to incorporate the Tourist Route to the practice in order to make it a way to attract tourists to the municipality of Valle de Bravo and generate economic revenue; as well as to make it part of the "modus vivendus" of the student who is part of the research project. The economic revenue that can be generated in a given region by the implementation of a gastronomic tourist route, including the promotion of typical regional dishes, which although there are none in the route under study, there are main dishes. The commercialization of the Gastronomic Tourist Route is feasible; the Business Plan carried out has been positive. The layout of the Route has been feasible. The promotion of the Route, after the Market Analysis has been correct. None of the authors collaborating in the research has a CONHACYT scholarship and none has a PRODEP scholarship. The authors who collaborate do not have citations either. All the authors collaborate in the same Institution of Public Higher Education of state control. The most used keywords are Valle de Bravo, Gastronomic Tourist Route, Tourist Route, Valle de Bravo food, State of Mexico.

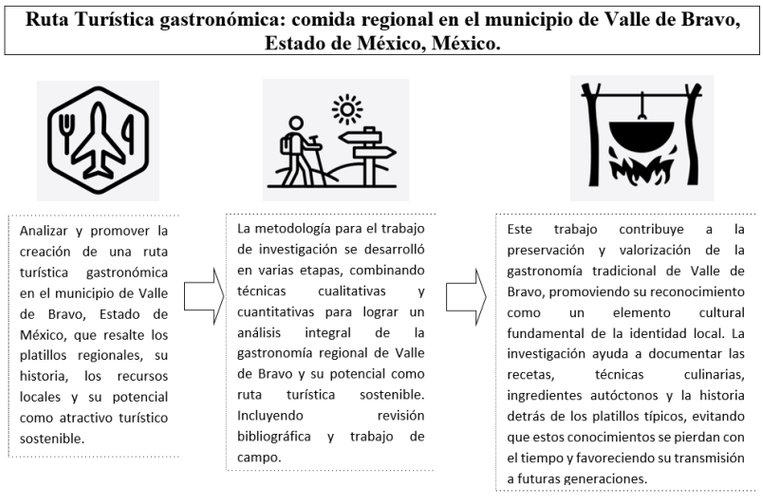
Citation: Mandujano-De Los Santos, Ariadna, Echavarría-Gudiño, Héctor, Guerrero-Alonso, Araceli and Santos-García, Adrián. Gastronomic Tourist Route: Regional food in the municipality of Valle de Bravo, State of Mexico, Mexico. 31-41. ECORFAN.

* ✉ ariadna.ms@vbravo.tecnm.mx

Handbook shelf URL: https://www.ecorfan.org/handbooks.php

Abstrtact

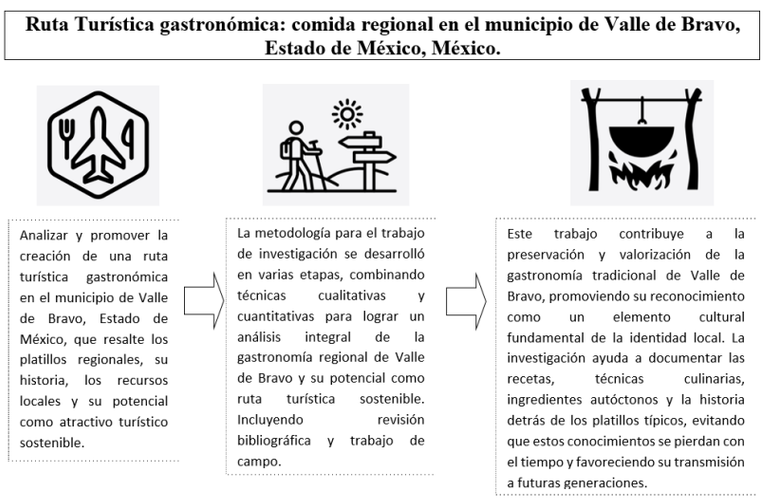
The municipality of Valle de Bravo does not currently have a Gastronomic Tourist Route that promotes the culinary diversity existing in the region, and that generates income to the same; for this reason the design of a Gastronomic Tourist Route of regional food in the municipality of Valle de Bravo, State of Mexico, Mexico is proposed; the methodology to be used is quantitative, qualitative, descriptive; and management of a reflective socio-critical/critical paradigm (the individual constructs his reality, and from it transforms it as a reflective critical creative subject). The route was traced to determine its feasibility, and the results were favorable. Market research is carried out at the Mexican Republic level with the support of Google Forms of Google Drive; and a market survey in the municipality of Valle de Bravo; obtaining optimal results that promote the commercialization of the Route.



Valle de Bravo, Gastronomic Tourist Route, Tourist Route

Resumen

El municipio de Valle de Bravo no cuenta actualmente con una Ruta Turística gastronómica que promueva la diversidad culinaria existente en la región, y que genere ingresos a la misma; por este motivo se propone el diseño de una Ruta Turística gastronómica de la comida regional en el municipio de Valle de Bravo, Estado de México, México; la metodología a utilizar es cuantitativa, cualitativa, descriptiva; y manejo de un paradigma sociocrítico/crítico reflexivo (el individuo construye su realidad, y desde ella la transforma como sujeto creativo crítico reflexivo). Se lleva a cabo el trazado de la Ruta para conocer la factibilidad del mismo, los resultados fueron favorables. Se realiza una investigación de mercado a nivel República Mexicana con apoyo de Google Forms de Google Drive; y un Sondeo de mercado en el municipio de Valle de Bravo; obteniendo resultados óptimos que promueven la comercialización de la Ruta.



Valle de Bravo, Ruta Turística gastronómica, Ruta turística

Introduction

Mexico, as never before, has grown in culinary matters, and the work of the sector deserves recognition. Our cuisine has stood out in a very important way in recent years; the work of traditional cooks, of elders, of avant-garde cooking talents, of researchers, of students and academics, has resulted in a gastronomic offer of enormous relevance. The global gastronomic situation is a key factor. The Government of the Republic is convinced that it is time to act decisively and jointly with the private sector to turn the country into a world-class gastronomic destination. We have the ingredients, the countryside, the tradition, the recipes and the chefs. It is time to show what we are to new regions. Mexican cuisine and its actors are factors of enormous relevance on the world gastronomic scene. The strategy that the Ministry of Tourism is designing will make it possible to plan and organise gastronomic promotion, which will translate into effective actions that will have an impact on the country's economic and tourism growth.

Mexico is a country rich in gastronomic diversity; its 32 States show that the offer of typical dishes is vast; cultural richness through cuisine in Mexico is the focus of the research project.

Traditional Mexican food has been recognised by UNESCO as intangible cultural heritage of humanity. The criteria considered by the World Heritage Committee to make this declaration were several: antiquity of our cuisine, continuity and permanence to the present day; geographical coverage and population coverage; daily character and festive character.

UNESCO (United Nations Educational, Scientific and Cultural Organisation) recognises traditional Mexican food as Intangible Cultural Heritage of Humanity; this has not really been an isolated case, but rather a long-awaited event. Gastronomic tourism in Mexico is on an upward trend.

The representative dishes are categorised according to the time of consumption at the table. First are the starters and soups, made up of 14 recipes which are: Baked artichokes, Fried ashes, Sweated mushrooms, Stuffed cactus, Potatoes with cactus and charales, Stuffed maguey stalk, Quelites (rabito, turnip, quintonil), Quesadillas with squash blossom, Corn soup, Mushroom soup, Mushroom soup (clavitos), Tortilla soup, Gualumbo tacos and Tamales de elote. The second category is the main courses, made up of 31 representative recipes: Caldo de pescado, Carne de puerco en salsa verde con ciruelas, Carne de puerco entomatado, Cenizos en mole rojo, Cenizos en salsa verde, Chiles rellenos, Coliflor capeada, Enchiladas verdes, Enfrijoladas con huevo y chorizo, Flor de colorín en pipián, Migas con huevo, Mole de guajolote, Mole rojo, Mole rojo de colorines, Mole con guajolote, Pipián, Chicken in calabacitas, Pozole rojo, Revoltijo, Tamal de chícharo, Tamal nejo con ceniza de encino, Tamal nejo de frijol, Tamal nejo de ejote, Tamales de ceniza con carne de puerco, Tortas enchiladas, Tortitas de quintonil, Trucha a las brasas, Trucha al cilantro, Trucha arcoíris, Trucha empapelada con verduras and Trucha empapelada con habas frescas. The third category is made up of 4 sauce recipes: Salsa de guajillo, Salsa martajada, Salsa roja en molcajete and Salsa verde. Then we have desserts, made up of 6 representative recipes: Ate de membrillo, Capultamal, Chilacayote dulce azul, Chilacayote dulce (white), Pan de muerto and Tamales agrios. And finally, the categorisation of drinks is shown, made up of 8 representative recipes: Atole agrio, Atole agrio 2, Atole de maíz caliente, Atole de masa de chocolate, Atole de masa con piloncillo, Atole de pinole, Atole de zarzamora and the Sende.

The preceding quotation tells the value of the traditional gastronomy of Valle de Bravo; a master's thesis work, about ‘what the people of Valle de Bravo eat and drink’. A first approach to get to know what is consumed in the municipality, and the points that offer these foods in order to place them within the gastronomic tourist route. Although it is true that Valle de Bravo does not have representative dishes and beverages of the region, like other tourist sites par excellence, it does have a variety of dishes that belong to traditional Mexican cuisine.

There is currently no gastronomic tourist route in the municipality of Valle de Bravo; for this reason, the proposal is to design a gastronomic tourist route of regional food in the municipality of Valle de Bravo, State of Mexico, Mexico, which promotes gastronomic tourism, generating income for the local population. The tactics to achieve the main objective of this Route; in the first instance, the Route has been marked using the Global Positioning System (GPS), and plotted with Google Earth for greater certainty in the layout of the Route; visits have been carried out as field work, to the places where these Mexican dishes are offered. Market research has been carried out to determine the marketing feasibility, which forms part of the basis for the financial feasibility of the project.

Design a Social Media marketing as a tool to promote the Route, with content marketing designed with digital applications (Piktochart, Venngage, PicsArt) and image banks (Pixabay, Freepik, Unsplash, Pexels). The realisation of the project assumes that the people involved in the offer of the Route, know the history and culture of each dish and drink that they market; it is not only to sell a product but to know information about them to be able to 'sell' it in an effective way to the tourist, or a specific market segment.

Definition of the problem

There is currently no gastronomic route in the municipality of Valle de Bravo, State of Mexico, Mexico, which has been designed with the intention of promoting gastronomic tourism and generating economic revenue. In addition to the fact that in Valle de Bravo there is the problem that some locals do not know the gastronomic culture of the place, therefore they lack information and tourists visit the establishments and do not know about the popular dishes: cecina, barbacoa, birria, mole de guajolote, steamed pork carnitas, trout, artisan bread, campechanas. Drinks include: sambumbia, pulque and liqueurs (blackberry, anise, guava and quince). There are also people who have adapted other types of food establishments such as: sushi, pizzas, Arabic and Chinese food; this causes the loss of our culture, causing Mexican tourism to deteriorate and because of the situation, other types of tourists are attracted, where the importance of regional food is reduced, and popularity is given to the aforementioned establishments.

Hypothesis

The main purpose of the Gastronomic Tourist Route is to promote and increase gastronomic tourism in the municipality of Valle de Bravo, State of Mexico, Mexico, as well as to improve the economy, to invite tourists to visit places of typical regional food and to go on tours on our Gastronomic Tourist Route. It is essential that this Gastronomic Tourist Route is toured so that visitors consume typical regional food and focus their attention on typical food establishments in Valle de Bravo.

Methodology

The methodology implemented by the project is quantitative (market research and a market survey are carried out), qualitative (focus groups are carried out), and descriptive (the facts and elements representing the project and the layout of the Route are described); it has a reflective socio-critical/critical paradigm (the subject constructs his/her reality from his/her perspective, and transforms it as an active and creative subject).

Quantitative research.

It is a structured way of collecting and analysing data obtained from different sources, which involves the use of computer tools, statistics and mathematics to obtain results. It is conclusive in its purpose as it tries to quantify the problem and understand how widespread it is by seeking results that can be projected to a larger population.

A first reconnaissance is carried out on the route that should be implemented in the tourist route in the municipality of Valle de Bravo. Quantitative research was carried out through a market research and a market survey; to know the perspectives of the market segment according to the tourist route; the results obtained were positive, revealing that the project is profitable and feasible. The market research is carried out through Google Forms, by Google Drive, with a previously determined market segmentation; with sample size calculated in a specific way; with a minimum margin of error and a significant level of confidence. Also a market survey in Valle de Bravo as a general and representative universe. The methodology is quantitative due to the use of surveys, but this is not the only instrument used to collect information, there are other instruments implemented such as: leading questionnaire, observation and interview.

For the collection of information, the market research methodology of Miguel Santesmases Mestre is followed.

1. Research design (identification of the problem to be investigated; determination of the type of research design; specification of the study hypotheses; definition, classification and measurement of the study variables).

2. Data collection (selection of the sources of information; determination of the ways of obtaining information; design and selection of the sample, if applicable; data collection).

3. Data processing and analysis (editing and recording of data; tabulation of results; application of statistical analysis techniques).

4. Interpretation of the results and presentation of conclusions (drafting of the general report; presentation).

Miguel Santesmases Mestre's methodology provided the guidelines for carrying out the market research of the project, as well as the market survey.

Qualitative research.

It can be concluded that qualitative research is generally used in the analysis of social sciences, being a methodological process that uses words, texts, speeches, drawings, graphs and images (qualitative data) as tools to understand social life by means of meanings, from a holistic vision, that is to say that it tries to understand the set of qualities that, when related, produce a determined phenomenon. According to Orozco 1997, quantitative and qualitative methods are not compatible from an epistemological point of view, however, they can be complementary, and there is an aspiration among social scientists to have an integrated quantitative and qualitative research.

The qualitative methodology consisted essentially of focus groups carried out with the people involved in the development of the tourist route; owners and employees of the food establishments along the route.

Descriptive research

Descriptive research aims to describe some fundamental characteristics of homogeneous sets of phenomena, using systematic criteria that make it possible to establish the structure or behaviour of the phenomena under study, providing information that is systematic and comparable with that from other sources. The researcher can choose to be a complete observer, a participant observer, a participant observer or a complete participant.

The descriptive methodology allowed the development of the Tourist Route, as it describes the route that was carried out (with coordinates). Subsequently, the data is fed into Google Earth for satellite marking of the route, in order to obtain the layout of the route.

The Critical Paradigm enjoys a qualitative approach with interpretative connotations that allow for an in-depth investigation from a holistic perspective, taking into account the significance of the real context in which it is framed (YIN, 1987). Although it is not easy to combine the diversity of criteria to be taken into account, it is a valuable option in research.

The socio-critical/critical reflective paradigm is used (the individual constructs his or her reality, and from it transforms it as a creative critical reflective subject). The subjects create their reality, situate themselves in it, and from it they are capable of transforming it as creative critical reflective subjects.

Results

Mapping of the Gastronomic Tourist Route: regional food in the municipality of Valle de Bravo, State of Mexico, Mexico.

The gastronomy of Valle de Bravo has favoured economic development in an important way for this municipality. The route was traced out; it took approximately eight hours to travel around and mark the establishments, which were then marked on Google Earth: Google Earth.

- The first and starting point of the gastronomic tourist route was the ‘Birria Erasmo’. Coordinates: N 19°13.32‘ W 100°07.47’. This restaurant is renowned in the region for the sale of the typical Mexican dish: birria.

- Point number two. Coordinates: N 19°13.466‘ W 100°07.824’. Elevation: 1,828 metres. ‘Carnitas El Bolillo. Restaurant renowned in the region for the sale of pork carnitas.

- Point number three. Coordinates: N 19°11'37‘ W 100°08'04’. Elevation: 1,836 metres. ‘Los Portales, Antojitos Mexicanos. It is well known among locals and tourists, among the antojitos you can find a variety of typical food (tacos, pambazos, enchiladas, tostadas and pozole).

- Point number four. Coordinates: N 19°11'39‘ W 100°07'42’. Elevation: 1,838 metres. ‘La Herencia Restaurant. Traditional Mexican restaurant selling typical regional and Mexican food.

- Point number five. Coordinates: N 19°11'19‘ W 100°07'47’. Elevation: 1,840 metres. ‘Lagartos Bar Restaurant. Restaurant positioned among local people and tourists, varied food.

- Point number six. Coordinates: N 19°11'18’ W 100°07'58°. Elevation: 1.8425 metres. ‘La Balsa Restaurant. Seafood, renowned for its quality cuisine.

- Point number seven. Coordinates: N 19°11'23‘ W 100°07'53’. Elevation: 1,825 metres. ‘El Paraíso Restaurant. Varied food and well known by locals and tourists.

- Point number eight. Coordinates: N 19°11'23‘ W 100°07'52’. Elevation: 1,826 metres. ‘Handmade ice cream’. The route includes not only food, but also desserts and snacks.

- Point number nine. N 10°11'37‘ W 100°07'55’. Elevation: 1,836 metres. ‘Helados La Michoacana’. Traditional Vallesan ice cream shop, located in front of the Vallesan central garden.

- Point number ten. Coordinates: N 19°11'37‘ W 100°07'54’. Elevation: 1.838 metres ‘Restaurante Alma Edith’. Traditional in Valle de Bravo, food: antojitos mexicanos.

- Point number eleven. Coordinates: N 19°11'38‘ W 100°07'56’. Elevation: 1,838 metres. ‘Callejón de los esquites’ and “Callejón del hambre”. Traditional Vallesan site selling products derived from corn (elote), and assorted tacos.

- Point number twelve. Coordinates: N 19°11'39‘ W 100°07'55’. Elevation: 1,838 metres. ‘Campechanas atole y tamales’. In the centre of Valle de Bravo.

- Point number thirteen. Coordinates: N 19°11'39‘ W 100°07'52’. Elevation: 1,838 metres. ‘Food from the Municipal Market. This has a variety of typical food; in addition, the cecina vallesana is found there.

Box 1

Figure 1

Marking of the Gastronomic Tourist Route: regional food in the municipality of Valle de Bravo, State of Mexico, Mexico

Source: own elaboration

.

Conduct a market survey through Google Forms by Google Drive, for some States of the Mexican Republic as a market segment.

Target market. In the first instance, the municipality of Valle de Bravo, State of Mexico for the purposes of local market survey (market survey); and the real target market, some States of the Mexican Republic.

Market segmentation. Men and women between the ages of 22 and 55, socio-economic level C-, D+, D; education level indistinct, nationality indistinct, who wish to go on a gastronomic tourist route, and who wish to experience convivial tourism (rural tourism approach).

Sample size. It is based on the principle of equiprobability, which means that all individuals in the selected sample will have the same probability of being chosen. This ensures that the sample drawn will be representative. The sample size is calculated, knowing the size of the unsegmented population, since we have statistical data provided by the National Institute of Statistics and Geography (INEGI). Market research States of the Mexican Republic.

Sample size calculation for the market segment, when the size of the segmented population is not known, or the size of the unsegmented population is known. In the intercensal survey 2020, conducted by the National Institute of Statistics and Geography (INEGI), 126 million 014 thousand 024 inhabitants were counted in the Mexican Republic; but the size of the target market population is not known. With a margin of error of 3%. No knowledge of the size of the population. Confidence level of 95%. Sample size: 1068 surveys (1,164 surveys were carried out because the system is closed and the calculation is not exact; in reality the surplus of data is not a problem, the problem is that fewer surveys were carried out).

Results of the surveys applied in the market research, to the States of the Mexican Republic.

1. How old are you?
a) 20-30 years old: 52.2 %.
b) 30-40 years old: 40.4%.
c) 40-50 years old: 7.4%.

2. What is your place of residence?
a) Mexico City: 8.6%.
b) Toluca: 12.1%.
c) Other: 79.3%.

3. How many times have you tried typical Mexican food in Valle de Bravo, State of Mexico?
a) 2-3 times: 50.3%.
b) 4-6 times: 22.9%.
c) Almost always: 26.8%.

4. Do you know what is the typical dish of the region?
a) Yes: 37.6%.
b) No: 29.9%.
c) Maybe: 32.5%.

5. Have you ever heard of typical Mexican dishes in Valle de Bravo?
a) Cecina vallesana: 32.8%.
b) Barbacoa: 33.9%.
c) Birria: 27.2%.
d) Mole de guajolote: 4.3%.
e) Variety of trout: 1.8%.

6. Choose the drinks you have consumed in Valle de Bravo.
a) Sambumbia: 15.9%.
b) Pulque: 25.1%.
c) Licor de zarza: 23.8%.
d) Quince liqueur: 19.5%.
e) Sendel: 4.3%.
f) Other: 11.4%.

7. Where do you usually enjoy any of these dishes and drinks?
a) At home: 21.0%.
b) In a restaurant: 23.3%.
c) In a restaurant: 31%.
d) In a café: 8.5%.
e) In a stall/on the street: 16.2%.

8. How much would you be willing to pay for the Gastronomic Tourist Route?
a) $100.00 - $200.00: 17.2%.
b) $200.00 - $300.00: 35.8%.
c) $300.00 - $400.00: 25.9%.
d) Other amount: 21.1%.

9. How much time would you spend on the Gastronomic Tourist Route?
a) One to two hours: 34.4%.
b) Between two and three hours: 51.8%.
c) More than three hours: 13.8%.

10. How would you like to travel along the Tourist Route?
a) Walking: 45.7%.
b) By car: 40.7%.
c) Other: 13.6%.

Market survey, for the municipality of Valle de Bravo.

Sample size calculation for the market segment, when the size of the segmented population is not known, or the size of the unsegmented population is known. In the intercensal survey 2020, conducted by the National Institute of Statistics and Geography (INEGI), 61,590 were counted in the municipality of Valle de Bravo, but the size of the target market population is not known. With a margin of error of 10%. No knowledge of the size of the population. Confidence level of 95%. Sample size: 96 surveys.

Instrument with results of the market survey in the municipality of Valle de Bravo.

1. How old are you?
a) 20-35 years old: 52.1%.
b) 35-40 years old: 26%.
c) More than 40 years old: 21.9%.

2. Do you have any knowledge of what a Gastronomic Tourist Route is?
a) Yes: 39%.
b) No: 34%.
c) Maybe: 27%.

3. What benefits does a Gastronomic Tourist Route bring to the region that promotes it?
a) Economic growth: 37.5%.
b) Generates jobs: 23.95%.
c) Attracts gastronomic tourists: 19.8%.
d) Increased competitiveness between establishments: 18.75%.

4. Do you know what is a typical dish of the region?
a) Yes: 57.3%.
b) No: 23.95%.
c) Maybe: 18.75%.

5. Which of these dishes is the most important in Valle de Bravo, according to your perspective?
a) Cecina vallesana: 44.8%.
b) Barbacoa: 31.25%.
c) Birria 7.30%.
d) Mole de guajolote 6.25%.
e) Variety of trout: 5.2%.
f) Artichoke with four cheeses: 5.2%.

6. Which of these foods is the most important one in Valle de Bravo?
a) Esquites/elote: 20.8%.
b) Tacos (adobada, pastor, chorizo, tripa, lengua and cabeza): 13.5%.
c) Pork carnitas: 17.7%.
d) Pozole, enchiladas, quesadillas, tostadas and sopes: 12.5 %.
e) Buñuelos: 6.25 %.
f) Campechanas: 10.4 %.
g) Atoles and tamales: 8.45 %.
h) Snowflakes with traditional regional flavours: 10.4%.

7. Are the dishes made by you from scratch or are they bought when you eat them?
a) Yes: 83.3%.
b) No: 16.7%.

8. Which of these drinks is considered the most important in Valle de Bravo?
a) Sambumbia: 70.8%.
b) Pulque: 10.4%.
c) Licor de zarza: 7.3%.
d) Quince liqueur: 6.3%.
e) Sendel: 5.2%.

f) Mosquito: 0%.

9. Would you be willing to buy any of these dishes and drinks on the Gastronomic Tourist Route?
a) Yes: 100%.
b) No: 0%.

10. Do you think that gastronomic tourism is important for the economic development of the region?
a) Yes: 94.8%.
b) No: 5.2%.

Discussion

The results obtained in the previous section show that the commercialisation of the tourist route is feasible, although the financial calculations, which were also encouraging, are not mentioned.

Conclusions

It could be mentioned that within the Bachelor's Degree in Tourism of the Tecnológico de Estudios Superiores de Valle de Bravo, various Tourist Routes are being developed: 'Trout Tourist Route, in the municipality of Amanalco, State of Mexico, Mexico', which is currently being marketed successfully. The 'Mushroom Route in the municipality of Amanalco, State of Mexico, Mexico', which is also being marketed by the students who have developed the project. There are two more routes that are ready to be marketed in the municipality of Donato Guerra: 'Route of Mazahua Handicrafts in the towns of San Simón and San Antonio de La Laguna in the municipality of Donato Guerra, State of Mexico, Mexico' and the 'Route of the Monarch Butterfly, in the municipality of Donato Guerra, State of Mexico, Mexico'; these last two routes are the result of theses of the Bachelor's Degree in Tourism. The tourist route under study in this research project is also the development of a thesis.

Declarations

Conflict of interest

The authors declare that they have no conflict of interest. They have no financial interests or personal relationships that could have influenced this book.

Authors' contribution

Mandujano, De los Santos Ariadna: with the formulation of the research project and the design of the methodology.
Echavarría, Gudiño Héctor: Contributed with support in the methodological process.

Guerrero, Alonso Araceli: Contributing to the process of mapping the route.

Santos, García Adrián: Contributes with support in the methodological design.

Availability of data and materials
All data and information presented in this research are available in the references.

Funding
This research did not require funding.

Acknowledgements

The authors declare that this research did not receive any type of funding from any public or private institution, but did receive support from the authorities of the communities and ejidos located along the route.

Abbreviations

INEGI National Institute of Statistics, Geography and Informatics

References

Background

AMAI, A. M. (2024). Retrieved from https://www.amai.org/NSE/index.php?queVeo=niveles

Mexico, G. d. (2024). Retrieved from https://www.gob.mx/sectur/articulos/gastronomia-mexicana

Neill, D. A. (2018). Processes and Foundations of Scientific Inquiry. *Procesos y Fundamentos de la Investigación Científica, Jorge Maza Córdova*, 125. UTMACH. https://doi:978-9942-24-093-4

Basics

Alban, G. P. (01 July 2020). *Educational research methodologies (descriptive, experimental, participatory, and action research)*, 163-173. Ecuador: Reci mundo Revista Científica Mundo de la Investigación y el COnocimiento. https://doi:10.26820/recimundo/4.(3).julio.2020.163-173.

INEGI, I. N. (2020). Main results, Census of population and housing 2020. Retrieved from https://www.inegi.org.mx/contenidos/productos/prod_serv/contenidos/espanol/bvinegi/productos/nueva_estruc/702825198060.pdf

Lorenzo, C. R. (2006). *Contribution on research paradigms, 31(1)*. Santa Maria, Brazil: Universidade Federal de Santa Maria. Retrieved April 15, 2023, from https://www.redalyc.org/pdf/1171/117117257002.pdf

Miguel Santesmases Mestre, A. S. (2014). *Fundamentals of Marketing.* (J. E. Callejas, Ed.) Mexico City, Mexico: Grupo Editorial PATRIA.

Support.

Gómez, G. O. (1997). *La Investigación en comunicación desde la perspectiva cuantitativa*. Mexico, La Investigación en comunicación desde la: Universidad Nacional de la Plata. Retrieved on April 15, 2023, from https://www.redalyc.org/pdf/2631/263153520009.pdf

Discussions

Bustamante, L. D. (23 September 2023). Puesta en valor de la gastronomía tradicional de Valle de Bravo. Mexico: Universidad Autónoma del Estado de México. Retrieved from http://ri.uaemex.mx/handle/20.500.11799/140380

Iturriaga, J. (2023). La Cocina Tradicional Mexicana: Patrimonio Cultural de la Humanidad. *Patrimonio: Economía Cultural y Educación para la paz., 1*(23). Retrieved from http://www.mec-edupaz.unam.mx/index.php/mecedupaz/article/view/77933

Morphological exploration of edible mushrooms from Monte Alto, Valle de Bravo, Mexico and their relationship with local culinary practices

Exploración morfológica de los hongos comestibles de Monte Alto, Valle de Bravo, México y su relación con las prácticas culinarias locales

Santillán-Álvarez, Ángel*[a], Morachis-Valdez, Ana Gabriela[b], Saucedo-Vence, Karinne[c] and Dublán-García, Octavio[d]

[a] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • LUZ-7573-2024 • 0000-0002-8201-1437 • 481406
[b] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • LUZ-7642-2024 • 0000-0001-6270-4757 • 369317
[c] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • LVS-7593-2024 • 0000-0002-4700-2033 • 370447
[d] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • D-3221-2016 • 0000-0001-6264-2912 • 36251

CONAHCYT classification **DOI:** https://doi.org/10.35429/H.2024.17.42.55

Area: Social Sciences
Field: Business and Administration
Discipline: Administration and Management
Sub-discipline: Business Administration

Key Handbooks

The main contributions to the generation of science and technology presented in this paper lie in the morphological characterization of edible wild mushrooms, which contributes significantly to the scientific knowledge of the biodiversity of edible macromycetes in the region of Monte Alto, Valle de Bravo, Mexico. This analysis not only represents an advance in the fields of mycology and gastronomy, but also provides detailed information on traditional harvesting practices and various forms of culinary preparation. These data are fundamental for the development of sustainable harvesting protocols and the responsible use of these species. In addition, it highlights the economic potential of mushroom collecting as a tourist resource, and the importance of collecting and preserving the traditional knowledge of collectors, facilitating the intergenerational transmission of local knowledge and its integration with scientific advances.In order to apply the knowledge generated, it is essential to validate traditional practices through scientific methods, guaranteeing their safety and effectiveness. Likewise, it is a priority to promote ecologically responsible harvesting practices that prevent overexploitation, possibly through the implementation of regulated mycological routes. The results obtained could be a replicable and adaptable model for other communities that depend economically or for food on macromycetes, considering their specific cultural and geographic context. The authors of this document are part of the National System of Researchers (SNI) as candidates and researchers recognized by CONAHCYT, and three of them also have PRODEP recognition. The participating institutions include the Tecnológico Nacional de México (TecNM), the Tecnológico de Estudios Superiores de Valle de Bravo (TESVB), the Universidad Autónoma del Estado de México (UAEMéx) and the Universidad Tecnológica del Valle de Toluca (UTVT), all public institutions of higher education.

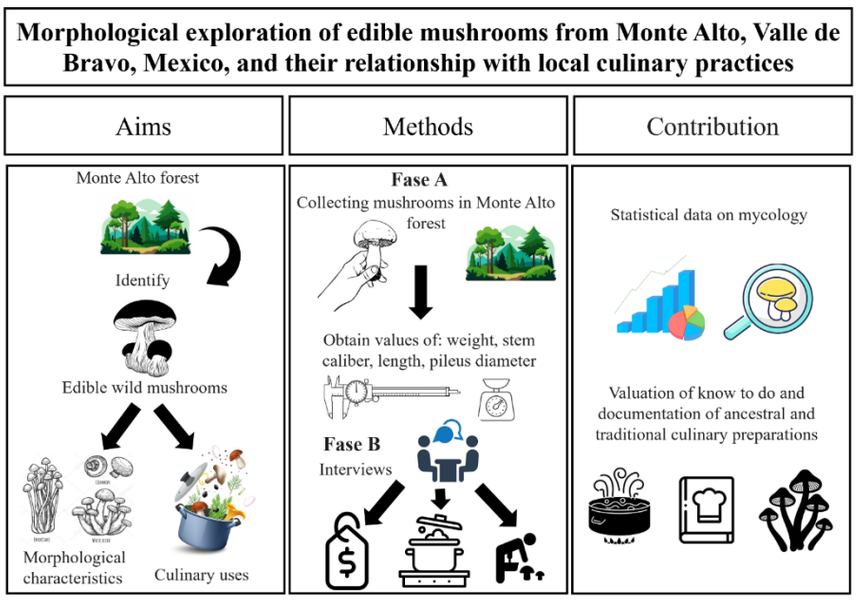
Citation: Santillán-Álvarez, Ángel, Morachis-Valdez, Ana Gabriela, Saucedo-Vence, Karinne and Dublán-García, Octavio. Morphological exploration of edible mushrooms from Monte Alto, Valle de Bravo, Mexico and their relationship with local culinary practices. 42-55. ECORFAN.

* ✉ angel.sa@vbravo.tecnm.mx

Handbook shelf URL: https://www.ecorfan.org/handbooks.php

Abstract

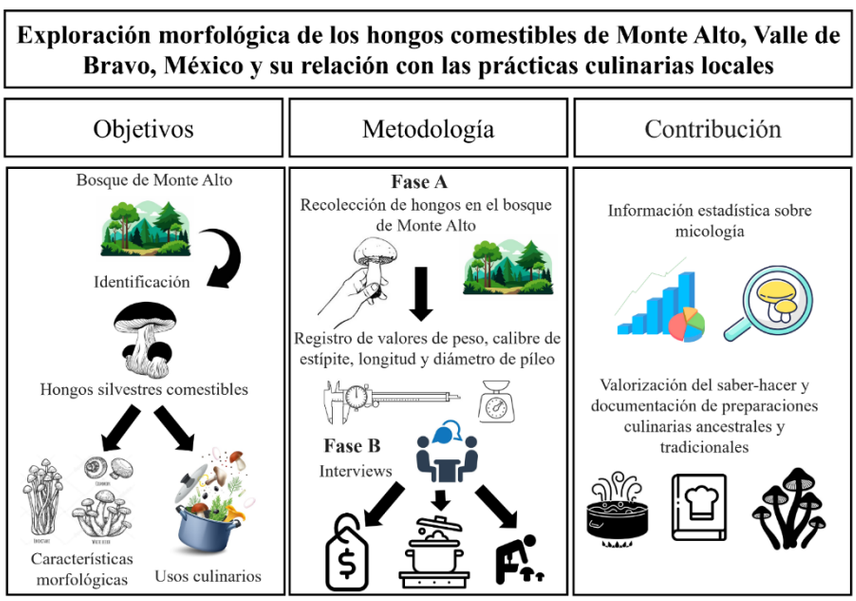
The aim of this study was to morphologically characterize the wild edible mushrooms of Monte Alto, Valle de Bravo, showing a relationship between this process, collection practices, and their culinary uses within the community. A mixed-methods approach was employed in two phases: the first involved showing areas of interest within forested regions, collecting specimens, and conducting morphological analyses; the second phase consisted of interviews with collectors and a description of the primary consumption methods. Eleven edible mushroom species and approximately 30 culinary preparations were found. Mushroom collection requires specialized knowledge due to the risk of toxicity, emphasizing the importance of preserving and transmitting traditional knowledge about shapes, names, and colors. Additionally, a significant economic potential was found, with prices ranging from 50 to 350 Mexican pesos per 200 grams, suggesting opportunities for tourism through regulated mycological reserves, thereby fostering a synergy between sustainability, local knowledge, and economic development.



Edible wild mushrooms, morphological characteristics, Valle de Bravo, know to do

Resumen

El objetivo del estudio fue caracterizar morfológicamente los hongos silvestres comestibles de Monte Alto, Valle de Bravo, estableciendo una relación entre este proceso, las prácticas de recolección y sus usos culinarios en la comunidad. Se utilizó una metodología mixta en dos fases: la primera incluyó la identificación de zonas boscosas de interés, la recolección de especímenes y su análisis morfológico; la segunda consistió en entrevistas a recolectores y la descripción de las principales formas de consumo. Se identificaron 11 especies de hongos comestibles y alrededor de 30 preparaciones culinarias. La recolección exige conocimientos especializados debido al riesgo de toxicidad, destacando la importancia de preservar y transmitir saberes tradicionales sobre formas, nombres y colores. Además, se identificó un potencial económico significativo, con precios que oscilan entre 50 y 350 pesos por 200 g, sugiriendo oportunidades turísticas mediante cotos micológicos regulados, promoviendo así una sinergia entre sostenibilidad, conocimiento local y desarrollo económico.



Hongos silvestres comestibles, características morfológicas, Valle de Bravo, saber hacer

Introduction

Knowledge of the territory and the products found there is probably the result of generational transmission, but this is also part of the trial and error when starting to obtain resources, especially food resources, since traditional knowledge is a construction that is built up over the years (Noriero, Almanza, and Torres, 2012; Sharif, Zahari, Nor and Muhammad, 2016), this knowledge is inherited and is what today gives meaning to the traditional knowledge that allows traditional culinary preparations to remain in force.

The knowledge involved in culinary preparations is vital because without it, preparations such as those made with edible wild mushrooms could not be obtained, given that each region is different and the number of mushrooms changes due to geographical conditions, the knowledge of the inhabitants of each region becomes relevant (Burrola-Aguilar, Montiel, Garibay-Orijel and Zizumbo-Villarreal 2012; Noriero, Almanza, and Torres, 2012), since without this knowledge, a person who does not know how to identify these products can suffer some type of intoxication, in the understanding that although all mushrooms can be ingested, there are some that cause health problems.

It should be noted that traditional knowledge and its transmission have been affected due to the current problems in forested areas: excessive logging, increase in armed groups, migration, change in land use and climate change (Thomé-Ortiz, 2016), so keeping tradition alive, particularly the collection and consumption of mushrooms in rural areas, has become a task that requires interdisciplinary work and with society, generating actions that promote territorial revaluation and, perhaps, become a source of income that allows the territory to be revitalised in different ways.

In this sense, the objective of the work focused on morphologically characterising the wild mushrooms of Monte Alto, with the aim of identifying and linking this process to the forms of collection and culinary uses. Knowing the diversity of mushrooms and their physical characteristics can be a valuable source of information both for the inhabitants of the region and for people who wish to learn more about culinary diversity, in addition to the fact that having an accurate record of some wild mushrooms contributes to the transmission of knowledge.

The collection of wild mushrooms is not exclusive to Monte Alto, Mexico is a country with a wide diversity of these products, so knowing their characteristics and uses is a way of making these varieties known, but at the same time it shows the complexity of each territory, the problems they face and the solutions they have found to maintain the collection of mushrooms and their consumption.

Valle de Bravo and the Monte Alto reserve

Valle de Bravo is part of the 125 municipalities that make up the State of Mexico, a member of the Magical Towns programme since 2005, its original name was Pameje (hot springs well) (Benítez Reyna, 2017), of Mazahua origin, which changed during the early colonial period when it received the title of San Francisco del Valle de Temascaltepec, then during the second half of the nineteenth century, it adopted its current name in honour of General Nicolás Bravo, (Gobierno del Estado de México, 2017; Secretary of Tourism, 2021).

With a temperate climate all year round, the temperature generally varies from 6 °C to 28 °C and rarely drops below 3 °C or rises above 30 °C, and a characteristic mesophilic mountain forest, also called cloud forest, are the winter refuge of the monarch butterfly and because of the particularity of the forest, it has the ideal characteristics for the growth of organisms of the fungi kingdom, during the rainy season.

Within the forested areas of the municipality, one that stands out is the area that makes up the Monte Alto National Park, characterised by the presence of pines and oaks, the dominant population of trees, which associated with the fungi that grow there, achieve a symbiosis called mycorrhiza, which is decisive in the degradation and incorporation of organic materials into the soil, facilitating the absorption of nutrients from the soil through the roots of the trees.

The area comprising the forested area is 476.00 hectares, making the diversity of wild mushrooms (edible and inedible), which grow in the rainy season, abundant (López-Pérez, *et al.*, 2011; Gaceta del Gobierno del Estado de México, 2012; Weather Spark, 2022; CEPANAF, 2022).

The rainy season in the valley presents a high variation, and its duration has an average of 6.1 months, from May to November (Weather Spark, 2021), a characteristic that favours the variety and growth of edible and inedible wild mushrooms, their growth contributes to the enrichment of the forest and their collection is part of the cultural-gastronomic tradition of Mexico, which in turn provides an economic benefit for the inhabitants of the territory.

Wild mushrooms as a non-timber forest resource are highly valued as food, but poisoning by ingestion without identification or knowledge has increased. These types of organisms are mistakenly identified as plants that do not contain chlorophyll, however their origin is more closely related to animals than to plants (Boa, 2005); their intensive harvesting in various regions of Mexico and the world during the rainy season is carried out both for self-consumption and for commercialisation, as they constitute an important protein supplement in the diet and their economic importance lies in obtaining a monetary benefit when sold, without leaving aside the cultural relevance they represent for society (Ruan-Soto *et al*, 2021; Ruan-Soto, 2018).

It is estimated that there are between 53 000 and 110 000 species of macromycetes in the world, and although some are toxic, others are edible and highly nutritious, providing a high protein content that can range from 0.81 to 1.8 g of crude protein, depending on the variety, and up to 2 g of crude fibre (Frutis Molina and Valenzuela, 2009; Cano-Estrada and Romero Bautista, 2016).

To date, there are records of the gastronomic use of mushrooms from around 370 species of edible wild mushrooms, which shows the importance of these products in the gastronomy of multiple cultures throughout the Mexican Republic (Díaz-Cano, 2016).

In Mexico, the tradition of eating mushrooms dates back to pre-Hispanic times (Morales-Díaz, 1998). The indigenous and mestizo communities living in the cold and temperate forests of Mexico have known about mushrooms and their varieties since pre-Hispanic times, and have known how to collect and differentiate them. The edible ones have been part of their daily diet and the inedible ones, called hallucinogens in some regions, are used in religious ceremonies (Huerta Guzmán, 1977).

In Valle de Bravo, Monte Alto State Park (See Figure 01. Geographical location of Monte Alto State Park, Valle de Bravo), is a state forest reserve, where every year locals hike to collect wild edible mushrooms, however studies in Mexico have reported the ravages on the forest and trees caused by climate change (Méndez Encina *et al.*, 2020), which directly affects the growth of edible mushrooms, so that in recent years, their development has decreased significantly, according to what collectors say; in addition to the above there are other factors that contribute to reducing the growth of fungal organisms in the Monte Alto area such as: clandestine logging, irregular human settlements, the practice of fires, as well as pests and diseases (Cárcamo-Solís, Juárez-Sánchez and Ortega-Hernández, 2013; Méndez Encina *et al.* , 2020)

Grouping of fungi that develop fruiting bodies of more than 1 mm in length and are visible, where edible, toxic and medicinal fungi are recorded).

Box 1

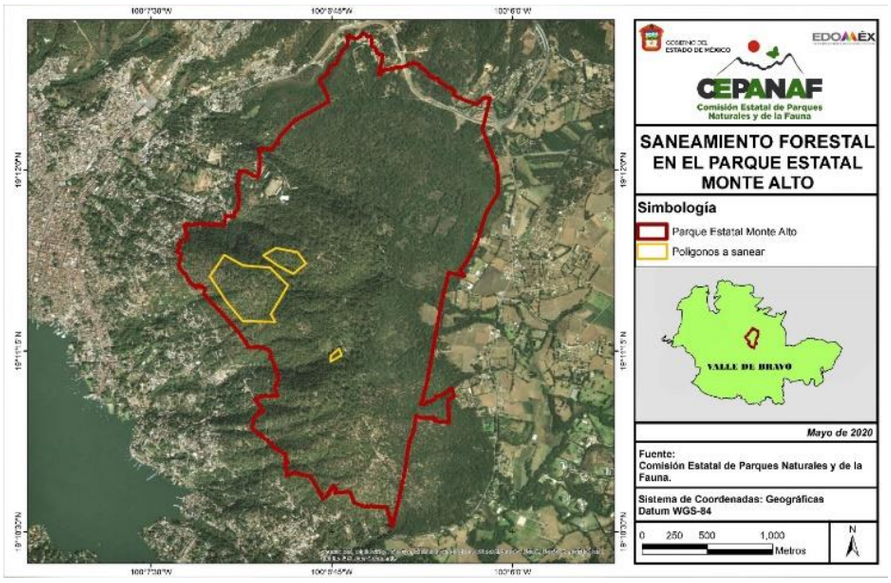


Figure 1

Geographical location of Monte Alto State Park, Valle de Bravo

Source CEPANAF, 2020 [22]

On the other hand, in Monte Alto State Park, although it is well signposted and has well-defined trails, the collecting areas are located only by the expert collectors, who identify the problems mentioned, such as the felling of trees or areas burnt by fires, which prevent the growth of the mushrooms and therefore the number of organisms collected is lower than the previous year. Therefore, it is important to take care of the forests, as well as to educate collectors and tourists about the correct way of collecting and identifying edible wild mushrooms, so that they can be collected in a way that allows the natural dissemination of spores and so that non-expert collectors (tourists), based on the physical characteristics of the mushrooms, can identify those that are not toxic and identify the traditional forms of culinary preparation in the region of Valle de Bravo.

Methodology

For the elaboration of the study, a mixed methodology was chosen, considering a particular territory where the know-how, the products, the people and their eating behaviour (Torres, Sanz and Muchnik; Valencia-Echeverry, 2011), are relevant for the collection of wild edible mushrooms, with a cross-sectional type of study, given that this activity is not carried out throughout the year, while the mixed approach allowed us to complement the quantitative data obtained from the characterisation of the mushrooms with the qualitative data from the interviews (Hernández, Fernández and Baptista, 2016).

Thus, the study was divided into two phases: in the first phase, the collection points of wild mushrooms were identified in the Municipality of Valle de Bravo, in the town of San Mateo Acatitlán, in the Monte Alto State Reserve (See Figure 01. Geographical location of the Monte Alto State Park, Valle de Bravo) where the organisms were also collected in triplicate, in two samplings between the months of June and October 2020.

For the morphological characterisation, the following parameters were taken as a basis: weight, foot size, cap length and diameter. A PCE-BSH 6000 precision balance was used to take the weights. A Westward vernier caliper, range 0 to 6 inches, accuracy range ± 0.001"/0.03mm, was used to determine the size and diameter of the cap. At the same time, a photographic record was taken of each sample using a Canon EOS Rebel T6 Reflex Camera, which was used due to its characteristics and the quality of the images it provides.

The statistical analysis of the results obtained was carried out based on an analysis of variance (ANOVA) to test the following hypotheses:

The null hypothesis is that all means are equal:

Ho= M1 = M2 = M3.... VS The alternative hypothesis (Ha) is that at least one mean is different from the others.
The null hypothesis (Ho) is rejected if the p value (p) is < 0.05.
Data analysis was performed using SPSS statistical software version 25.3.1.1.5.

The second phase of the study included the interview of 5 mushroom pickers, where data were obtained such as: the culinary preparations, the ways in which they are identified and the selling price, it is necessary to clarify that the interviewees in addition to having a role as pickers are also involved in the sale of mushrooms.

Results and discussion

A. Morphological characteristics of mushrooms

The sites identified for collecting within the Monte Alto State Reserve were 4: Plan, Mesa de Capulín, La Hojarasca and La Piedra del Muerto. In *Table 01. Fungi collected and their identification key*, the organisms collected are listed. It should be noted that they are part of the organisms that can be found according to the harvesting season, so it is an approach to the edible mushrooms of the Valle de Bravo area. Since the present work stems from the undergraduate thesis Characterisation and gastronomic uses of edible mushrooms from the Valle de Bravo region, which was presented as a degree thesis, it contains narrative descriptions of the collectors and some experiences of consumers, as well as the recipe book proposed as a result of the research.

Box 2

Table 1
Fungi collected and identification key

Hongo	Scientific name	Identification key
Witch-hazel or closed wild portobello	*Macrolepiota procera*	BSC
Witch or wild portobello open	*Macrolepiota procera*	BSA
Robellon mushroom/enchilado mushroom	*Lactarius aff. deliciosus L. Gray*	HR
Morel	*Morcella esculenta*	MO
Pancitas	*Boletus aurantiacus*	PAN
Peach	*Contharellus cibarius*	DU
Gachupín/false morel	*Helvella lacunosa*	GACH
Clavitos or piles	*Lyophyllum decastes*	CLA
Amarillitos yemitas con calzón	*Amanita caesaria*	ACC
Amarillitos yemitas without pants	*Amanita caesaria*	ASC
Amarillitos yemitas large without pants	*Amanita caesaria*	AGSC
Amarillitos yemitas comales	*Amanita caesaria*	ACOM

Own Source

The morphological characteristics of the mushrooms are given by their species, each one has dominant features and some of their properties could be measured in a similar way, as shown in *Table 02. Morphological characteristics of mushrooms Lepiota procera, Lactarius Delicius, Morcella esculenta Boletus aurantiacus, Contharellus cibarius and Helvella lacunosa, grouped by similar parameters*, where the height of the stem, the diameter of the cap (open or closed), the circumference and the weight were determined.

In the case of the brujas or wild portobellos (*macrolepiota procera*) as they are known in some parts of Mexico, they receive the name of apagador, matacandelas, sombrilla, galipierno, this in Spain (Sánchez Nova, 2019); when the píleo is still closed it presents a circumference of 13.91±3.41 cm, and when it is already open of 30.16±9. 94 cm, with weights of 42.5 g and 34.16 g, when the pileus is closed and when it is open correspondingly (see *Table No. 02. Morphological characteristics of mushrooms macrolepiota procera, Lactarius aff. deliciosus L. Gray, Morcella esculenta, Boletus aurantiacus, Contharellus cibarius and Helvella lacunosa, grouped by similar parameters*).

Box 3

Table 2

Morphological characteristics of macrolepiota procera, Lactarius aff. deliciosus L. Gray, Morcella esculenta, Boletus aurantiacus, Contharellus cibarius and Helvella lacunosa mushrooms, grouped by similar parameters.

Hongo	Thallus (cm)	Hat circumference (cm)	Weight
Witch-hazel or closed wild portobello	27.41±4.13	13.91±3.41	42.5±12.94
Witch or wild portobello open	19.08±0.58	30.16±9.94	34.16±5.85
Enchilado mushroom	4.2±1.04	22.3±2.52	51.7±12.58
Morel	5.2±0.76	14.8±4.2	61.7±22.5
Pancitas	8.1±1.73	26.4±3.61	85.6±13.23
Peach	5.5±0.50	16.2±3.1	66.7±16.07
Gachupín/false morel	7.3±1.53	6.7±0.58	16.7±7.64

Data are averages and standard deviation

According to Salazar-Vidal, Dibán and Ponce (2017), the procerous lepiotes studied in Chile have an umbonate pileus between 7 - 30 cm in diameter, ovoid when young (closed) and flattened-convex when mature (open), white to cream in colour, characteristics that are present in the mushrooms in the region of Valle de Bravo.

On the other hand, Ge, Yang and Vellinga (2010), mention that the mushrooms have a diameter between 40 and 160 mm when young, values similar to those found in this research (average 13.91 cm) and a stipe between 150 and 340 mm long, where the value found for the brujas of Valle de Bravo also corresponds (27.41 cm average).

Morels, or morel mushrooms (*Morchella esculenta*) as they are known in the region of Valle de Bravo, belong to the ascomycetes with alveolate apothecia, with an average stem or foot length of 5.2 cm and an average circumference of 14.8 cm (see *Table 02). Morphological characteristics of fungi macrolepiota procera, Lactarius aff. deliciosus L. Gray, Morcella esculenta, Boletus aurantiacus, Contharellus cibarius and Helvella lacunosa, grouped by similar parameters*), characteristics that differ from those found by Carrillo (2007), for this variety, where he mentions having a width between 3 to 5 cm in the apothecium and a total height of between 5 and 10 cm.

Among the organisms analysed, we also found the enchilada mushrooms (*Lactarius delicious*), the common name given to them in the region; although the *lactarius delicius* are edible, the majority of the species of this mycorrhizal genus are toxic and have an unpleasant taste. Carrillo (2007), hence the importance of identifying exactly which are the enchilada mushrooms, characterised by having an orange-saffron coloured pileus, with the appearance of a funnel.

Mushrooms of the genus amanita are classic macromycetes fungi, highly poisonous, with lethal toxins that destroy cells of the central nervous system, kidneys, liver and muscles Carrillo (2007), however, the *amanita caesaria* is an edible variety; the characteristics of this type of organism are spherical when they come out of the ground and form a reddish-yellow pileus with white blades when ripe. In the Valle de Bravo area, the volva of the mushroom is colloquially called ‘calzone’. When they are young, this volva is easily observed (see *Figure 2. Yemitas or amarillitos (Amanita Caesaria)).*

The morphological characteristics of *Amanita caesaria* depend on the degree of maturity, and the name given to them by collectors and settlers also depends on this, when they are young they are only called ‘yemitas’ and once they have reached maturity and the pileus is fully open they can be ‘amarillitos’, ‘tecomates’ or ‘quishimos’.

Box 4

Figure 2

Yemites (Amanita caesaria)

Own Source

The yemitas (Amanita caesaria) can have an average circumference of 11.86 cm and an average height of 9.5 cm, with a weight of 42.83 g; in contrast to when they are mature they can reach an average circumference of 14.33 cm, a height of 15.08 cm and a weight of 85.33 g, without the presence of the volva (see Table 03). Morphological characteristics of Amanita caesaria mushrooms in their various growth stages).

Box 5

Table 3

Morphological characteristics of Amanita caesaria mushrooms in their various growth phases

Hongo	Circumference (cm)	Height (cm)	Weight (g)
Witch-hazel or closed wild portobello	27.41±4.13	13.91±3.41	42.5±12.94
Witch or wild portobello open	19.08±0.58	30.16±9.94	34.16±5.85
Enchilado mushroom	4.2±1.04	22.3±2.52	51.7±12.58
Morel	5.2±0.76	14.8±4.2	61.7±22.5
Pancitas	8.1±1.73	26.4±3.61	85.6±13.23
Peach	5.5±0.50	16.2±3.1	66.7±16.07
Gachupín/false morel	7.3±1.53	6.7±0.58	16.7±7.64

Data are averages and standard deviation.

The *Lyophyllum decastes*, called cloves or mounds, due to the way they are grouped, were studied by group, not by individual organism. The average weight of the mushroom cluster (heap) is 163.5 grams, and the average number of mushrooms it can contain is 50 organisms (see *Table 04. Morphological characteristics of clavite mushrooms*); the macroscopic description of a species of *Lyophyllum* found in the Basque Country, *L. paelochroum Clémençon*, has a petiole between 2.5 and 6 cm in diameter and a stipe of between approximately 1.5 cm at the base. Their colouring is white, creamy white to beige, coinciding with the cloves collected in Monte Alto.

Box 6

Table 4

Morphological characteristics of clavite or pile mushrooms

Hongo	High of the heap (cm)	Width pile (cm)	Number of mushrooms per pile	Weight pile (g)
Nails or piles	7.25±2.16	15.91±2.85	50±5.48	163.5±54.97

Data are averages and standard deviation

On the other hand, the fungi Hypomyces lactifluorum and Lactarius indigo are among the most striking macromycetes, the former because of its size, and Lactarius because of its typical blue colouring. Hypomyces lactifluorum, called pig's ears or pig's trunks because of the shape of their pycelium, which can resemble these characteristics, have a pycelium with an average diameter of 9.68 cm in mature specimens and 7.1 in small mushrooms, reaching a weight of 61.5 and 37.16 g according to their maturity (see Table 05. Morphological characteristics of Hypomyces lactifluorum, Ramaria Botrytis and Lactarius indigo mushrooms). For example, according to Zamora Equihua *et al*. (2007) in Michoacán they are known as San pedro, oreja de San pedro, San Pedro blanco and Pedro café, and it is the same fungus that in the region of Valle de Bravo is identified as oreja or trompa de puerco. It is worth mentioning that these organisms can be white or reddish in colour. The blue mushrooms (Lactarius indigo), a very colourful mushroom, can weigh an average of 22.33 g and have a diameter of 8.9 cm; the colouring present decreases according to their maturity, when they are young the colour is intense and when they get older they turn brownish.

Box 7

Table 5

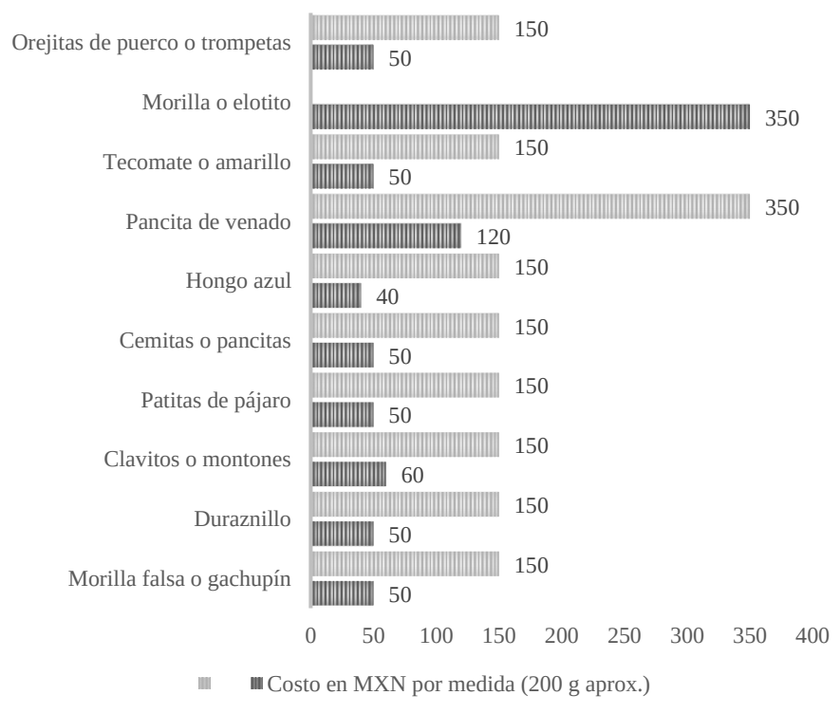
Morphological characteristics of Hypomyces lactifluorum, *Ramaria Botrytis and Lactarius indigo fungi*

Hongo	Diameter (cm)	Height	Weight (g)
Large pig's ears or horns	9.68±1.09	(cm)	61.5±18.96
Small pork ears or horns	7.1±0.45	6.88±1.63	37.16±8.81
Bird's feet	38±10.73	15.5±0.81	283.75±85.57
Large blue mushrooms	8.9±1.45	7.83±2.52	22.33±9.5
Small blue mushrooms	7.08±0.37	5±0.31	11.75±1.83

Data are averages and standard deviation

The cost of mushrooms varies from species to species, and this is due to factors such as the difficulty of finding them or the abundance of the organism. Prices have changed significantly, as reported by Marica Méndez *et al*. (2001), from 1995 to the current 2022, the increase has been between 75% and 94% in the cost per kilogram of mushrooms, depending on the variety (see Graph 01. Variation in the cost of mushrooms per measure (approximately 200g of product).

Box 8



Graph 1

Cost variation of mushrooms per measure (approx. 200g of product)

Own Source

From the second stage of research, the result is a recipe book with the main forms of culinary preparations made with wild mushrooms collected, in Table 06. Recipes identified from interviews with collectors, the main dishes are shown.

Box 9

Table 6

Recipes identified from interviewing collectors

Entrances	Sopas	Main courses
Roasted blue mushrooms.	Peasant soup.	Blue mushrooms with onions.
Pan-fried blue mushrooms.	Mushroom broth.	Sautéed tecomate mushrooms.
Mushroom quesadilla.	Broth of bellies.	Capped bird's feet in red sauce.
Bird's feet ceviche.	Peach peasant soup.	Sauteed bird's feet.

Own Source

A. Traditional knowledge and the characteristics of mushrooms

It is relevant to contrast the issue of morphology with traditional knowledge, in the case of wild mushrooms an expertise is needed that is forged over time (Boucher and Reyes, 2013; Noreiro *et al.*, 2012; Torres, Sanz, and Muchnik, 2010; Torres, 2016; Thomé-Ortiz, 2016), being a resource that the territory has in a specific season the use of these elements is limited, therefore, it is possible that the transmission of knowledge is being lost.

Despite possible problems such as deforestation, the culinary uses of mushrooms are extensive, this reflects the deep-rooted food that the area has, so that being able to taste some of the dishes today is a representation of continuity, the culinary space in the broad sense, kitchen-territory, accounts for the ingredients, techniques and skills that have been refined and inherited (Ayora, 2014; Valencia, 2019). Determining together with the inhabitants of Monte Alto the morphological characteristics of mushrooms aims to strengthen the transmission of knowledge, in the sense of being able to identify some products that are edible for non-experts or for those who, despite living in the region, do not have the degree of expertise.

This is why the kitchen, being an open space, allows these approaches. There is a complexity in these fields, as it is not possible to carry out the study systematically throughout the year, but systematising these data opens the door to a problematic field that revolves around the fungi kingdom.

Conclusions

The wooded area of Valle de Bravo is extensive, and one of the main areas is the Monte Alto National Park, which has a surface area of 476 hectares. There is a wide diversity of wild mushrooms that grow in the rainy season, however, the natural growth of these organisms has decreased due to changes in the ecosystem such as tree felling and deforestation.

Mushrooms show a variation in their morphology due to the season of harvesting, the growth they have at the time of cutting and now also climatic changes, logging and deforestation.

The season and harvesting varies, ranging from June to December. In the first part of the season, the clove mushrooms grow, in the middle part the yellow and bird's feet mushrooms grow, and at the end of the season the last mushrooms to be harvested are the blue and morel mushrooms, so not all types of mushrooms can be found during all the months of the rainy season, this is important for their consumption and sale, and to be able to offer certain dishes based on seasonal mushrooms within the season. Most of the mushrooms collected belong to the *basidiomycota* family.

The gastronomic preparations that can be made from the edible mushrooms that are collected in Valle de Bravo vary from household to household and depending on the knowledge of the person preparing them, as they can range from traditional preparations such as broths, to more complex preparations with the introduction of other gastronomic techniques.

It is relevant to disseminate both the morphology of the mushrooms, all those physical characteristics that can facilitate the distinction between an edible wild mushroom and a toxic wild mushroom, once the collection has been based only on edible organisms, the culinary preparations of the area or those commonly made by the collectors can be carried out.

Finally, a considerable number of families depend on the collection and subsequent sale of these organisms as a form of temporary economic subsistence.

Statements

Conflict of interest

The authors declare that they have no conflicts of interest. They have no financial interests or personal relationships that could have influenced this book.

Authors' contribution

Santillán-Álvarez, Ángel: Contributed to the conceptualization, data curation, formal analysis, investigation, validation, writing: original draft preparation

Morachis-Valdez, Ana Gabriela: validation, visualization and writing: review & editing

Saucedo-Vence, Karinne: data curation, method and investigation

Dublán-García, Octavio: project administration, supervision, writing: review & editing

Availability of data and materials

All research data can be found in the paper.

Funding

The research was not funded.

Acknowledgements

Santillán-Álvarez Ángel thanks the TecNM, campus Tecnológico de Estudios Superiores de Valle de Bravo.

Morachis-Valdez Ana Gabriela would like to thank CONAHCYT for the Academic Postdoctoral Fellowship 2022.

Saucedo-Vence Karinne would like to thank CONAHCYT for the Academic Postdoctoral Fellowship 2022.

Abbreviations

ACC	Amarillitos yemitas con calzón (Yellow and small yemitas with pants)
ACOM	Amarillitos yemitas comales
AGSC	Amarillitos yemitas grandes sin calzón (Big yellow yemitas without pants)
ASC	Amarillitos yemitas sin calzón (Yellow Yemitas without pants)
BSA	Bruja or open portobello silvestre
BSCC	Bruja or portobello silvestre closed
CLA	Clavitos o montones
CONAHCYT	Consejo Nacional de Humanidades, Ciencia y Tecnología (National Council of Humanities, Science and Technology)
DU	Duraznillo
GACH	Gachupín/false moorilla
HR	Robellón/enchilado mushroom

MO	Morel
PAN	Pancitas
PRODEP	Programa de Desarrollo de Estímulo Profesional (Professional Stimulus Development Programme)
TecNM	Tecnologíco Nacional de México
TESVB	Tecnologíco de Estudios Superiores de Valle de Bravo
UAEMex	Universidad Autónoma del Estado de México
UTVT	Technological University of Valle de Toluca

References

Ayora Diaz, S. I. (2014). The performance of the yucatecan: cuisine, technology and taste. Alteridades, 24(48), 59-69.

Benítez Reyna, R. (2017). Practical bilingual MAZAHUA-SPANISH vocabulary. Colección Vocabularios en Lenguas Indígenas. National Commission for the Development of Indigenous Peoples.https://www.gob.mx/cms/uploads/attachment/file/192866/cdi-vocabulario-mazahua-rufino-benitez-reyna-web.pdf

Boa, E. (2005). Edible wild mushrooms: a global perspective on their use and importance to people. FAO: Rome Italy, Retrieved from: http://www.fao.org/3/a-y5489s.pdf

Boucher, F., & Reyes, J. A. (2013). Localised agri-food system approach (LFS) and territorial management. Reflexiones a partir del proceso de activación de cuatro territorios en América Latina, 25.

Burrola-Aguilar, C., Montiel, O., Garibay-Orijel, R., & Zizumbo-Villarreal, L. (2012). Traditional knowledge and use of wild edible mushrooms in the region of Amanalco, State of Mexico. Revista mexicana de micología, 35 (1), 01-16.

Cano-Estrada and Romero Bautista (2016). Economic, nutritional and medicinal value of wild edible mushrooms'. Rev. Chil. Nutr., 43 (1) pp. 75-80.

Cárcamo-Solís, M. L., Juárez-Sánchez, J. P., Ortega-Hernández, A. (2013). The reconstruction of civil society in Monte Alto, a democratic project in Valle de Bravo.' Ra Ximhai, 9(2), pp. 65-87. DOI:10.35197/rx.09.02.e.2013.05.mc

Carrillo, L. (2003). Los Hongos de los alimentos y forrajes#. Salta, Argentina: National University of Salta.

Comisión Estatal de Parques Naturales y de la Fauna (CEPANAF) (2022). Monte Alto State Park. Secretaria del Medio Ambiente. https://cepanaf.edomex.gob.mx/parque_monte_alto

Comisión Estatal de Parques Naturales y de la Fauna (CEPANAF). (2020). Map of Forest Sanitation in Monte Alto State Park. Secretaria del Medio Ambiente', https://cepanaf.edomex.gob.mx/sites/cepanaf.edomex.gob.mx/files/files/Monte%20Alto/Normatividad/Mapa%20de%20Saneamiento%20Monte%20Alto.jpg

Díaz-Cano D., Vargas-Huesca I., Chévez E., Pacheco-Cobos L. (2016). De hongo me como un taco: recetario-catálogo de hongos recolectados en El Llanillo Redondo'. Xalapa, Mexico: Facultad de Biología - Xalapa, Universidad Veracruzana. SEP (PRODEP 40912 DSA/103.5/15/7127).

Frutis Molina I. and Valenzuela R. (2009). Chapter: Macromicetos in Ceballos, G., List, R., Garduño, G., López-Cano, R., Muñozcano-Quintanar, M. J., Collado, E. and San Román, J. E. La diversidad biológica del Estado de México estudio de estado, Gobierno del Estado de México. 1 (1), pp. 243-249.

Gaceta del Gobierno del Estado de México (2012). Periódico Oficial del Gobierno del Estado Libre y Soberano de México. https://legislacion.edomex.gob.mx/sites/legislacion.edomex.gob.mx/files/files/pdf/gct/2012/nov071.PDF

Ge, Z. W., Yang, Z. L. and Vellinga, E.C. (2010). The genus Macrolepiota (*Agaricaceae, Basidiomycota*) in China. Fungal diversity, 45 (1), 81-98.

Government of the State of Mexico (2017). Our municipalities. Edomex.gob.mx. Retrieved on August 29, 2022, from https://edomex.gob.mx/nuestros_municipios

Hernández, R., Fernández, C., & Baptista, P. (1991). Metodología de la investigación. 6th Edition Sampieri. Soriano, RR. Guía para realizar investigaciones sociales. Plaza y Valdés.

Huerta Guzmán, G. (1977). Identification of fungi'. Editorial Limusa: Mexico (1977).

López-Pérez, Y., Tejero-Díez, J. D., Torres-Díaz, A. N. and Luna-Vega, I. (2011). Flora of the mountain mesophyll forest and adjacent vegetation in Avándaro, Valle de Bravo, Estado de México, Mexico. Bol. Soc. Bot. Méx. 88 (1). 35-53.

Mariaca Méndez, R., Silva Pérez. L. C. and Castaños Montes, C.A. (2001). Process of collection and commercialisation of wild edible mushrooms in the Toluca Valley, Mexico. SCIENCE ergo-sum, Multidisciplinary Scientific Journal of Foresight, 8 (1). ISSN:1405-0269. From: https://www.redalyc.org/articulo.oa?id=10402004

Méndez Encina, F. M., Méndez González. J. and Cerano Paredes, J. (2020). Current and potential distribution of Dendroctonus mexicanus Hopkins under two climate change scenarios'. Wood and Forests, 26 (2) pp. 1-14. doi: 10.21829/myb.2020.2622002.

Noriero, L., Almanza, M., and Torres, G (2012). El saber tradicional y el desarrollo rural sustentable, visto desde una perspectiva cultural como premisas para una ruralidad alternativa. Mexico. Universidad Autónoma de Chapingo. p 24.

Ruan-Soto, F. (2018). Collection of wild edible mushrooms and strategies for the recognition of toxic species among the Tsotsiles of Chamula, Chiapas, Mexico. Scientia fungorum, 48, 1-13, https://doi.org/10.33885/sf.2018.48.1179

Ruan-Soto, F., Cifuentes, J., Garibay-Orijel, R., and Caballero, J. (2021). Comparison of edible mushroom availability in the highlands and lowlands of Chiapas, Mexico, and its implications for traditional harvesting strategies. Acta botánica mexicana, (128).

Salazar-Vidal, V., Dibán, M.J., and Ponce, S. (2017). Revision of the genus Macrolepiota Singer (Agaricales, Basidiomycota). Chile. Bol. Micol., 32(1). 13-18. DOI: 10.22370/bolmicol.2017.32.1.687

Sánchez Nova, M. (2019). Macrolepiota Procera in Mushrooms of Extremadura. Macrolepiota procera 'Parasol'.' In-Nova-Acción. http://in-nova-accion.blogspot.com/2019/11/setas-de-extremadura-macrolepiota.html

Secretary of Tourism (2021). Valle de Bravo, Estado de México. https://www.gob.mx/sectur/articulos/valle-de-bravo-mexico

Sharif, M. S. M., Zahari, M. S. M., Nor, N. M., and Muhammad, R. (2016). The importance of knowledge transmission and its relation towards the Malay traditional food practice continuity. Procedia-Social and Behavioral Sciences, 222, 567-577.

Thomé-Ortiz, H. (2016). Rural Tourism and Sustainability: The case of mycological tourism in the state of Mexico. In Carreño F, A Vázquez coords. Ambiente y Patrimonio Cultural. Mexico. CEDES, UAEMEX. p. 43-71.

Torres, G. (2016). Territories in movement and localised agri-food systems (Sial). Territorios en movimiento y sistemas agroalimentarios localizados (Sial), 9-30.

Torres, G., Sanz, J., and Muchnik, J. (2010). Territories, rural development and social capital. Torres G., Sanz J., and Muchnik J.(coords) Territorios rurales. Poverty, collective action and multifunctionality'. Mexico: UNAM. pp. 157-189.

Valencia, E. L., López, I. G., and Patiño, A. C. (2019). The culinary space. A proposal for analysis from the Anthropology of Food'. Antropología Experimental, 1 (19).

Valencia-Echeverry, L. (2011). Towards a new methodology for territorial analysis'. Buenaventura, Colombia: Editorial Universidad del Pacífico.

Weather Spark (2021). The average year-round climate and weather in Valle de Bravo Mexico, from: https://es.weatherspark.com/y/4860/Clima-promedio-en-Valle-de-Bravo-M%C3%A9xico-durante-todo-el-a%C3%B1o

Weather Spark (2022). The climate and the average weather throughout the year in Valle de Bravo Mexico, from https://es.weatherspark.com/y/4860/Clima-promedio-en-Valle-de-Bravo-M%C3%A9xico-durante-todo-el-a%C3%B1o#:~:text=En%20Valle%20de%20Bravo%2C%20la,m%C3%A1s%20de%2030%20%C2%B0C.

Zamora Equihua, V., Gómez Peralta, M., Vázquez Marrufo, G. and Angón Torres, M.P. (2007). Ethnomycological knowledge of wild edible fungi recorded for the area of Tancítaro, Michoacán. Biológicas, 9 (1), pp. 41-46.

Habits and preferences of mobile applications in students of the Bachelor's Degree in Management

Hábitos y preferencias de aplicaciones móviles en los estudiantes de la Licenciatura en Administración

Hernández-Sánchez, Josefina[*a], González-Flores, Adalberto[b] and Echavarria-Gudiño, Héctor[c]

[a] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • KUD-8522-2024 • 0009-0006-4771-5099 • 537400
[b] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • KVB-3506-2024 • 0000-0002-8045-295X • 950822
[c] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • KVB-4738-2024 • 0009-0002-3356-1667

CONAHCYT classification:

DOI: https://doi.org/10.35429/H.2024.17.56.63

Area: Social sciences
Field: Sociology
Discipline: Change and social development
Sub-discipline: Technology and social change

Key Handbooks

Within this research, the understanding of how users interact with mobile technologies is deepened. The data obtained will allow the development of personalized learning experiences through tools according to the specific demands of management students, such as project management, data analysis or collaborative learning. In researching this topic, it is necessary to classify mobile applications according to their usefulness, identify the functionalities most valued by students in the and evaluate the factors that influence the adoption and continued use of mobile applications. The most important findings are: WhatsApp is consolidated as the most popular application in all student groups, demonstrating its importance as a communication tool and its integration into the daily lives of young people. TikTok has gained ground and is positioned as the second most used application in several groups, even surpassing Instagram in some cases. This reflects the growing influence of short videos and user-generated content in students' preferences. Facebook, which in the past was the dominant social network, shows a downward trend in its popularity among younger students, migrating to the use of Instagram, leaving the latter in third place. With the above, it is concluded that the mobile applications preferred by students are those that show interactive content, i.e., that include audio and video, therefore, they become the most important source of distraction in the classroom. At this moment none of the authors has a scholarship, one of them applied to CONAHCyT, so he will benefit until January 2025 and generated 16 citations until the last year. All the authors belong to the Tecnológico Nacional de México campus Valle de Bravo, being this an Institution of higher public education of the Government of the State of Mexico. The most used keywords in this research are mobile applications, distractions and teaching-learning.

Citation: Hernández-Sánchez, Josefina, González-Flores, Adalberto and Echavarria-Gudiño, Héctor. Habits and preferences of mobile applications in students of the Bachelor's Degree in Management. 56-63. ECORFAN.

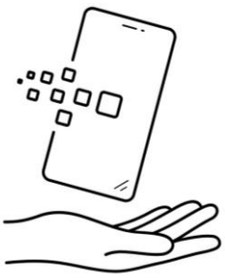
* ✉ josefina.hs@vbravo.tecnm.mx

Handbook shelf URL: https://www.ecorfan.org/handbooks.php

Abstract

The use of mobile devices has had a great impact on people's lives, this research will focus on the students of Administration of the Tecnológico de Estudios Superiores de Valle de Bravo, who are digital natives and make intensive use of technology. However, they have noticed great distractions, despite being in class, interacting with their teacher and classmates, there is influence by the interactive content created in different applications that are available to them. Therefore, it was necessary to determine through interviews and direct observation, the frequency of use of different mobile applications and identify which are the most popular among them. The results obtained will serve as a basis for future research and can be used by educational institutions and teachers to make informed decisions on the integration of strategies using mobile applications in the teaching-learning processes.

Habits and preferences of mobile applications in students of the Bachelor's Degree in Management



This research aims to identify the applications most used by undergraduate students in order to determine the main distractor that prevails in them and thus seek strategies to counteract.

This research is descriptive, quantitative and cross-sectional. After detecting the frequency of distraction through the use of their cell phones during classes. A specific review of 193 cell phones was conducted to identify the 3 applications they use the most and thus detect the most common source of distraction among undergraduate students.

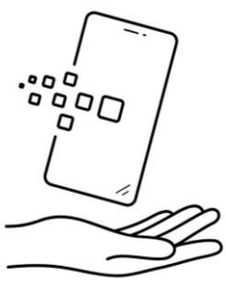
The results obtained will have practical implications for improving the quality of the learning process and promoting a responsible and effective use of mobile applications in the educational environment.

Social platforms, virtual communities and digital habits

Resumen

El uso de los dispositivos móviles ha tenido gran impacto en la vida de las personas, esta investigación se enfocará a los estudiantes de Administración del Tecnológico de Estudios Superiores de Valle de Bravo, que son nativos digitales y hacen uso intensivo de la tecnología. Sin embargo, se ha notado grandes distractores, a pesar de estar en clase, interactuando con su docente y compañeros, hay influencia por parte de los contenidos interactivos creados en diferentes aplicaciones que están a su alcance. Por lo anterior fue necesario determinar a través de entrevistas y observación directa, la frecuencia de uso de las diferentes aplicaciones móviles e identificar cuáles son las más populares entre ellos. Los resultados obtenidos servirán como base para futuras investigaciones y podrán ser utilizados por instituciones educativas y docentes para tomar decisiones informadas sobre la integración de estrategias utilizando las aplicaciones móviles en los procesos de enseñanza-aprendizaje

Hábitos y preferencias de aplicaciones móviles en los estudiantes de la Licenciatura en Administración



Esta investigación tiene como objetivo identificar las aplicaciones más utilizadas por los estudiantes de la Licenciatura para poder determinar el principal distractor que en ellos prevalecen y de esa forma buscar estrategias para contrarrestar.

Esta investigación es de tipo descriptiva, de carácter cuantitativo y de tipo transversal. Después de detectar la frecuencia de distracción a través del uso de sus teléfonos celulares durante las clases. Se realizó una revisión específica de 193 teléfonos celulares para identificar cuáles son las 3 aplicaciones que más utilizan y así detectar la fuente de distracción más común entre los estudiantes de la Licenciatura.

Los resultados obtenidos tendrán implicaciones prácticas para mejorar la calidad del proceso de aprendizaje y promover un uso responsable y efectivo de las aplicaciones móviles en el entorno educativo.

Plataformas sociales, comunidades virtuales y hábitos digitales

Introduction

The use of mobile phones has become an indispensable tool in everyday life and has permeated all areas, including academia. University students, as a digital native generation, have integrated mobile applications into their routine in a significant way and it has changed the way they communicate, organise themselves and entertain themselves.

Generally speaking, young people use most of the tools presented by mobile phones, with instant messaging prevailing as a distinctive feature of the generation to which they belong. The multimedia potential of these devices has given them access to different audiovisual resources for both academic and personal use, and the majority of pupils make use of them.

The tools associated with the organisation of young people's time and tasks show an incipient level of use, as only a little more than a third say they use them. In addition, WhatsApp appears as the social network most used by young people, followed by Facebook and Instagram. Added to the above is the fact that many young people are experimenting with emerging networks linked mainly to the generation of friendships and links (Merino Pantoja, 2017, p. 13).

On observing that the students of the Bachelor's Degree in Administration have a high degree of distraction by mobile phones, the concern was born to carry out an analysis to find out the reasons why they were restless and used their mobile phones even though they were in class.

The aim of this study is to identify the applications most used by students of the Bachelor's Degree in order to determine the main distractor that prevails in them and thus seek strategies to counteract.

Development of the topic

Mobile applications

‘A mobile application is a computer application developed to be executed through a smart mobile device, tablet or other device for which you want to implement. These are found in shops, through which they are accessed by the public who wish to use them’. (Guadalupe, 2015, p. 4)

Mobile applications according to their development and the platform through which they work are classified as: native, web and hybrid.

Native applications after being downloaded and installed through the app shops do not need an internet connection to work, they are fast, they achieve superior performance as they have been optimised specifically for the hardware and operating system of the device. Example: WhatsApp, Facebook, Twitter, Netflix, Spotify, Airbnb, Duolingo and some games.

Web applications are specially designed for mobile browsers and do not need to be downloaded, as they are accessed from a web browser via a URL and therefore require an internet connection. Example: Google Docs, Microsoft Office Online, Pixlr, Spotify (web), Netflix (web) and online video games.

And hybrid applications are a combination of web and native applications, as it uses web technologies to create the user interface, but packaged in a native application. Which allows access to the functions of the device and have full functionality. Example: Facebook, Instagram, Uber, Twitter and Evernote.

The combination of all of the above result in the tools available on students' mobiles, however, at some point in the day they become a distraction.

Due to the characteristics and layout of the internet in classrooms, it is more common for young people to use native mobile applications.

According to their functionality, applications are divided into:

Games. Designed for the user's entertainment and recreation. There is a wide variety of these from the simplest to the most complex. Example: Pokémon GO, Call of Duty, Candy Crush, PUBG Mobile, among others.

Social networking. Aims to connect people and facilitate communication and social interaction. Example: Instagram, TikTok, Facebook, Telegram, Snapchat, Twitter and Tik Tok.

Productivity. these types of applications are most useful as they help to organise tasks, manage projects and increase efficiency in all areas, especially in the field of education. Examples: Google Driv, Zoom, Calendar, Microsoft Office, Evernote, OnlyOffice, Trello and Canva.

Utilities. These are applications that provide practical and specific functions, thus optimising the performance of our device. Example: Flashlights, QR code reader, Unit converter, Notepad, Calculator, PDF reader, Battery optimiser and File cleaner.

Entertainment. Here we find applications that allow us to relax, have fun and explore different things. Example: Streaming platforms (Netflix, Disney and HBO Max); Music and podcasts (Spotify, Apple Music and SoundCloud); Social networks (TikTok, Instagram and YouTube) and games.

E-commerce. These are applications that allow the user to search, compare and buy products and services online. Example: Amazon, eBay, Mercado Libre, Shein and other online shops.

Health and wellness. They help the user to monitor their health, measure their level of exercise and lead a healthy lifestyle. Example: MyFitnessPal, Strava, Headspace, Calm and Sleep Cycle.

Instant messaging. They allow the user to keep in touch with family, friends and acquaintances through text messages, audio, images, files and videos. Examples: WhatsApp, Telegram, Discord and Facebook Messenger.

Nowadays, technology is advancing rapidly, it has become a great ally in communications and has accelerated the exchange of information in the different areas of family, work and education, especially in the latter. ‘Technology has significantly affected teaching and learning processes, to the point of becoming one of the main distractions in the classroom’. (Picado Juárez, Valenzuela Flores, & Peralta Calderón, 2017, p. 51).

As there are all these changes and application of technology in communication, it has also modified the change of behaviour and concentration during the development of the class.

Use and application of smartphones in the teaching-learning process

In a general way, we can state that smartphones are of great use among the vast majority of students and offer amazing capabilities by having excellent applications to enhance the teaching and learning process, but at the same time, these same applications could represent huge distractions and have a negative impact on students so the way they are used in classroom environments, must be carefully thought and designed to achieve positive results at all times. (Brosig Rodríguez, Niño Rodríguez, & Jesús, 2021, p. 4). Most young university students think that the use of mobile phones is positive, as they believe that it is a useful and beneficial tool in the teaching-learning process; however, because of the use they make of it, rather than being a beneficial tool, it becomes a distractor, due to the large number of applications that it can contain.

Methodology

This research is descriptive, quantitative and cross-sectional. The attitudes of eight groups of students (101, 102, 301, 302, 501, 502, 502, 701 and 702 of the Bachelor's Degree in Administration) were observed over a period of weeks. After detecting the frequency of distraction through the use of their mobile phones during classes, interviews were carried out to ask about the reasons why they were distracted by their mobile phones in the course of their academic hours, the data detected in both activities gave a guideline to counteract, with a specific review of 193 mobile phones.

The user's authorisation was requested in order to identify the 3 applications they use the most and thus detect the most common source of distraction among Bachelor's Degree students.

Results

The frequency of distraction through the use of their mobile phones during classes among students of the Bachelor's Degree in Administration at the Tecnológico de Estudios Superiores de Valle de Bravo is high. The reasons given by the students as to why they use their mobile phones during classes are very varied, however, it was necessary to make a review to identify the use they make of their mobile phones and to determine the source of distraction.

The results of the frequency of use of the different applications by group are shown below.

Table 1 Preferences of mobile applications among students in group 101.

Application	FIRST PLACE Students	SECOND PLACE Students	THIRD PLACE Students	TOTAL
WhatsApp	21	3	13	37
Instagram	12	8	10	30
Tik Tok	1	22	3	26
Facebook	0	2	5	7
Music	2	0	5	7
Google	0	0	0	0
Other	1	2	1	4
TOTAL	37	37	37	

Own source

Figure 1 Distribution of preferences by application in group 101.

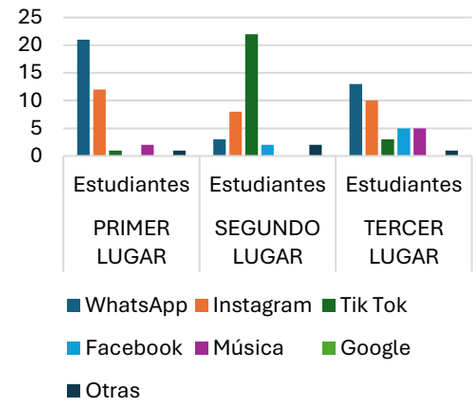


Table 2 Preferences of mobile applications among students in group 102

Application	FIRST PLACE Students	SECOND PLACE Students	THIRD PLACE Students	TOTAL
WhatsApp	4	13	3	20
Instagram	2	1	7	10
Tik Tok	9	6	4	19
Facebook	8	1	1	10
Music	2	3	3	8
Google	0	0	0	0
Other	1	2	8	11
TOTAL	26	26	26	

Own source

Figure 2 Distribution of preferences by application in group 102

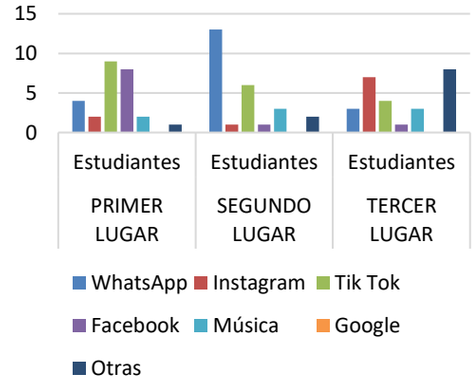


Table 3 Preferences for mobile applications among group 301 students

Application	FIRST PLACE Students	SECOND PLACE Students	THIRD PLACE Students	TOTAL
WhatsApp	11	10	5	26
Instagram	1	6	3	10
Tik Tok	9	7	5	21
Facebook	5	2	6	13
Music	0	1	0	1
Google	0	0	3	3
Other	3	3	7	13
TOTAL	29	29	29	

Own source

Figure 3 Distribution of preferences by application in group 301

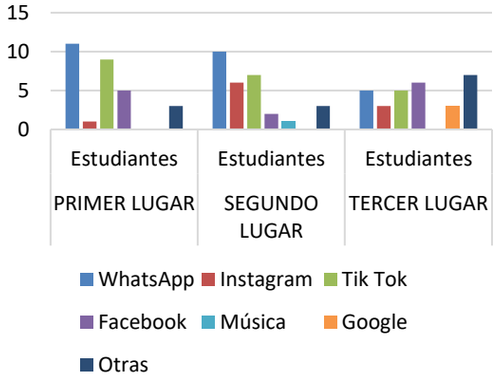


Table 4: Preferences for mobile applications among group 302 students.

Application	FIRST PLACE Students	SECOND PLACE Students	THIRD PLACE Students	TOTAL
WhatsApp	11	0	1	12
Instagram	0	2	3	5
Tik Tok	2	4	5	11
Facebook	1	4	3	8
Music	0	1	0	1
Google	0	0	0	0
Other	1	4	3	8
TOTAL	15	15	15	

Own source

Figure 4 Distribution of preferences by application in group 302.

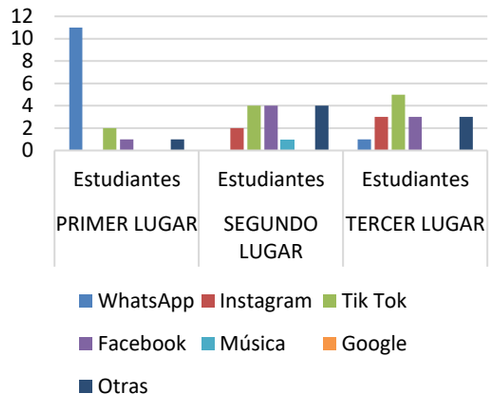


Table 5: Preferences for mobile applications among students in the 501st cohort.

Application	FIRST PLACE Students	SECOND PLACE Students	THIRD PLACE Students	TOTAL
WhatsApp	7	5	5	17
Instagram	2	3	4	9
Tik Tok	10	5	3	18
Facebook	3	7	6	16
Music	1	1	1	3
Google	0	0	0	0
Other	3	5	7	15
TOTAL	26	26	26	

Own source

Figure 5: Distribution of preferences by application in group 501.

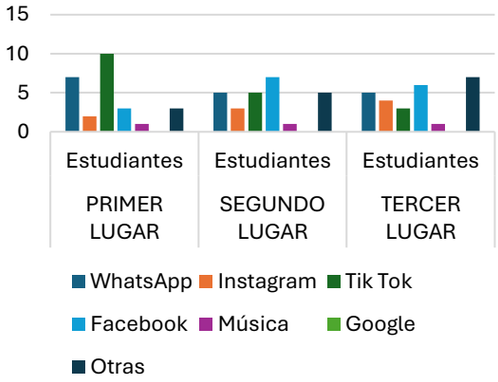


Table 6: Preferences for mobile applications among students in the 502 group.

Application	FIRST PLACE Students	SECOND PLACE Students	THIRD PLACE Students	TOTAL
WhatsApp	11	9	2	22
Instagram	0	4	8	12
Tik Tok	4	7	3	14
Facebook	8	2	5	15
Music	2	2	3	7
Google	0	0	1	1
Other	2	3	5	10
TOTAL	27	27	27	

Own source

Figure 6: Distribution of preferences by application in group 502.

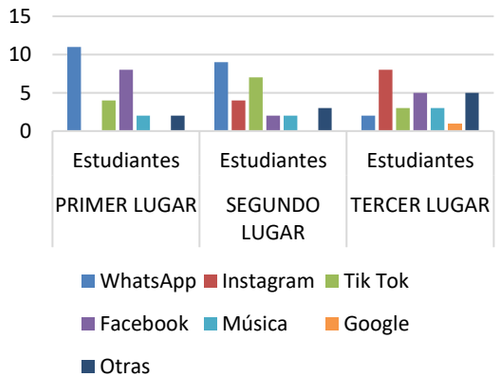


Table 7: Preferences for mobile applications among students in the 701 group.

Application	FIRST PLACE Students	SECOND PLACE Students	THIRD PLACE Students	TOTAL
WhatsApp	9	2	3	14
Instagram	1	7	2	10
Tik Tok	4	0	0	4
Facebook	2	3	4	9
Spotify Music	0	4	0	4
Google	0	0	0	0
Other	1	1	8	10
TOTAL	17	17	17	

Own source

Figure 7: Distribution of preferences by applications in group 701.

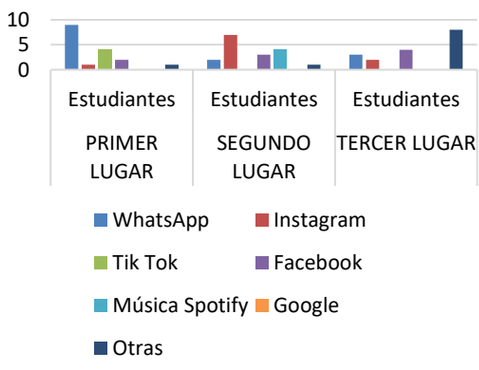
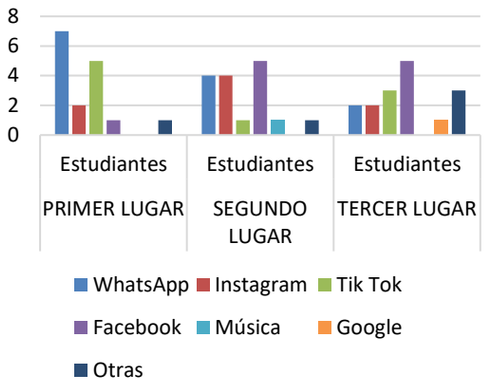


Table 8: Preferences for mobile applications among students in the 702 group.

Application	FIRST PLACE Students	SECOND PLACE Students	THIRD PLACE Students	TOTAL
WhatsApp	7	4	2	13
Instagram	2	4	2	8
Tik Tok	5	1	3	9
Facebook	1	5	5	11
Music	0	1	0	1
Google	0	0	1	1
Other	1	1	3	5
TOTAL	16	16	16	

Own source

Figure 8: Distribution of preferences by application in group 702.



We detected a frequency of use of three hybrid applications that fall into the classification of social networks: WhatsApp in first place, Tik Tok in second place and Instagram in third place.

Discussion

Unfortunately mobile phones have become a major distractor for higher level students.

Smartphones have invaded the minds of these students, have led them to a transformation of sometimes childishness and in class he observes them rejegos being more interested in seeing their latest WhatsApp than paying attention to the development of the session. He also states that smartphones are having a numbing effect on them. In relation to behaviour, she perceives them as restless and lacking concentration to reflect (Vázquez García, 2018, p. 187).

Lack of concentration in class generates low performance, frequent errors in the completion of tasks and problems with memory, resulting in a decrease in productivity and a change in students' attitudes.

'The behaviour of young people has changed, finding a daily practice of mobile phone use without academic purposes, becoming a distractor of the teaching-learning process' (Pinos Paredes, Hurtado). (Pinos Paredes, Hurtado Pantoja, & Rebolledo Malpica, 2018, p. 170)

'The behaviour of young university students in mobile media is focused on communication, entertainment, the use of social networks, the downloading of apps for study, and the consumption of audio and video.' (Portilla Jaramillo & Gangotena Flores, 2024, p. 2).

This research reaffirms previous studies because WhatsApp was detected as the mobile application most used by students of the Bachelor's Degree in Administration, being a common social network among young people, followed by Tik Tok and Instagram, because they are the current tools through which the majority of the population uses to communicate and maintain contact with their environment.

Conclusions

WhatsApp is consolidated as the most popular application in all student groups, occupying the first place in most of them. This demonstrates its importance as a communication tool and its integration into the daily lives of young people.

TikTok has gained ground and is positioned as the second most used app in several groups, even surpassing Instagram in some cases. This reflects the growing influence of short videos and user-generated content in students' preferences.

Facebook, once the dominant social network, shows a downward trend in popularity among younger students, migrating to the use of Instagram, which is now in third place.

With the above, it can be concluded that students' preferred mobile applications are those that show interactive content, i.e. that include audio and video, thus becoming the most important source of distraction in the classroom.

Statements

Conflict of interest

The authors declare that they have no conflicts of interest. They have no financial interests or personal relationships that could have influenced this book.

Authors' contributions

Hernández-Sánchez, Josefina - Research design and implementation.

González-Flores, Adalberto - Document review.

Echavarría-Gudiño, Hector - Design of data collection instruments.

Availability of data and materials

The data used in this research were extracted directly from the students of the TESVB Bachelor's Degree in Management and from the sources cited in the document.

Funding
This research did not require funding.

References

Background

Brosig Rodríguez, M. E., Niño Rodríguez, C. I., & Jesús, C. R. (20 December 2021). Smartphone use among young university students in times of pandemic. *VicculaTégica Efan, 7*(2), 1023-1034. doi:https://doi.org/10.29105/vtga7.1-161

Mendoza, G., & Guadalupe, M. (2015). *Use and types of mobile applications*. Research work, Instituto tecnológico de Salina Cruz, Salina Cruz Oaxaca. Retrieved on 10/08/2024, from https://d1wqtxts1xzle7.cloudfront.net/38125181/u1._Inv._Usos_y_tipos_de_aplicaciones_moviles_-Maria_Guadalupe_Garcia_Mendoza-libre.pdf?1436325128=&response-content-disposition=inline%3B+filename%3DUSES_AND_TYPES_OF_MOBILE_APPLICATIONS.pdf&Expires=173401708

Statistical analysis using Excel and RStudium of the EGEL-ARQUI graduation EXAM + 2023

Análisis estadístico con Excel y RStudio del examen de egreso EGEL-ARQUI + 2023

Castelán-Urquiza, Demetrio*[a] & González-Vázquez, Gabriela[b]

[a] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • ABE-3295-2020 • 0000-0003-0250-7908 • 1166247

[b] Tecnológico Nacional de México - Tecnológico de Estudios Superiores de Valle de Bravo • LWH-9597-2024 • 0000-0003-0780-6392

CONAHCYT classification

DOI: https://doi.org/10.35429/H.2024.17.64.76

Area: Social Sciences
Field: Education
Discipline: Educational theory and methods
Sub-discipline: Student assessment

Key Handbooks

This paper provides a detailed approach to tools such as Excel and RStudio, which can be used to analyze the results of standardized tests, specifically the EGEL-ARQUI plus. It highlights the use of descriptive statistics, Pearson's linear correlation and multiple linear regression to understand the factors associated with academic performance, providing a replicable model for similar research in other educational contexts. These methods can also be applied to curricular improvement and identification of critical areas in higher education. The use of accessible (Excel) and advanced (RStudio) statistical tools for educational analysis. Clear methodology for compensation and regression, which can be applied in other studies. Identification of specific areas for improvement in student performance (disciplinary and cross-cutting sections) for the optimization of educational programs at the international level. The Disciplinary section shows the lowest performance compared to the Transversal section, with the areas of regulation, administration and work control being the weakest. On the other hand, correlations indicate a significant relationship between direct writing and reading comprehension. The proposed actions include specific counseling to improve performance in critical areas, such as Architectural Design and Regulations. This analysis reinforces the importance of alignment between curriculum design and expected competencies.

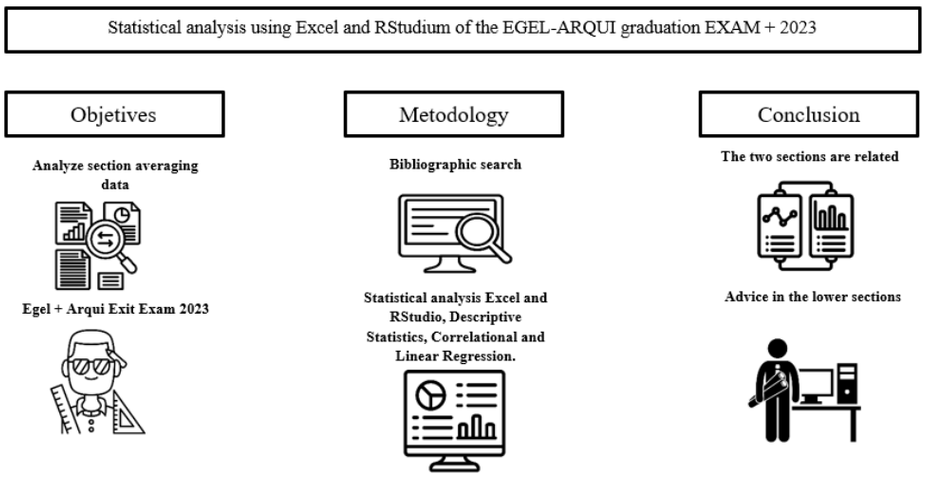
Citation: Castelán-Urquiza, Demetrio & González-Vázquez, Gabriela. Statistical analysis using Excel and RStudium of the EGEL-ARQUI graduation EXAM + 2023. 64-76. ECORFAN.

* ✉ demetrio.cu@vbravo.tecnm.mx

Handbook shelf URL: https://www.ecorfan.org/handbooks.php

Resumen

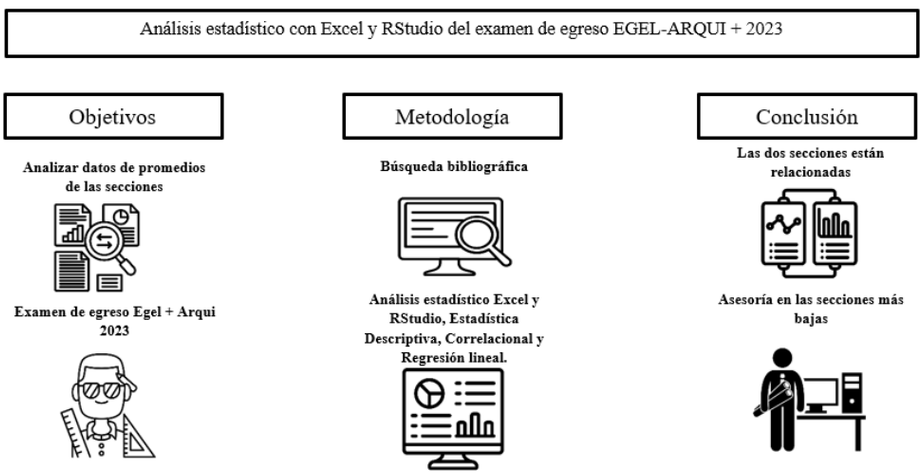
The objective of this analysis was to evaluate the results of the EGEL-Arqui+ exam utilizing both Excel and RStudio software. We focused on the overall averages across various Disciplinary sections, which encompass integral design of living spaces, regulations, administration and control of work, and construction systems for building. Additionally, we examined Transversal sections, including reading comprehension and indirect writing. The analysis revealed that within the Disciplinary section, the category of building construction systems achieved the highest average score, recorded at 1.033. In the Transversal section, reading comprehension had the highest average, reaching 1.026. Moreover, we identified the strongest linear correlation among the five variables between direct writing and reading comprehension, producing a correlation coefficient of 0.63. The linear regression analysis demonstrated that the Disciplinary sections yielded a value of 0.166, while the Transversal sections reached a value of 0.25. Notably, the Disciplinary section exhibited the lowest performance results overall.



Analysis of Academic Performance, Pedagogical Intervention, Educational Quality

Resumen

El objetivo fue analizar los resultados del examen (EGEL-Arqui +), utilizando software Excel y RStudio. Los promedios generales de las secciones Disciplinares, diseño integral del espacio habitable, normativa, administración y control de obra, sistemas constructivos para la edificación y secciones Transversales, comprensión lectora y redacción indirecta. Los resultados obtenidos en la sección Disciplinar, el mayor promedio le corresponde a sistemas constructivos para la edificación de 1,033 y en la sección transversal de Lenguaje y Comunicación, el mayor promedio lo tiene la sección comprensión lectora con un valor de 1,026. La mayor correlación lineal de las cinco variables lo obtuvo la sección transversal redacción directa y la comprensión lectora con un valor de 0.63. La regresión lineal indica que los valores de las secciones Disciplinares tienen un valor de 0.166 y las secciones Transversales un valor de 0.25. Las sección disciplinar es la que tiene resultados más bajos en su desempeño.



Análisis de Rendimiento Académico, Intervención Pedagógica, Calidad Educativa

Introduction

In the current global context in which, as a result of the health emergency caused by Covid-19, the activities of our daily lives have undergone an unprecedented radical change, global education has new challenges to face, not only in terms of educational policies, adaptation of educational infrastructure and study plans, but also in the proposal of new forms of learning and interrelation between the teacher and the student, as these changes have meant that the student, especially the university student, must be the protagonist of his or her own learning as never before.

The accelerated changes, technological progress and the various ways of transmitting knowledge have led university authorities and teachers to take a particular interest in knowing the academic performance of university students, because it is an essential indicator for approaching the reality and quality of education (Castillo, 2021).

Exit exams can improve the quality of the academic programme just as inter-departmental cooperation can improve higher education (MA Ahmad & AHA Marzouqi, 2013). Such exit exams should be properly designed to be challenging regardless of students' performance in the exam. El-Hassan *et al*., (2024), comment in their research that the exit examination assesses student learning and programme outcomes. Warren & Grodsky (2009), state that exit exams disadvantage students who fail, offer no passing benefits and lack academic impact, increase costs and lower graduation rates.

Mamani (2021), states that to educate is to communicate, to produce change in the parties. Cruz (2021), comments that in families great weight is given to elements such as prevailing gender mandates and social position, which are fundamental in the generation of expectations and future school strategies of women and men. López (2021), in her research, comments on the limitations and problems that adults may face, theories about their learning, including approaches such as cognitive, humanistic and communicative.

Vargas (2012), comments that the analysis of educational quality is necessary and should include research results on the academic performance of students, as it is very useful in decision-making processes for the sake of a fairer education system. Numerous researchers have addressed the study of vocational skills. However, they all recognise the role and importance of the achievement of these skills in learners for a satisfactory job performance upon graduation from educational institutions (López *et al*., 2023).

The General Exit Examinations for Bachelor's Degrees (EGEL) administered by the National Evaluation Centre for Higher Education (CENEVAL) are intended to assess and publicly report the level of knowledge and skills (Díaz *et al*., 2022).

The Centro Nacional de Evaluación para la Educación Superior, A.C. (CENEVAL) is a Civil Association that offers, since 1994, assessment services to hundreds of schools, universities, companies, educational authorities, professional organisations and other private and governmental bodies. Its main activity is the design and application of assessment instruments. Its mission is to provide reliable information on the learning achieved by students at different levels of education. In the field of education, as in all human activities, assessment is the process of evaluating successes, recognising failures and detecting potential.

The General Examination for Bachelor's Degree Graduation (EGEL) is an assessment instrument of national coverage whose purpose is to determine whether graduates who conclude a Bachelor's degree curriculum have the knowledge and skills that are considered indispensable at the end of their academic training (CENEVAL, 2023). Who is it aimed at? To graduates of higher education programmes who have completed 100% of the credits and, where appropriate, to students who are in the last semester of their degree, provided that the training institution so requests. Ceneval offers a specific EGEL for 39 undergraduate and engineering programmes, and one for technical professional.

One way in which universities measure the level of competences achieved or identify the level of academic knowledge and skills of graduates is through the General Examination for Graduation (EGEL), the results of this test have not been entirely satisfactory since its inception to date, leaving a gap of opportunity in the educational endeavour.

For students, the EGEL test is an option as a mode of graduation and it is a mandatory requirement to take the test (TESVB, 2017), but it is not something that prevents or determines graduation; that is, a student can obtain a result of No Testimonial and graduate in another mode without any problem. Therefore, the relevance of the test does not lie in the possible direct consequences for the student, but at an institutional level (which also includes students, but not directly in the graduation-degree process) (Jiménez Moreno & Gutiérrez Zavala, 2017).

Fitch Osuna & Araiza Vázquez (2020), investigated the factors related to the student with respect to the evaluation of the graduation exam in the Bachelor of Architecture, interpreting the results of the evaluations during the trajectory of their degree, taking into account from their access score to the degree, the final average and other variables that could be correlated with the four areas of knowledge of the General Examination for the Graduation of the Degree (EGEL).

The purpose of this is to make suggestions to the academy that will allow it to focus efforts and carry out academic-administrative strategies that will help to achieve improvements in the results of the students and that the students themselves achieve the competences necessary for their graduation.

Tecnológico de Estudios Superiores de Valle de Bravo

The Tecnológico de Estudios Superiores de Valle de Bravo is located in the municipality of Valle de Bravo, in the southern zone, region 13 of the State of Mexico. In the 2022-2023 school year, 7,119 students graduated from the Tecnológico de Estudios Superiores del Estado de México and the Tecnológico de Estudios Superiores de Valle de Bravo (TESVB) registered a total of 284 students who successfully completed their studies, with 45 graduates from the Architecture course (TESVB, 2024).

Structure of the EGEL Plus in Architecture (EGEL Plus ARQUI)

General structure of the exam: This instrument consists of two sections, five areas and 201 items. One section assesses knowledge and skills specific to the profession; the other section assesses language and communication skills in Spanish. The general structure of the EGEL Plus ARQUI is presented in Table 1 below.

Box 1

Table 1

General structure of the EGEL Plus ARQUI

	Section	Areas	No. of reagents
EGEL Plus ARQUI	Discipline specific to the profession	Area 1. Integral design of the habitable space	141
		Area 2. Regulations, administration and control of work	
		Area 3. Construction systems for building	
	Transversal Language and Communication, common to all professions.	Area 1. Reading comprehension	60
		Area 2. Indirect writing	
		Total	201

Source: (CENEVAL, 2023)

The aim of the research was to analyse the results of the averages of the Disciplinary sections, sub-areas integral design of living space, regulations, construction administration and control, construction systems for building, and Transversal sections, sub-areas reading comprehension and indirect writing.

Methodology

The research is of documentary type with a quantitative-correlational and descriptive approach, of non-experimental design, it is a transversal study of the year 2023, based on the bibliographic documentary review, the results of 44 students who took the exam were analysed, of the Architecture degree of the Tecnológico de Estudios Superiores de Valle de Bravo, taking the total averages of the areas and sub-areas, with Excel and R software, RStudio (2024. 04.2+764), descriptive statistics, Pearson's linear correlation and multiple linear regression of the variables were calculated. The research is characterised by a non-experimental, cross-sectional study design. Data were collected from the students' examination averages at a single point in time, allowing a snapshot view of their academic performance.

Sample

The sample consisted of 44 students, whose results were analysed for averages in various areas and sub-areas of study.

Analysis Tools

Two software packages were used for data analysis: Excel and RStudio. Excel was used for the initial organisation and calculation of averages, while RStudio was used to perform more complex statistical analyses, including:

Descriptive Statistics: Measures of central tendency and dispersion were calculated to better understand the distribution of results.

Pearson's Linear Correlation: The relationship between different variables was assessed to determine if a significant correlation exists.

Linear Regression: This was applied to predict academic performance as a function of different factors.

Document analysis: From similar research in ResearchRabbit (https://researchrabbitapp.com/home), an artificial intelligence-based tool that aims to facilitate the search and organisation of scientific information for researchers, students and professionals in different fields.

Taking as a root base the author's node, Fitch Osuna, (2019) with his research on the Factors in the use of information and communication technologies reflected in the graduate profile of the Faculty of Architecture of the UANL, PhD thesis, Autonomous University of Nuevo Leon and Fitch Osuna & Araiza (2020) with the research entitled the Variables related to performance in the general examination for the Graduation of Bachelor of Architecture, case Autonomous University of Nuevo Leon.

Results

Based on the theoretical research in different bibliographic sources, it is inferred that there is no relation of research among different authors with respect to the keywords EGEL Architecture Examination, although there is bibliography that studies and analyses the EGEL Examination of other careers at a national level, in (Figure 1) the nodes of the research are appreciated.

Box 2

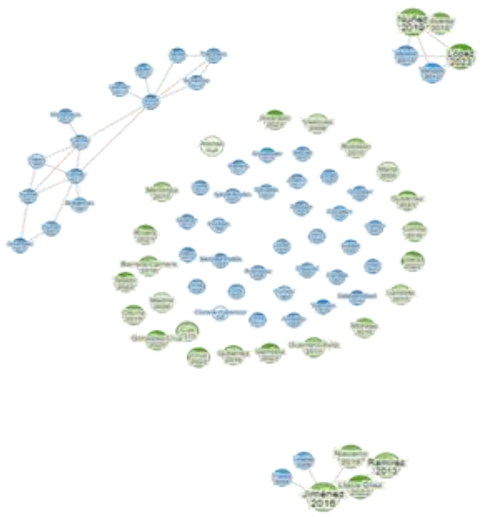


Figure 1

Research nodes related to the topic EGEL ARQUI Examination

Source: Conejo Research, (2024)

Examination data were collected in (Figure 2). The box plot shows the averages of the overall averages of the Disciplinary and Transversal sections of the EGEL-ARQUI 2023 exam.

Box 3

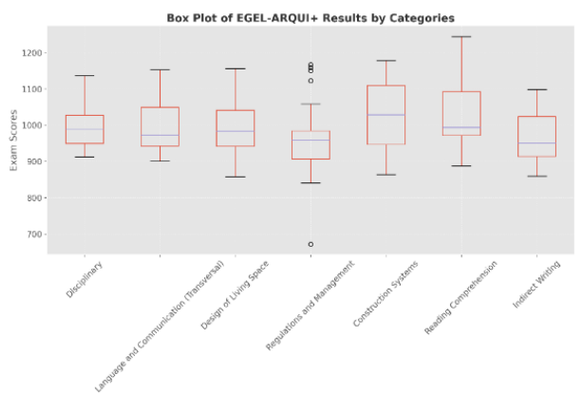


Figure 2

Box plot of section averages

Source: own elaboration

Of the total of 44 students who took the EGEL ARQUI, of which 17 are female and 27 are male, the satisfactory performance was 45 % which is equivalent to 20 students out of the total, of which 10 are female and 10 are male. The analysis of the overall averages shows that there is not much difference in the two sections of the exam, with the disciplinary section 997 and the cross-sectional section 998 being unsatisfactory, missing only three and two points to achieve the satisfactory which is equivalent to 1,000 points.

From the disciplinary section, the highest average obtained corresponds to constructive systems for building with a value of 1,033 being satisfactory, followed by the integral design of the habitable space with a value of 990 lacking 10 points to achieve a satisfactory and finally the lowest is regulations, administration and control of work with a value of 958 lacking 42 points to achieve a satisfactory.

In the cross section of Language and Communication the highest average is Reading comprehension with a value of 1026 being satisfactory and the lowest section is Indirect writing with an average value of 969 being unsatisfactory and lacking 31 points to achieve satisfactory.

Descriptive Statistics in Excel and RStudio

R is a language and environment for graphics and statistical computing. It is a GNU project similar to the S language and environment that was developed at Bell Laboratories (formerly AT&T, now Lucent Technologies) by John Chambers and colleagues. R can be considered as a different implementation of S. There are some important differences, but much of the code written for S runs unchanged in R, (2024),(https://www.r-project.org/about.html).

For the analysis of descriptive statistical data, software tools such as Excel as shown in (Table 2) and RStudio in (Table 3) were used).

Box 4

Table 2

Descriptive statistics data in Excel

Metrics	Integral design of the living space	Regulations, administration and control of works	Building construction systems	Reading comprehension	Indirect drafting
Media	990.113636	957.795455	1032.75	1026.34091	968.909091
Typical error	9.97455621	13.1292727	14.06313217	12.6230076	9.955702625
Medium	983	952	1029	994	962
Moda	989	932	1005	1065	994
Standard deviation	66.1637208	87.0927287	93.27235217	83.7315598	66.0368281
Sample variance	4377.637935	7585.143233	8699.762474	7010.91741	4360.834031
Curtosis	-0.07117078	2.83144012	-1.245678238	0.48242088	-0.73548782
Asymmetry coefficient	0.48061035	1.13730256	-0.03886885	0.48421088	0.51827921
Rango	298	392	398	213	185
Minimum	858	676	864	869	859
Maximum	1156	1068	1262	1082	1044
Suma	43565	42143	45441	45159	42632
Account	44	44	44	44	44

Source: Own Elaboration

Box 5

Table 3

Descriptive statistics data in RStudio

Metrica	Design space	Regulations	Construction systems	Reading comprehension	Indirect drafting
Minimum	858.0	672.0	864.0	888.0	859.0
1er Cuartil	942.0	907.0	947.0	972.5	914.0
Medium	983.0	959.0	1029.0	994.0	951.0
Media	990.1	957.8	1033.0	1026.3	968.9
3er Cuartil	1042.0	985.0	1110.0	1093.0	1024.0
Maximum	1156.0	1167.0	1179.0	1245.0	1098.0

Source: Own Elaboration

Obtaining results for the mean, median, standard deviation, mode, average, maximum and minimum. The lowest figure was found in the disciplinary section on regulations, administration and control of construction work with 672 points and the highest figure was found in the cross-sectional section on reading comprehension with a value of 1,245 points. The highest median score was in the discipline section on construction systems with 1,029 points and the lowest was in the cross-sectional section on indirect writing with 951 points. The mean was highest in the disciplinary section of construction systems with 1,033 points and lowest in regulations, administration and construction control with 957.8 points.

These results indicate the tendency of the descriptive statistical data, which we can infer that the lowest data were presented in the disciplinary section in the area of regulations, administration and control of transversal work with an average of 958 points and in the disciplinary section in the area of indirect drafting with an overall average of 969 points.

Pearson's linear correlation in Excel and RStudio

Pearson's correlation coefficient is a measure widely used in various areas of scientific endeavour, from technical, econometric or engineering studies to research related to social, behavioural or health sciences (Hernández *et al*., 2018).

Linear correlation is a particular case in which such correspondence has well-defined characteristics and is usually measured by Pearson's R coefficient. Originally developed by Karl Pearson in 1895, who built on Sir Francis Galton's research published ten years earlier (Rodgers, 1988).

Interpretation of the magnitude of Pearson's correlation coefficient according to Cohen's suggestions. The relationship is assumed to be between X and Y, but applies to any pair of variables. The absolute value of the coefficient is assumed, so that the magnitude is independent of the sign of the coefficient.

Interpretation of the magnitude of Pearson's correlation coefficient

Range of Interpretation values

$0.00 \leq |r_{xy}| < 0.10$ Null correlation
$0.10 \leq |r_{xy}| < 0.30$ Weak correlation
$0.30 \leq |r_{xy}| < 0.50$ Moderate correlation
$0.50 \leq |r_{xy}| < 1.00$ Strong correlation

A linear correlation was carried out in Excel and RStudio of the sections and their respective sub-areas, to find out if there is any linear correlation between the five variables of the two sections, the disciplinary and the transversal, to observe whether a variable increases positively or negatively and how much relationship it may have with the other variables from -1 to +1, as shown in (Tables 4 and 5) and their respective results.

Box 6

Table 4

Pearson's linear correlation results in Excel

	Integral design of the living space	Regulations, administration and control of works	Building construction systems	Reading comprehension	Indirect drafting
Integral design of the living space	1	0.352902628	0.340096701	0.532862435	0.562241525
Regulations, administration and control of works	0.352902628	1	0.14203329	0.543831028	0.455826061
Building construction systems	0.340096701	0.14203329	1	0.28854411	0.318195876
Reading comprehension	0.532862435	0.543831028	0.28854411	1	0.629960515
Indirect drafting	0.562241525	0.455826061	0.318195876	0.629960515	1

Source: Own Elaboration

Box 7

Table 5

Results of Pearson's linear correlation in RStudio

	Design space	Regulations	Systems systems	Understanding reading	Editorial staff indirect
Design space	1.0000000	0.3529026	0.3400967	0.5328624	0.5622415
Regulations	0.3529026	1.0000000	0.1420333	0.5438310	0.4558261
Systems systems	0.3400967	0.1420333	1.0000000	0.2885441	0.3181959
Understanding reading	0.5328624	0.5438310	0.2885441	1.0000000	0.6299605
Editorial staff indirect	0.5622415	0.4558261	0.3181959	0.6299605	1.0000000

Source: Own Elaboration

The results of the Excel and RStudio software, of the linear correlations are similar in their respective sections, analysing the correlation it can be deduced that the highest is the relationship between the variables of the Transversal section and its sub-areas indirect writing and reading comprehension with a value of 0.63 being a strong positive correlation according to Cohen's magnitude table, with respect to the disciplinary variables it has a positive correlation with the integral design of the space having a value of 0.56.

The Disciplinary variables that reached values above 0.50 related to the transversal variable of reading comprehension are regulations, administration and control of work with a value of 0.54 and followed by the integral design of the habitable space with a value of 0.53. The correlations of the disciplinary variables are below 0.50, which indicates that their correlation is weak, as can be seen in the RStudio correlation (Figure 3).

Box 8

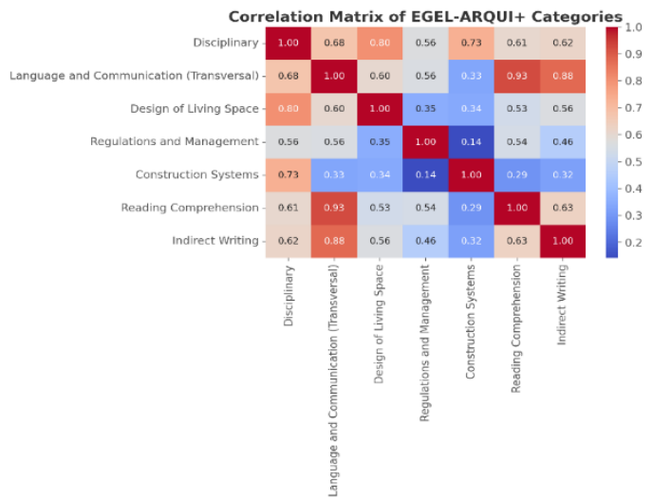


Figure 3

Linear correlation of disciplinary and cross-cutting variables *Source: RStudio*

Multiple linear regression in Excel and RStudio

Batista et al. (2016) comment that multiple linear regression is a statistical technique used to model the relationship between a dependent (or response) variable and multiple independent (or predictor) variables. The aim is to find the equation of the straight line that best fits the data, so that it can be used to predict the value of the dependent variable from the values of the independent variables.
The multiple linear regression equation has the following form:

$$y=\beta 0+\beta 1x1+\beta 2x2+\cdots+\beta pxp+\epsilon$$

Where:
y is the dependent variable
x1,x2,…,xp are the independent variables

β0,β1,β2,…,βp are the regression coefficients
ϵ is the random error term

The regression coefficients βi are estimated from the data using the least squares method, so that the sum of squares of the residuals (difference between the observed values and the values predicted by the model) is minimised. Multiple linear regression is a powerful tool for analysing the relationship between multiple variables and making predictions. Some of its applications include:

Modelling and predicting the behaviour of economic, financial, social, etc. variables. Identifying the factors that influence a phenomenon of interest. Assessing the impact of changes in the independent variables on the dependent variable. Perform sensitivity analyses and study the relative importance of each independent variable. It is important to take into account the assumptions and limitations of multiple linear regression, such as linearity, independence of errors, homoscedasticity and normality of residuals, to ensure the validity of the results. The results of the multiple linear regression of the independent variables which are the sections of the disciplinary and cross-sectional areas having as dependent variable the general average of the five areas, these results obtained in Excel are shown in (Table 5) and (Table 6) in RStudio.

Box 9

Table 5

Multiple linear regression results in Excel

	Coefficients	Typical error	Statistic t	Probability	Lower 95%	Superior 95%	Lower 95.0%	Superior 95.0%
Interception	8.52651E-14	2.22333E-13	0.38350221	0.703484729	-3.64824E-13	5.35354E-13	-3.64824E-13	5.35354E-13
Integral design of the living space	0.166666667	2.388E-16	6.97935E+14	0	0.166666667	0.166666667	0.166666667	0.166666667
Regulations, administration and control of works	0.166666667	1.7173E-16	9.70518E+14	0	0.166666667	0.166666667	0.166666667	0.166666667
Building construction systems	0.166666667	1.43083E-16	1.16483E+15	0	0.166666667	0.166666667	0.166666667	0.166666667
Reading comprehension	0.25	2.11647E-16	1.18121E+15	0	0.25	0.25	0.25	0.25
Indirect drafting	0.25	2.61169E-16	9.57233E+14	0	0.25	0.25	0.25	0.25

Source: Own Elaboration

Box 10

Table 6

RStudio Multiple Linear Regression Results

Term	Estimate	Std. Error	t value	Pr(>t)
(Interception)	7.198e-13	6.490e-13	1.109e+00	0.274
Design	1.667e-01	6.970e-16	2.391e+14	<2e-16 ***
Regulations	1.667e-01	5.013e-16	3.325e+14	<2e-16 ***
Systems	1.667e-01	4.176e-16	3.991e+14	<2e-16 ***
Compression	2.500e-01	6.178e-16	4.047e+14	<2e-16 ***
Editorial staff	2.500e-01	7.623e-16	3.279e+14	<2e-16 ***

The results obtained in the Excel and RStudio software indicate that the values of the multiple linear regression formula coincide in both cases, indicating that they are correct. The independent variables of the disciplinary section were the lowest with a value of 0.1667 and the variables of the transversal section were both with a value of 0.25. This translated into percentage values represents 16% of the total of each independent variable, each disciplinary variable achieving a total of 50% and the cross-sectional area in duma of the two independent variables add up to a total of 50%.

Figure 4 shows the trend of the data of the observed values and the predicted values in the range less than 1,000 points, it can be seen that the values are more grouped and less dispersed in the straight line with positive slope, going beyond 1,000 points the values are dispersed and move away from each other.

Box 11

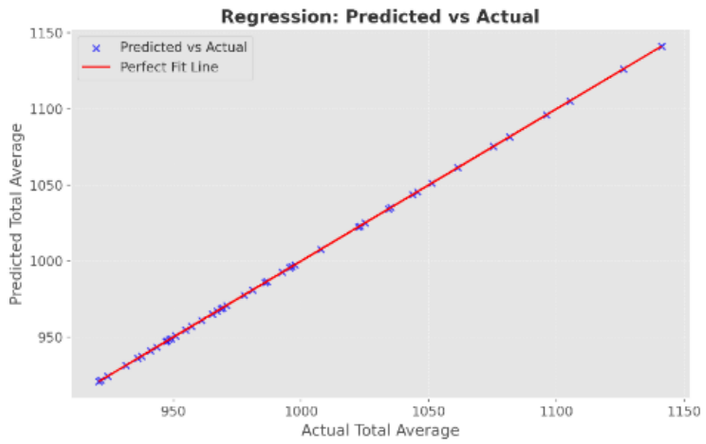


Figure 4

Multiple linear regression plot

Source: RStudio

Conclusions

Statistical analysis is of utmost importance to interpret the results obtained in the exit exam, generating adequate and relevant information to know which sections have a higher or lower achievement rate, based on these interpretations it is possible to attack the problem and provide a better solution to the low achievement rate in the areas of the Disciplinary section (Fitch Osuna & Araiza Vázquez, 2020).

With the data obtained, it is shown that the disciplinary and transversal sections are closely related, this indicates that they correlate if one increases the other may decrease or increase, the linear regression indicates the percentages of each variable that have to be achieved of the total points to achieve a satisfactory score. Greater attention needs to be paid to the subjects that are directly related to the Architectural Project, especially in Architectural Design, as students lack the competences to achieve a satisfactory performance, to present the final executive project and to work under pressure in the delivery of the architectural project. Reinforce the area of regulations, administration and control of work and the integral design of the habitable space. In the cross-cutting section of Indirect Writing, emphasis must be placed on its low achievement, which is related to reading comprehension.

With the analysis and results obtained, the pertinent actions are proposed to achieve satisfactory and outstanding performance by students when taking the EGEL ARQUI + exit exam, attending to the lowest indices in the sections. Academic counselling will be assigned to the groups that will take the exit exam, with teachers in charge of the five areas of the exam. Group and individual counselling will be provided by teachers in the different areas, which include Architectural Design, Construction Management, Costs and Budgets, Supervision and Control of Work, Structures, Installations and the Transversal Section of Language and Communication.

Declarations

Conflict of interest

The authors declare that they have no conflicts of interest. They have no financial interests or personal relationships that could have influenced this book**.**

Authors' contribution

Castelán-Urquiza, Demetrio: The content of the chapter and its different sections were developed jointly by the authors. The bibliographical analysis of the Introduction, methodology and statistical analysis with Excel and RStudio, analysis of results, discussion and conclusions.

González-Vázquez, Gabriela: Development of the bibliographic search in ResearchRabbit, statistical analysis with Excel and RStudio, analysis of results and discussion.

Availability of data and materials

The data obtained in this research is fully available.

Funding

The research did not receive any funding.

Acknowledgements

Thanks are due to the Tecnológico Nacional de México/TES de Valle de Bravo and the Jefatura de Arquitectura for their support of research hours.

Abbreviations

CENEVAL	Centro Nacional de Evaluación para la Educación Superior (National Evaluation Centre for Higher Education).
EGEL	General Examination for the Graduation of Bachelor's Degrees
TESVB	Tecnológico de Estudios Superiores de Valle de Bravo (Technological University of Valle de Bravo).

References

Background

CENEVAL. (November 2023). Retrieved from https://ceneval.edu.mx/examenes-egreso-egel/

Fitch Osuna, Miguel Ángel (2019). Factores en el aprovechamiento de las tecnologías de información y comunicación reflejados en el perfil de egreso de la Facultad de Arquitectura de la UANL, Doctorado thesis, Universidad Autónoma de Nuevo León.

Jiménez Moreno, J. A., & Gutiérrez Zavala, A. P. (2017). La Calidad Educativa en Educación Superior: La importancia de su definición por parte de las IES y la evaluación de sus estudiantes al egreso de la licenciatura. San Luis Potosí, Mexico.

Mamani Coaquira, H. (2021). Neuroeducation and teaching performance in the Professional School of Primary Education UNAP-2020.

TESVB (20 December 2017). Reglamento de Titulación Integral del Tecnológico de Estudios Superiores de Valle de Bravo. (P. O. LEGISTEL, Ed.) Retrieved from http://legislacion.edomex.gob.mx/node/34338

TESVB, (2024). Institutional Development Programme 2024-2028

Basic

Batista, A. C., Rodríguez, A. C., Montero, K. N., Espinoza, O. G., Cerdas, J. V., & Barrantes, M. G. (2016). Simple and multiple linear regression: application in the prediction of natural variables related to microalgal growth. Dialnet. https://dialnet.unirioja.es/servlet/articulo?codigo=5761475

Cruz Pérez, A. M. Trayectorias, encuentros y desencuentros en la aspiración a la UN:¿ Cómo van las desigualdades de género? (Doctoral dissertation, Universidad Nacional de Colombia). R, (2024), https://www.r-project.org/

ResearchRabbit, (2024). https://researchrabbitapp.com/home

Support

Díaz, J. M. L., Espino, D. G. R., & Pérez, P. C. (2022). Variables associated with EGEL-QUICLI performance in graduates of Clinical Biological Chemistry UANL. Innovaciones De Negocios Magazine, 19(38). https://doi.org/10.29105/revin19.38-398

El-Hassan, H., Issa, A., Hamouda, M. A., Maraqa, M. A., & El-Maaddawy, T. (2024). Continuous improvement of an exit exam tool for the effective assessment of student learning in engineering education. Trends in Higher Education, 3(3), 560-577. https://doi.org/10.3390/higheredu3030033

Fitch Osuna, M. A. A., & Araiza Vázquez, M. de J. (2020). Variables related to performance in the general exam for the Bachelor of Architecture Degree Graduation, case Universidad Autónoma de Nuevo. https://doi.org/10.29105/rinn17.34-2

M. A. Ahmad and A. H. A. A. Marzouqi, 'Exit exam as academic indicator,' 2013 Second International Conference on E-Learning and E-Technologies in Education (ICEEE), Lodz, Poland, 2013, pp. 224-228, doi: 10.1109/ICeLeTE.2013.6644378.

Differences

López, S. E. C., Cortés, M. M. P., Núñez, J. J. V., & Guzmán, J. a. N. (2023). Professional skills of CUCSUR - UDG undergraduate students in Public Accounting in the discipline of costs. Revista Visión Contable, 27, 11-33. https://doi. org/10.24142/rvc.n27a2

Vargas, G. M. G. (2012). Factors associated with academic performance in university students, a reflection from the quality of public higher education. Education Journal, 31(1), 43. https://doi. org/10.15517/revedu.v31i1.1252

Warren, J. R., & Grodsky, E. (2009). Exit exams harm students who fail them - and don't benefit students who pass them. Phi Delta Kappan, 90(9), 645-649. https://doi.org/10.1177/003172170909000908

Discussions

Castillo Zumaran, S. J., & Leon Diaz, E. E. (2021). Flipped Classroom model in the academic performance of university students.

Hernández Lalinde, JD, Espinosa Castro, F., Rodríguez, JE, Chacón Rangel, JG, Toloza Sierra, CA, Arenas Torrado, MK, Carrillo Sierra, SM, & Bermúdez Pirela, VJ (2018). On the proper use of Pearson's precision coefficient: definition, properties and assumptions. Archivos Venezolanos de Farmacología y Terapéutica , 37 (5), 587-595.

López, G. B. (2021). Intermediate adult English language learning with young learners in the TuxtlaLanguage Department, UNACH.

Rodgers, JL., and Nicewander, WA (1988). Thirteen Ways to Look at the Correlation Coefficient. The American Statistician, 42 (1), 59-66. https://doi. org/10.1080/00031305.1988.10475524

[Title in TNRoman and Bold No. 14 in English and Spanish]

Surname, Name 1st Author*[a], Surname, Name 1st Co-author[b], Surname, Name 2nd Co-author[c] and Surname, Name 3rd Co-author[d] [No.12 TNRoman]

[a] Affiliation institution, Researcher ID, ORC ID, SNI-CONAHCYT ID or CVU PNPC [No.10 TNRoman]
[b] Affiliation institution, Researcher ID, ORC ID, SNI-CONAHCYT ID or CVU PNPC [No.10 TNRoman]
[c] Affiliation institution, Researcher ID, ORC ID, SNI-CONAHCYT ID or CVU PNPC [No.10 TNRoman]
[d] Affiliation institution, Researcher ID, ORC ID, SNI-CONAHCYT ID or CVU PNPC [No.10 TNRoman]

All ROR-Clarivate-ORCID and CONAHCYT profiles must be hyperlinked to your website.
Prot- University of South Australia • 7038-2013• 0000-0001-6442-4409 • 416112

CONAHCYT classification: https://marvid.org/area-i.php [No.10 TNRoman]
Area:
Field:
Discipline:
Subdiscipline:
DOI: https://doi.org/

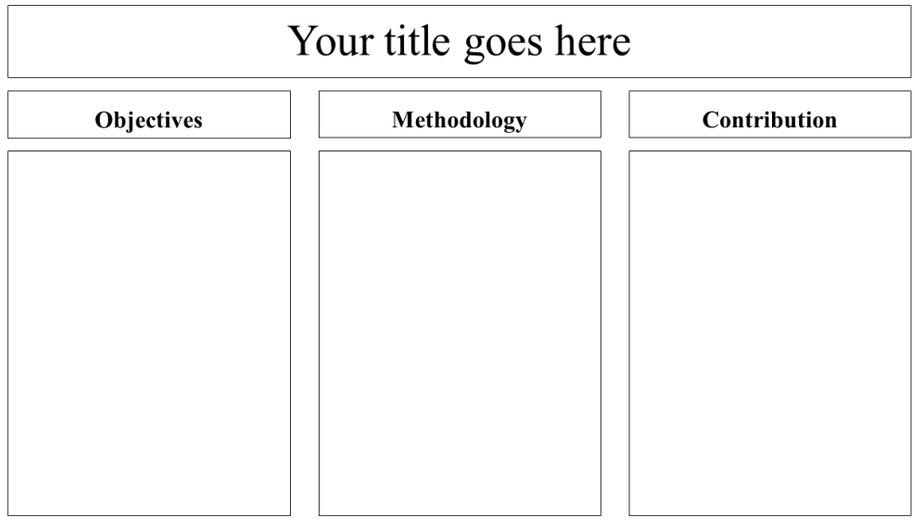
Key Handbooks
(Explain the following aspects:)
-What are the main contributions to generating Science and Technology written in this research? -What are the key aspects to be understood in order to apply to the generation of universal knowledge? -Outline the main conclusions of the research. -How many citations did the authors of the work generate in the last year? -From which institutions do they originate?

Citation: Surname, Name 1st Author, Surname, Name 1st Co-author, Surname, Name 2nd Co-author and Surname, Name 3rd Co-author. Year. Book title. [Pages]. ECORFAN.
Contact e-mail address:
* ✉ [example@example.org]

Handbook shelf URL: https://www.ecorfan.org/handbooks.php

Abstract [In English]
Must contain up to 150 words

Graphical abstract [In English]

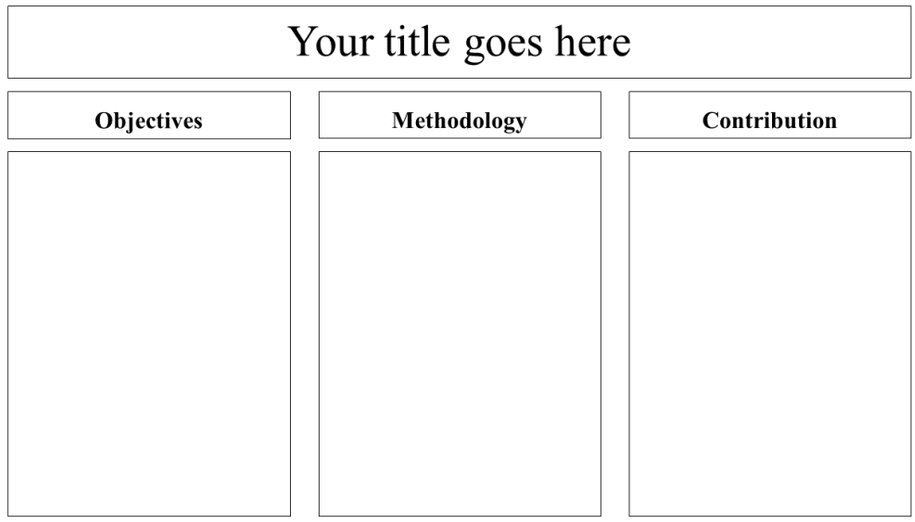


Authors must provide an original image that clearly represents the work described in the chapter. Graphical abstracts should be submitted as a separate file. Please note that, as well as each article must be unique.File type: the file types are MS Office files.No additional text, outline or synopsis should be included. Any text or captions must be part of the image file. Do not use unnecessary white space or a "graphic abstract" header within the image file.

Keywords [In English]
Indicate 3 keywords in TNRoman and Bold No. 12

Abstract [In Spanish].
Must contain up to 150 words

Graphical abstract [In Spanish]



Authors must provide an original image that clearly represents the work described in the book. Graphical abstracts should be submitted as a separate file. Please note that, as well as each article must be unique.File type: the file types are MS Office files.No additional text, outline or synopsis should be included. Any text or captions must be part of the image file. Do not use unnecessary white space or a "graphic abstract" header within the image file.

Keywords [In Spanish]
Indicate 3 keywords in TNRoman and Bold No. 12

Introduction

Text in TNRoman No.12, single space.

General explanation of the subject and explain why it is important.

What is your added value with respect to other techniques?

Clearly focus each of its features

Clearly explain the problem to be solved and the central hypothesis.

Explanation of sections Chapter.

Development of headings and subheadings of the chapter with subsequent numbers

Products in development No.12 TNRoman, single spaced.

Including figures and tables-Editable

In the Chapter content any figure and table should be editable formats that can change size, type and number of letters, for the purposes of edition, these must be high quality, not pixelated and should be noticeable even reducing image scale.

[Indicating the title at the top with No.12 and TNRoman Bold]

Box

Table 1

Title [Should not be images-everything must be editable]

Source [in italic]

Box

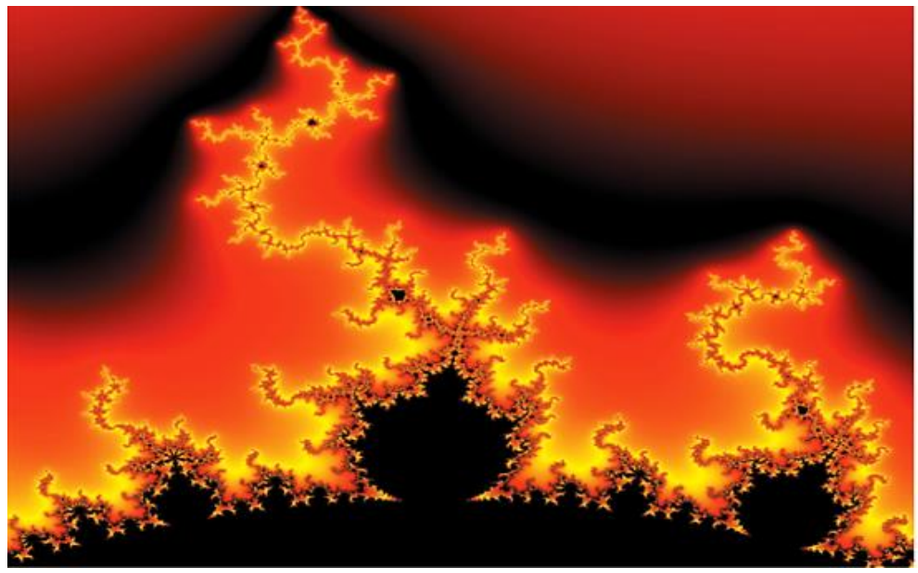


Figure 1

Title [Should not be images-everything must be editable]

Source [in italic]

The maximum number of Boxes is 10 items

For the use of equations, noted as follows:

$$\int_{lim^{-1}}^{lim^{1}} = \int \frac{lim^{1}}{lim^{-1}} = \left[\frac{1\,(-1)}{lim}\right]^{2} = \frac{(0)^{2}}{lim} = \sqrt{lim} = 0 = 0 \rightarrow \propto \quad [1]$$

Must be editable and number aligned on the right side.

Methodology

Develop give the meaning of the variables in linear writing and important is the comparison of the used criteria.

Results

The results shall be by section of the chapter.

Conclusions

Clearly explain the results and possibilities of improvement.

Annexes

Tables and adequate sources.

The international standard is 7 pages minimum and 14 pages maximum.

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence in this chapter.

Author contribution

Specify the contribution of each researcher in each of the points developed in this research.

Prot-
Benoit-Pauleter, Gerard: Contributed to the project idea, research method and technique.

Availability of data and materials

Indicate the availability of the data obtained in this research.

Funding

Indicate if the research received some financing.

Acknowledgements

Indicate if they were financed by any institution, University or company.

Abbreviations

List abbreviations in alphabetical order.

ANN	Artificial Neural Network

References

Use APA system. Should not be numbered, nor with bullets, however if necessary numbering will be because reference or mention is made somewhere in the chapter.

Use the Roman alphabet, all references you have used should be in Roman alphabet, even if you have cited a chapter, book in any of the official languages of the United Nations [English, French, German, Chinese, Russian, Portuguese, Italian, Spanish, Arabic], you should write the reference in Roman alphabet and not in any of the official languages.

Citations are classified the following categories:

Antecedents. The citation is due to previously published research and orients the citing document within a particular scholarly area.

Basics. The citation is intended to report data sets, methods, concepts and ideas on which the authors of the citing document base their work.

Supports. The citing article reports similar results. It may also refer to similarities in methodology or, in some cases, to the reproduction of results.

Differences. The citing document reports by means of a citation that it has obtained different results to those obtained in the cited document. This may also refer to differences in methodology or differences in sample sizes that affect the results.

Discussions. The citing article cites another study because it is providing a more detailed discussion of the subject matter.

The URL of the resource is activated in the DOI or in the title of the resource.

Prot-
Mandelbrot, B. B. [2020]. Negative dimensions and Hölders, multifractals and their Hölder spectra, and the role of lateral preasymptotics in science. Journal of Fourier Analysis and Applications Special. 409-432.

Intellectual Property Requirements for editing:

- Authentic Signature in Color of Originality Format Author and Coauthors.
- Authentic Signature in Color of the Acceptance Format of Author and Coauthors.
- Authentic Signature in blue color of the Conflict of Interest Format of Author and Co-authors.

Reservation to the Editorial Policy

ECORFAN Handbooks reserves the right to make any editorial changes required to bring the Scientific Work into compliance with the ECORFAN Handbooks Editorial Policy. Once the Scientific Work has been accepted in its final version, ECORFAN Handbooks will send the author the proofs for review. ECORFAN® will only accept the correction of errata and errors or omissions arising from the editing process of the journal, reserving in its entirety the rights of authorship and dissemination of content. Deletions, substitutions or additions that alter the formation of the Scientific Work will not be accepted.

Code of Ethics - Good Practices and Statement of Solution to Editorial Conflicts

Declaration of Originality and unpublished character of the Scientific Work, of Authorship, on the obtaining of data and interpretation of results, Acknowledgements, Conflict of interests, Assignment of rights and distribution.

The Management of ECORFAN-Mexico, S.C. claims to the Authors of the Scientific Work that its content must be original, unpublished and of Scientific, Technological and Innovation content in order to submit it for evaluation.

The Authors signing the Scientific Work must be the same who have contributed to its conception, realization and development, as well as to the obtaining of the data, the interpretation of the results, its writing and revision. The Corresponding Author of the proposed Scientific Work should fill in the following form.

Title of the Scientific Work:

- The submission of a Scientific Paper to ECORFAN Handbooks implies the author's commitment not to submit it simultaneously to the consideration of other serial publications. To do so, he/she must complete the Originality Form for his/her Scientific Paper, unless it is rejected by the Referee Committee, it may be withdrawn.

- None of the data presented in this Scientific Work has been plagiarized or invented. The original data are clearly distinguishable from those already published. And we are aware of the PLAGSCAN test, if a positive plagiarism level is detected, we will not proceed to refereeing.

- The references on which the information contained in the Scientific Work is based are cited, as well as theories and data from other previously published Scientific Works.

- The authors sign the Authorization Form for their Scientific Work to be disseminated by the means that ECORFAN-Mexico, S.C. in its Holding Mexico considers pertinent for the dissemination and diffusion of their Scientific Work, ceding their Scientific Work Rights.

- Consent has been obtained from those who have provided unpublished data obtained through verbal or written communication, and such communication and authorship are properly identified.

- The Author and Co-Authors signing this work have participated in its planning, design and execution, as well as in the interpretation of the results. Likewise, they critically reviewed the work, approved its final version and agree with its publication.

- No signature responsible for the work has been omitted and the criteria for Scientific Authorship have been met.

- The results of this Scientific Work have been interpreted objectively. Any results contrary to the views of the signatories are stated and discussed in the Scientific Work

Copyright and Access

The publication of this Scientific Work implies the assignment of the copyright to ECORFAN-Mexico, S.C. in its Holding Mexico for its ECORFAN Handbooks, which reserves the right to distribute on the Web the published version of the Scientific Work and the availability of the Scientific Work in this format implies for its Authors the compliance with the provisions of the Law of Science and Technology of the United Mexican States, regarding the obligation to allow access to the results of Scientific Research.

Title of the Scientific Work:

Name and surname(s) of Contact Author and Co-authors	Signature
1.	
2.	
3.	
4.	

Principles of Ethics and Editorial Conflict Resolution Statement

Editor's Responsibilities

The Editor undertakes to guarantee the confidentiality of the evaluation process, and may not reveal the identity of the Authors to the Referees, nor may he/she reveal the identity of the Referees at any time.

The Editor assumes the responsibility of duly informing the Author of the stage of the editorial process in which the submitted text is, as well as of the resolutions of the Double Blind Arbitration.

The Editor must evaluate manuscripts and their intellectual content without distinction of race, gender, sexual orientation, religious beliefs, ethnic origin, nationality, or political philosophy of the Authors.

The Editor and its editorial staff of ECORFAN® Holdings will not disclose any information about the submitted Scientific Work to anyone other than the corresponding Author.

The Editor must make fair and impartial decisions and ensure a fair peer review process.

Responsibilities of the Editorial Board

The description of the peer review process is made known by the Editorial Board so that the Authors are aware of the evaluation criteria and will always be ready to justify any controversy in the evaluation process. In case of Plagiarism Detection to the Scientific Work, the Committee notifies the Authors for Violation of the Right of Scientific, Technological and Innovation Authorship.

Responsibilities of the Referee Committee

The Referees undertake to notify any unethical conduct on the part of the Authors and to point out any information that may be a reason to reject the publication of the Scientific Work. In addition, they must undertake to keep confidential the information related to the Scientific Work they evaluate.

Any manuscript received for refereeing must be treated as a confidential document, not to be shown or discussed with other experts, except with the permission of the Editor.

Referees should conduct themselves in an objective manner; any personal criticism of the Author is inappropriate.

Referees should express their views clearly and with valid arguments that contribute to the Scientific, Technological and Innovation achievements of the Author.

Referees should not evaluate manuscripts in which they have conflicts of interest and which have been notified to the Editor before submitting the Scientific Work for evaluation.

Responsibilities of Authors

Authors must guarantee that their Scientific Works are the product of their original work and that the data have been obtained in an ethical manner.

Authors must guarantee that they have not been previously published or that they are not being considered in another serial publication.

Authors must strictly follow the rules for the publication of Scientific Works defined by the Editorial Board.

Authors should consider that plagiarism in all its forms constitutes unethical editorial conduct and is unacceptable; consequently, any manuscript that incurs in plagiarism will be eliminated and will not be considered for publication.

Authors should cite publications that have been influential in the nature of the Scientific Work submitted for refereeing.

Information Services

Indexing - Bases and Repositories

V|LEX (Global Legal Intelligence Platform)
RESEARCH GATE (Germany)
MENDELEY (Bibliographic Reference Manager)
GOOGLE SCHOLAR (Citation Indexes-Google)
REDIB (Ibero-American Network of Innovation and Scientific Knowledge- CSIC)

Editorial Services

Citation Identification and H Index
Originality and Authorization Format Management
Handbooks Testing with PLAGSCAN
Evaluation of Scientific Work
Issuance of Referee Certificate
Scientific Work Editing
Web Layout
Indexing and Repository
Publication of Scientific Work
Scientific Work Certificate
Invoicing for Publishing Services

Editorial Policy and Administration

Park Pedregal Business 3580 – Adolfo Ruiz Cortines Boulevar, CP-01900. San Jeronimo Aculco Álvaro Obregón - Mexico City. Tel: +52 1 55 6159 2296, +52 1 55 1260 0355, +52 1 55 6034 9181; E-mail: contact@ecorfan.org www.ecorfan.org

9 786078 948550
ISBN 978-607-8948-55-0