Handbook T-V

Education, Sustainability and Planning of Cities and Universities

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Handbooks

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ECORFAN Education, Sustainability and Planning of Cities and Universities

Volumen V

The Handbook will offer volumes of selected contributions from researchers who contribute to the scientific dissemination activity of the Universidad Autónoma de Guerrero in its research areas of Education, Sustainability and Planning. In addition to having a full evaluation, in the hands of the coordinators of the Universidad Autónoma de Guerrero, 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.

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Education, Sustainability and Planning of Cities and Universities T-V

Handbooks

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Abstract

Education, sustainability, and the planning of cities and universities are part of the basic and applied research conducted at the Autonomous University of Guerrero (UAGro) within the Research and Incidence Line (LII): Environment, Society, and Tourism, which was established in 2010 in the Faculty of Tourism and consolidated in 2013 as part of the Master of Science: Sustainable Tourism Management program at UAGro. The academic leader is Dr. Niño-Gutiérrez, who collaborates with top-tier academic personnel both in Mexico and abroad. In the current context, where sustainability and education emerge as fundamental pillars to address global challenges, the Handbook 2024 presents itself as a work of great academic and practical relevance. This book arises in response to the need to integrate multidisciplinary knowledge in the geographic, environmental, and educational sciences to foster more sustainable and equitable development. The main objective of the book is to offer an in-depth exploration of the challenges and opportunities facing education in the context of sustainability and urban planning. Through a series of case studies and theoretical analyses, it examines the intersections between educational institutions, sustainability policies, and city planning.

The secondary objective of the Handbook 2024 is to provide researchers, academics, urban planners, and policymakers with a comprehensive and practical guide to understanding and addressing the challenges of sustainability in education and urban planning. The work aims not only to describe existing problems but also to offer innovative solutions and adaptable strategies that promote long-term resilience and sustainability.The book also addresses the challenges faced by developing cities, where rapid urbanization and resource scarcity can hinder the implementation of sustainable practices. Through practical examples, it suggests strategies to overcome these obstacles and promote urban planning that considers both economic growth and environmental preservation.

It is important to note that the content of this work underwent a double-blind peer review process by experts in the field, strictly adhering to the current editorial standards of the National Council of Humanities, Science and Technology (Conahcyt) of Mexico. Therefore, it is expected that the ideas presented in this volume will be useful for researchers, members of civil society, and personnel from various public and private institutions at different levels: local, state, national, regional, and global. To this end, the Handbook IV includes figures, tables, diagrams, and important and current references that help reinforce the knowledge of various aspects related to geographic sciences, agricultural sciences, environmental sciences, and health sciences, among others.

The book is organized into seven chapters that cover case studies, theoretical analyses, and methodological proposals. The first part of the manual examines the relationship between sustainable territorial development and the transformation of urban landscapes in the post-COVID-19 era, providing concrete examples of cities in Latin America that have successfully integrated education and sustainability into their urban planning. Subsequently, it explores active methodologies in education, such as problem-based learning, and their application in various academic contexts, including veterinary medicine and animal husbandry.

Another crucial section of the Handbook 2024 addresses the impact of pesticides on environmental sustainability, health, and agriculture, emphasizing the need for effective regulation and public health programs to mitigate the adverse effects of these chemicals. Finally, the book includes chapters dedicated to the assessment of learning styles and the implementation of tutoring programs in higher education, highlighting the importance of inclusion and personalization in educational processes.

In terms of relevance and originality, the Handbook 2024 stands out for its interdisciplinary approach and its ability to integrate knowledge from various scientific fields, offering a holistic perspective that is crucial for addressing the complex challenges of sustainability and education in the 21st century. The originality of this work lies in its combination of practical case studies with deep theoretical analyses, as well as its emphasis on the practical application of its methodological proposals. Its academic value is demonstrated by the rigorous peer review process it has undergone, ensuring that the ideas and strategies presented are both relevant and applicable to real-world contexts.

In summary, the Handbook 2024 not only contributes to the advancement of knowledge in geographic, environmental, and educational sciences but also provides valuable tools for creating more resilient, inclusive, and sustainable communities.

The authors of Handbook 2024 are distinguished academics and professionals in their respective fields of expertise. Lozano-Salmorán, Edgar Fidel, Hernández-Rivera, Juan Augusto, Gómez-Nashiki, Antonio, and Silva del Río, Noelia are experts in veterinary medicine and animal husbandry, with extensive experience in the application of active methodologies in education.

Ferraresi-De Araujo, Geraldo José, Niño-Castillo, Isaías Naú and Abdel-Wahab, Sherif are recognized for their work in sustainable territorial development and urban planning, particularly in the post-COVID-19 context.

Antonio-Vieira, Elías; Niño-Castillo, Jacob Elías; Velandia Silva, César Augusto; and Condori-Chura, Delia combine their vast experiences and knowledge to offer innovative and practical perspectives on addressing current and future challenges at the intersection of sustainability, education, and urban planning.

Peña-Escalona, Fleider Leiser, González-Garduño, Roberto and Cruz-Tamayo, Alvar Alonzo have made significant contributions in the assessment of learning styles and the improvement of teaching processes. Arturo César García-Casillas, Omar Francisco Prado-Rebolledo, Sergio Martínez-González, and Isaías Guillermo Téllez are specialists in the impacts of pesticides on health and environmental sustainability.

García-Casillas, Arturo César; Prado-Rebolledo, Omar Francisco; Martínez-González, Sergio; and Téllez, Isaías Guillermo have led several studies on the incidence of diseases related to pesticide exposure in agri cultural populations. Their work has been crucial in understanding the relationship between pesticide use and the emergence of chronic diseases, and they have advised governmental institutions in creating stricter regulations and effective public health programs.

Arellano-Amaya, María de los Dolores; Macías-Huerta, María del Carmen; and Niño-Castillo, Jacob Elías combine their expertise in education, inclusion, and sustainability to offer a comprehensive view on the application of the ethics of care in the academic field, highlighting the importance of inclusive educational policies and sustainable practices.

Duarte-Ubaldo, Ivonne Esmeralda; Méndez Ortiz, Francisco Alejandro; Vargas-Magaña, Juan José; and Suárez-Suárez, Lady Yesenia bring a rich diversity of experiences and knowledge in the field of academic tutoring, providing valuable perspectives on how to enhance the interaction between students and tutors to foster a more effective and welcoming learning environment in higher education.

This book would not have been possible without the support and collaboration of numerous individuals and institutions. The authors wish to express their deep gratitude to the National Council of Humanities, Science and Technology (Conahcyt) of Mexico for their funding and support during the research and publication process. They also thank the universities and research centers that provided resources and platforms for carrying out this work. Special recognition goes to the reviewers for their meticulous work in the peer review process, ensuring the quality and relevance of this volume. Finally, the authors extend their gratitude to their families and colleagues for their constant support and motivation throughout this project.

Chunga-Chinguel, Gerardo. PhD
ITED-Chiclayo, Perú
June 30, 2024

Resumen

Educación, sostenibilidad y planificación de las ciudades y universidades, es parte de la investigación básica y aplicada llevada a cabo en la Universidad Autónoma de Guerrero (UAGro) dentro de la Línea de Investigación e Incidencia (LII): Medio Ambiente, Sociedad y Turismo, la cual se creó en 2010 en la Facultad de Turismo y se consolidó en 2013 como parte de la Maestría en Ciencias: Gestión Sostenible del Turismo, UAGro. Su líder académico es el Dr. Niño-Gutiérrez, quien colabora con personal académico del más alto nivel en México y en el extranjero. En el contexto actual, donde la sostenibilidad y la educación emergen como pilares fundamentales para enfrentar los desafíos globales, el Handbook 2024 se presenta como una obra de gran relevancia académica y práctica. Este libro surge en respuesta a la necesidad de integrar conocimientos multidisciplinarios en las ciencias geográficas, ambientales y de la educación para fomentar un desarrollo más sostenible y equitativo. El objetivo principal del libro es ofrecer una exploración profunda de los desafíos y oportunidades que enfrenta la educación en el contexto de la sustentabilidad y la planeación urbana. A través de una serie de estudios de caso y análisis teóricos, se examinan las intersecciones entre las instituciones educativas, las políticas de sostenibilidad y la planificación de las ciudades.

El Handbook 2024 tiene como objetivo secundario proporcionar a investigadores, académicos, planificadores urbanos y responsables de políticas una guía comprensiva y práctica para entender y abordar los retos de la sostenibilidad en la educación y la planificación urbana. La obra busca no solo describir los problemas existentes, sino también ofrecer soluciones innovadoras y estrategias adaptables que promuevan la resiliencia y la sostenibilidad a largo plazo. El libro también aborda los desafíos que enfrentan las ciudades en desarrollo, donde la rápida urbanización y la falta de recursos pueden obstaculizar la implementación de prácticas sostenibles. A través de ejemplos prácticos, se sugieren estrategias para superar estos obstáculos y promover una planificación urbana que tenga en cuenta tanto el crecimiento económico como la preservación del medio ambiente.

Es importante señalar que el contenido de este trabajo fue sometido a un proceso de revisión por pares académicos bajo la modalidad de doble ciego (blind peer review) por especialistas en el campo y en estricto apego a las normas editoriales vigentes del Consejo Nacional de Humanidades, Ciencia y Tecnología (Conahcyt) de México. Por lo tanto, se espera que las ideas que conforman este volumen sean útiles para investigadores, miembros de la sociedad civil, personal de diversas instituciones públicas y privadas a diferentes niveles: local, estatal, nacional, regional y global. Para ello, el Manual IV presenta figuras, tablas, diagramas, referencias importantes y actuales que ayudan a reafirmar el conocimiento de diversos aspectos relacionados con las ciencias geográficas, ciencias agrícolas, ciencias ambientales y ciencias de la salud, entre otras.

El libro está organizado en siete capítulos que abarcan estudios de caso, análisis teóricos y propuestas metodológicas. La primera parte del manual examina la relación entre el desarrollo territorial sostenible y la transformación de los paisajes urbanos en la era post-COVID-19, proporcionando ejemplos concretos de ciudades en América Latina que han integrado exitosamente educación y sostenibilidad en su planificación urbana. Subsecuentemente, se exploran las metodologías activas en la educación, como el aprendizaje basado en problemas, y su aplicación en diversos contextos académicos, incluyendo la medicina veterinaria y la zootecnia.

Otra sección crucial del Handbook 2024 aborda el impacto de los pesticidas en la sostenibilidad ambiental, la salud y la agricultura, subrayando la necesidad de una regulación eficaz y de programas de salud pública para mitigar los efectos adversos de estos químicos. Finalmente, el libro incluye capítulos dedicados a la evaluación de estilos de aprendizaje y la implementación de programas de tutoría en educación superior, enfatizando la importancia de la inclusión y la personalización en los procesos educativos. En cuanto a la relevancia y originalidad, el Handbook 2024 destaca por su enfoque interdisciplinario y su capacidad para integrar conocimientos de diversas áreas científicas, ofreciendo una perspectiva holística que es crucial para abordar los complejos desafíos de la sostenibilidad y la educación en el siglo XXI. La originalidad de esta obra reside en su combinación de estudios de caso prácticos con análisis teóricos profundos, así como en su énfasis en la aplicación práctica de sus propuestas metodológicas. Su valor académico se manifiesta en la rigurosa revisión por pares a la que ha sido sometido, asegurando que las ideas y estrategias presentadas sean tanto relevantes como aplicables a contextos reales.

En suma, el Handbook 2024 no solo contribuye al avance del conocimiento en las ciencias geográficas, ambientales y de la educación, sino que también proporciona herramientas valiosas para la creación de comunidades más resilientes, inclusivas y sostenibles.

Los autores del Handbook 2024 son destacados académicos y profesionales en sus respectivas áreas de expertise. Lozano-Salmorán, Edgar Fidel, Hernández-Rivera, Juan Augusto, Gómez-Nashiki, Antonio y Silva-del Río, Noelia son expertos en medicina veterinaria y zootecnia, con una vasta experiencia en la aplicación de metodologías activas en la educación.

Ferraresi-De Araujo, Geraldo José, Niño-Castillo, Isaías Naú y Abdel-Wahab, Sherif son reconocidos por su trabajo en desarrollo territorial sostenible y planificación urbana, especialmente en el contexto post-COVID-19.

Antonio-Vieira, Elías, Niño-Castillo, Jacob Elías, Velandia Silva, César Augusto y Condori-Chura, Delia combinan sus vastas experiencias y conocimientos para ofrecer perspectivas innovadoras y prácticas sobre cómo enfrentar los desafíos actuales y futuros en la intersección de la sostenibilidad, la educación y la planificación urbana.

Peña-Escalona, Fleider Leiser, González-Garduño, Roberto y Cruz-Tamayo, Alvar Alonzo han hecho contribuciones significativas en la evaluación de estilos de aprendizaje y mejora de los procesos de enseñanza. García-Casillas, Arturo César, Prado-Rebolledo, Omar Francisco, Martínez-González Sergio y Téllez, Isaías Guillermo son especialistas en los impactos de los pesticidas en la salud y la sostenibilidad ambiental.

García-Casillas, Arturo César; Prado-Rebolledo, Omar Francisco; Martínez-González, Sergio y Téllez, Isaías Guillermo. Ha dirigido varios estudios sobre la incidencia de enfermedades relacionadas con la exposición a pesticidas en poblaciones agrícolas. Sus trabajos han sido fundamentales para entender la relación entre el uso de pesticidas y la aparición de enfermedades crónicas, y han asesorado a instituciones gubernamentales en la creación de regulaciones más estrictas y programas de salud pública eficaces.

Arellano Amaya, María de los Dolores; Macías-Huerta, María del Carmen y Niño-Castillo, Jacob Elías. Estos autores combinan sus conocimientos en educación, inclusión y sostenibilidad para ofrecer una visión integral sobre la aplicación de la ética del cuidado en el ámbito académico, subrayando la importancia de políticas educativas inclusivas y prácticas sostenibles.

Duarte-Ubaldo, Ivonne Esmeralda; Méndez Ortiz, Francisco Alejandro; Vargas-Magaña, Juan José y Suárez-Suárez, Lady Yesenia. Estos autores aportan una rica diversidad de experiencias y conocimientos en el ámbito de la tutoría académica, ofreciendo perspectivas valiosas sobre cómo mejorar la interacción entre estudiantes y tutores para fomentar un ambiente de aprendizaje más eficaz y acogedor en la educación superior.

Este libro no habría sido posible sin el apoyo y la colaboración de numerosas personas e instituciones. Los autores desean expresar su profundo agradecimiento al Consejo Nacional de Humanidades, Ciencia y Tecnología (Conahcyt) de México por su financiamiento y respaldo durante el proceso de investigación y publicación. También agradecen a las universidades y centros de investigación que proporcionaron recursos y plataformas para llevar a cabo esta obra. Un reconocimiento especial va dirigido a los revisores por su meticuloso trabajo en la revisión por pares, asegurando la calidad y relevancia de este volumen. Finalmente, los autores extienden su gratitud a sus familias y colegas por su apoyo constante y motivación durante este proyecto.

Chunga-Chinguel, Gerardo. PhD
ITED-Chiclayo, Perú
Junio 30 de 2024

Content

A contextualized design of Problem-Based Learning cases as a curricular innovation in Veterinary Medicine and Animal Husbandry

Diseño contextualizado de casos de Aprendizaje Basado en Problemas como innovación curricular en la Facultad de Medicina Veterinaria y Zootecnia

Lozano-Salmorán, Edgar Fidel * [a], Hernández-Rivera, Juan Augusto [b], Gómez-Nashiki, Antonio [c] and Silva del Rio, Noelia [d]

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Key Handbooks

The purpose of this paper is to describe and exemplify a theoretical-methodological proposal for the design of case studies used in Problem-Based Learning (PBL). The profession and the empirical knowledge that teachers who use this theoretical-methodological proposal possess in order to meet the formative needs of students were analyzed. The Investigation-Action (IA) was used as a methodological perspective, supported by a focus group, with the participation of 10 tutor-teachers who use this proposal. The results strengthen the central importance of the PBL theoretical-methodological proposal as a triggering element and starting point for the teaching of Veterinary Medicine and Animal Husbandry (VMAH). The teaching experience on the phenomenon was examined and the elaboration of more case studies was reconsidered. Finally, a case study design is proposed, supported by the Clinical and Animal Husbandry of the profession, united by a didactic-pedagogical system of learning activities and evaluation criteria.

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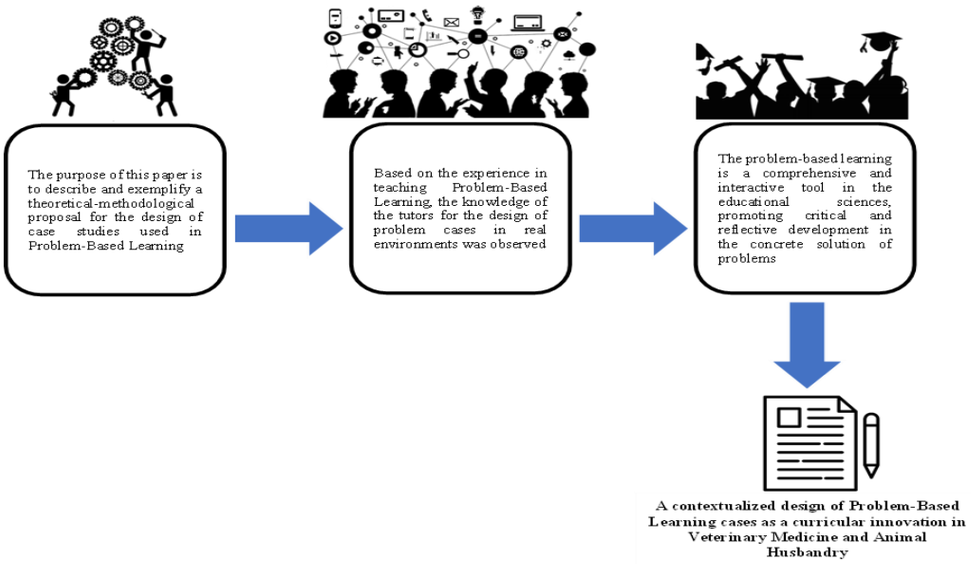
Abstract

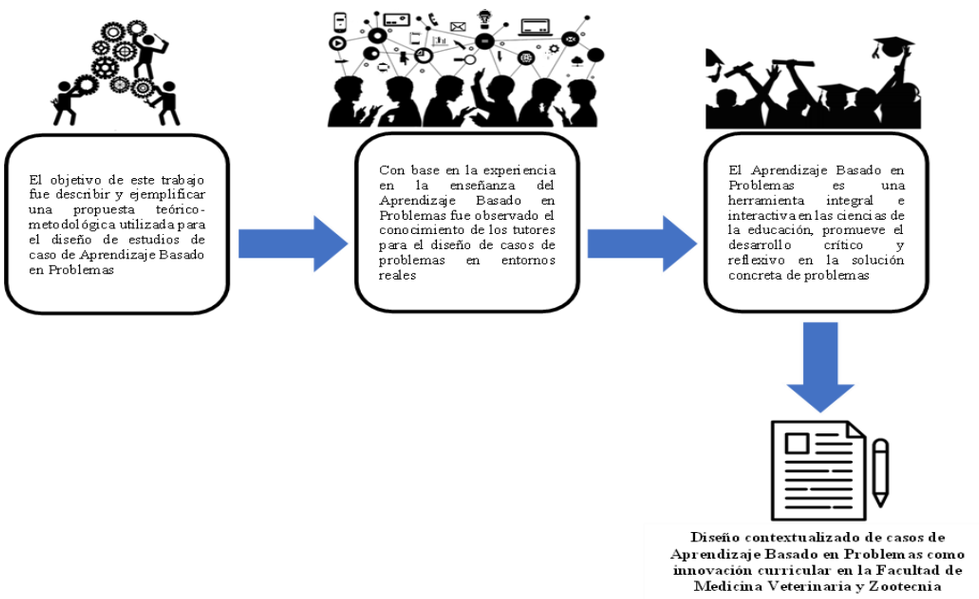
The purpose of this paper is to describe and exemplify a theoretical-methodological proposal for the design of case studies used in Problem-Based Learning (PBL). The profession and the empirical knowledge that teachers who use this theoretical-methodological proposal possess in order to meet the formative needs of students were analyzed. The Investigation-Action (IA) was used as a methodological perspective, supported by a focus group, with the participation of 10 tutor-teachers who use this proposal. The results strengthen the central importance of the PBL theoretical-methodological proposal as a triggering element and starting point for the teaching of Veterinary Medicine and Animal Husbandry (VMAH). The teaching experience on the phenomenon was examined and the elaboration of more case studies was reconsidered. Finally, a case study design is proposed, supported by the Clinical and Animal Husbandry of the profession, united by a didactic-pedagogical system of learning activities and evaluation criteria.



Methodological, Pedagogical, Formative, Husbandry, Evaluation

Resumen

El propósito de este capítulo es describir y ejemplificar una propuesta teórico-metodológica para el diseño de estudios de caso utilizados en el Aprendizaje Basado en Problemas (ABP). Se analizó la profesión y los conocimientos empíricos que poseen los docentes que utilizan esta propuesta teórico-metodológica para satisfacer las necesidades formativas del estudiantado. Se utilizó como perspectiva metodológica la Investigación-Acción (IA), apoyada en un grupo focal, con la participación de 10 docentes-tutores que utilizan esta propuesta. Los resultados fortalecen la importancia central de la propuesta teórico-metodológica del ABP como elemento desencadenante y punto de partida para la enseñanza de la Medicina Veterinaria y Zootecnia (MVZ). Se examinó la experiencia docente sobre el fenómeno y se reconsideró la elaboración de más estudios de caso. Finalmente, se propone un diseño de estudio de caso, apoyado en la Clínica y Ganadería de la profesión, unidos por un sistema didáctico-pedagógico de actividades de aprendizaje y criterios de evaluación.



Metodológico, Pedagógico, Formativo, Ganadero, Evaluación

Introduction

Problem-Based Learning (**PBL**) is a didactic methodology of an active nature (Zhang et al., 2023) which arose from the need for knowledge and learning to be student-centered (Wang et al., 2023). Currently, university health careers have accepted, with popularity, this theoretical-methodological approach to teaching (Lang and Parkinson, 2023; Shad et al., 2023; Sharma et al., 2023; Showstark et al., 2023).

However, the main obstacle for schools implementing PBL for the first time lies in the absence of case studies, or "problems" appropriate to the discipline to be taught (Bai et al., 2023; Fung et al., 2023). Therefore, the need represented by this issue is solved to the extent that professionals in the field design and write these educational resources (Zheng and Wang, 2022; Zhu and Zhang, 2022).

The educational resource called PBL case/problem can be oriented, adjusted, and shaped according to the needs of a school's context (Wang et al., 2023), as it has the didactic ability to be adapted to the needs of the institution or profession (Staff, 2023). Even as it is the trigger of this teaching methodology, elements can be combined and adapted from the reflection of the context, such as experience and knowledge, without compromising the active nature of the methodology (Bai et al., 2023).

PBL is a methodology, since its development involves a series of specific pedagogical steps (Tadesse *et al.*, 2022). It is also a didactic strategy in itself, since it employs activities that promote discovery, information searching, and knowledge construction for the conception of new knowledge (Zhang *et al.*, 2022). In this research, methodology, method, and strategy are used as synonyms of interchangeable concepts to refer to PBL (Xu *et al.*, 2022). In case/problem design, there is an attractive reservoir for change management to improve processes, procedures, instruments, and structures around the current phenomenon (Xie *et al.*, 2022), which provide PBL with new didactic resources for teaching professional competencies (Lang and Parkinson, 2023).

Additionally, at the Faculty of Veterinary Medicine and Animal Husbandry (**FVMAH**) of the University of Colima, we have had the opportunity to work for seven years with PBL as a teaching strategy in the last semesters of the profession. As a result of this experience, it was identified that the implementation of this methodology required using triggering "problems" that went beyond a conceptual construct in its design, since the case/problem as a starting point was ambiguous, precisely because of its theoretical elaboration that, although attached to reality, was decontextualized, and lacked meaning in relation to the Clinical and Animal Husbandry. Therefore, this paper aims to describe and exemplify a theoretical-methodological proposal for the design of case studies used in PBL through an analysis of the profession and the empirical knowledge that teachers who use this theoretical-methodological proposal possess.

Problem-Based Learning

As it is considered an integrative, didactic activity, PBL allows for the introduction of curricular innovation processes (Fung *et al.*, 2023). This does not respond to an unfounded institutional procedure, but rather to an intentional change that emerges from the needs of the school context (Bai *et al.*, 2023).

The central feature of PBL as a teaching method is the use of case study "problems", which map out a didactic path for information seeking (Zhu and Zhang, 2022). It also considers the construction of new knowledge and the conception of the student as a leader in the management of their learning (Zhang *et al.*, 2022). Innovating from this perspective is valuable, since it has a direct impact on how it is taught, and on the starting point for the transmission of knowledge (Xu *et al.*, 2022). The PBL methodology (**Figure 1**) is active in nature (Lang and Parkinson, 2023). Therefore, it utilizes self-directed and autonomous learning skills (Wormley *et al.*, 2022). In combination with IA and information seeking by the learner (Wong and Kan, 2022), these activities should be preceded and motivated by a didactically triggering element, referred to as a "problem" (Wang *et al.*, 2023).

Lang and Parkinson (2023) indicated that the student body is not a passive entity that receives all knowledge from the teacher; rather, it is based on the analysis of case studies, where the student body is in constant discovery and construction of its own learning. In this regard, Xu *et al.* (2022) identified the "problem" as a fundamental, didactic structure in PBL, pointing out that learning begins with it, and there is no achievement of knowledge without it.

In practical terms, the case study “problems” used by PBL are generally presented in simple and non-technical language (Wondie *et al.*, 2022). They are a series of sets, facts, or phenomena that pose a challenge or a question about a specific topic (Webster *et al.*, 2022). The “problem” must be interesting and relevant to the students, so that it captures their attention (Wang *et al.*, 2022). Therefore, what is to be problematized should reflect a real -life situation- i.e., with a real-life context (Virk *et al.*, 2022).

Box 1

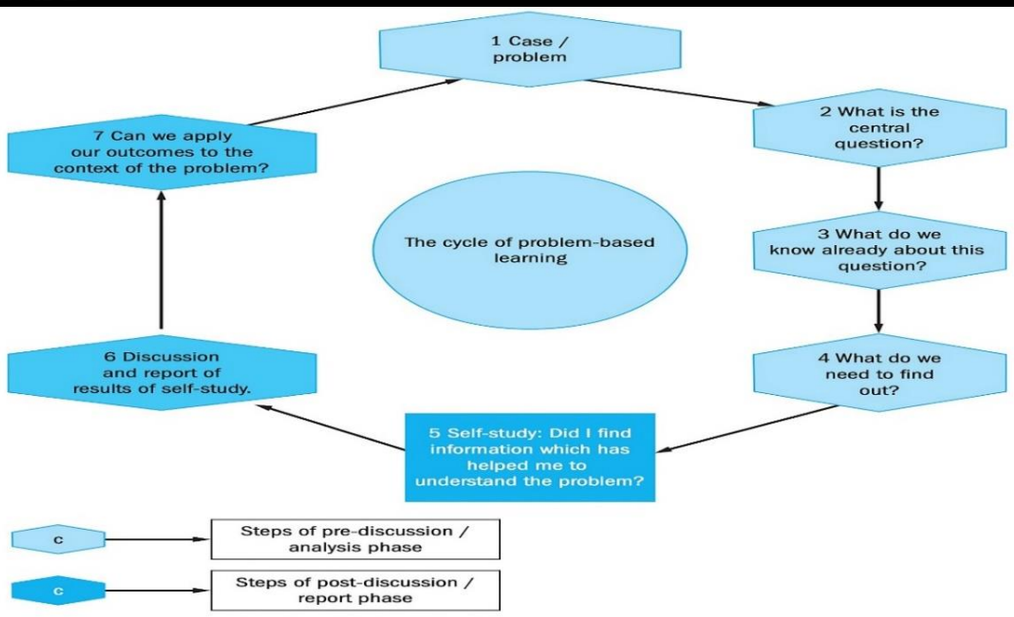


Figure 1

The cycle of Problem-Based Learning

Source Virk et al., 2022

Elaborating upon a “problem” to be executed under the PBL methodology is a critical issue that helps determine whether or not the student's work in constructing their learning was a significant achievement (Tsai *et al.*, 2022; Wang *et al.*, 2023). Therefore, the situations with which PBL starts are a key factor for its optimal performance (Nomura *et al.*, 2023), and, in that vein, the adequate design of this educational resource is a key factor for the success of the method (Trullas *et al.*, 2022).

The pedagogical role played by the PBL “problem” is fundamental, similar to the axle of a wheel, which, in essence, is the center of gravity from which the entire teaching-learning process of the method revolves (Tadesse *et al.*, 2022; Servos *et al.*, 2023). Therefore, the following section outlines some methodologies for the elaboration of PBL “problem” case studies, which propose how they should be designed, including the situations circumscribed in this regard.

PBL “problem” case study design

It is difficult to deny the evidence that PBL is an active methodology with proven effectiveness in education (Zamir *et al.*, 2022; Fung *et al.*, 2023; Lang and Parkinson, 2023; Shad *et al.*, 2023). As a result, PBL has positioned itself as a preferred learning method, especially in the health sciences (Virk *et al.*, 2022; Wondie *et al.*, 2022). Thus, over time, several dimensions and/or typologies have been created around the design of case study “problems” for learning (Sun *et al.*, 2022). The most used dimensions in the design of PBL “problem” case studies are concentrated in three main groups:

1) Based on constructivist educational and learning principles.

2) Founded on philosophical bases of the unstructured or Brunerian type (Lara *et al.*, 2017), and, vice versa, of the structured or non-Brunerian type; and

3) They consist of a series of recommendations or general principles for their elaboration in the form of a checklist.

The 1st dimension designs PBL "problem" case studies based on the learning objectives set out in the course (Lang and Parkinson, 2023). These objectives are derived from the professional competencies that the students should achieve in a given subject or educational program (Sharma *et al.*, 2023). To make PBL "problem" case studies more appealing to students, Schmeltz and Ganesh (2022) suggest that, in addition to ensuring professional competencies, the "problems" should be related to real-life situations, so that students find more meaning in the work they are assigned.

The 2nd dimension designs PBL "problem" case studies based on structured and unstructured philosophical questions (Virk *et al.*, 2022)-that is to say-, structured "problems" with a high degree of detail can be encountered (Sarmiento *et al.*, 2022), including open "problems" that do not present central data (Bai *et al.*, 2023). Therefore, it is up to the students to identify the IA "problem" and, to a certain extent, define it (Trullas *et al.*, 2022; Tsai *et al.*, 2022).

The 3rd dimension designs PBL "problem" case studies based on a list of recommendations for the search of information (Tadesse *et al.*, 2022). Therefore, the structuring of such a "problem" should ensure the motivation of the student body (Zhang *et al.*, 2023) and lead them to make their own judgments (Alduraibi *et al.*, 2022), based on facts (Ali *et al.*, 2022a), which combine prior knowledge with new knowledge (Ali *et al.*, 2022b), thus promoting discussion (Allert *et al.*, 2022) and development of collaborative work (Almulhem and Almulhem, 2022).

The typologies around the design of PBL case study "problems" described above indicate that there is no single execution in the structuring/construction of such educational resources (Alt *et al.*, 2022; Álvarez *et al.*, 2022). Thus, the development of the method and its implementation under an educational context is made more difficult (Chan *et al.*, 2022). When striking a balance, there is a theoretical and practical difficulty in designing PBL "problem" case studies, especially when they must be adjusted to the didactic needs of a particular discipline (Brown, 2022; Bukumiric *et al.*, 2022; Chan *et al.*, 2022; Chi *et al.*, 2022).

PBL and the teaching of Veterinary Medicine and Animal Husbandry

Designing PBL "problem" case studies to be applied in VMAH teaching involves specialized work in two areas: i) a pedagogical mediation, and ii) a disciplinary guideline (Álvarez *et al.*, 2022; Micieli *et al.*, 2022). Both directions must find a point of connection that allows the correct structure of the phenomenon (Virk *et al.*, 2022) and, as a consequence, the success of the cognitive impact of the method (Tsai *et al.*, 2022). Thanks to the experience gained in the use of PBL as a teaching strategy in VMAH (Farnsworth, 1997; Rand and Baglioni, 1997; Rivarola and García, 2000; Cox, 2001; Howell *et al.*, 2002; Schoenfeld-Tacher *et al.*, 2005), the design of case studies has been identified as "problems", based on empirical knowledge of the profession (Lane, 2008; Schmidt *et al.*, 2008), and "problem" case study design, based on good practices of contextualized teaching (David and Irizarry, 2009; Tarlinton *et al.*, 2011; Putra *et al.*, 2016) as the correct structure to address the phenomenon. In this regard, it should be noted that the professional training of VMAH is influenced by two study paradigms: i) the Clinical and Biosecurity vision of animal medicine (Schmidt *et al.*, 2008), and ii) the Animal Husbandry production of productive species in each region (Lane, 2008). Therefore, it is necessary to reflect on how the integrative teaching of VMAH implicit in real scenarios and contexts should be. This brings necessities that connect the Clinical with Animal Husbandry (Álvarez *et al.*, 2022). The professionalizing areas of the educational programs should be conceived in such a way that a homogeneous teaching of the profession is performed (Lane, 2008; Schmidt *et al.*, 2008). Finally, several authors Chan *et al.* (2022); Ma (2022); Bai *et al.* (2023); Fung *et al.* (2023) have illustrated how PBL can transform the social and cultural environment of each curriculum. Central to this approach is the importance of the design of learning "problems" as the core around which educational resources that adequately integrate, define, and describe the teaching-learning needs within the context in which they are to be implemented.

Design of a PBL "problem" case study at the Faculty of Veterinary Medicine and Animal Husbandry of the University of Colima

In the case of FVMAH at the University of Colima (**Figure 2**), this is a curricular challenge that seeks to increase good educational and training practices in vital areas of the profession. PBL is an efficient teaching-learning process, where the faculty's students can appropriate the curricular content necessary to perform effectively in the labor field.

Box 2

Figure 2

Faculty of Veterinary Medicine and Animal Husbandry of the University of Colima

Source personal photo

The following is presented as an example: **Case. Campaign diseases and mandatory reporting in poultry for meat and egg production** (as a conceptual approach; **Figure 3**).

Frame of reference and key words of the case

The eradication of hunger represents a challenge that extends beyond the capacity of the **Food and Agriculture Organization** alone. Therefore, animal production professionals must understand the different **poultry production systems**, ensure the **five freedoms of animal welfare,** and consider many other aspects before starting the construction of a livestock production facility (e.g., **ecological components**, **biological components**, **host susceptibility**, **agent-host-environment interaction,** and **disease control programs**).

Box 3

Figure 3

Case: Campaign diseases and mandatory reporting in poultry for meat and egg production

Source personal photo

The **poultry sector** is pivotal in supplying animal protein to humans. Proper **record-keeping** in poultry production systems is necessary to facilitate quick and effective decision making. Professionals should attend continuing education courses (held in the country) to be up to date with the latest recommendation in antibiotic resistance, food safety, animal welfare, ethology, as well as **product traceability**. The latter is the field of professional practice where the owner of a livestock production center is entrusted to a VMAH, in order to track the production and distribution of the animal products in the market.

The VMAH in question receives the production records from his/her digital device through the application (*Chicken-App*); the livestock production center is located in an area with a high density of poultry. According to the **Mexican Official Standards (NOM) for domestic poultry**, the **biosecurity** criteria in the livestock production center have become a challenge, due to the proximity to other farms. The Chicken-App issues an alert when the reference parameters indicated by the company are exceeded (Ross®, Aviagen Group, Huntsville, AL, USA).

Problem-Oriented Medical Record of the case

Because mortality is apparently above average, the VMAH requests necropsy records from the person in charge, noting the following clinic pathological findings:

1. Sneezing, tracheal rales, conjunctivitis, nasal discharge, green diarrhea, incoordination, and torticollis in live birds; and
2. Hemorrhages in coronary fat, proventriculus, caecum in the small intestine and in the isthmus, facial edema, and button-like ulcers in the intestine in 80% of the birds inspected at necropsy.

Samples were taken for histopathological study, and the following lesions were found:

1. Nervous system: non-purulent encephalomyelitis with neuronal degeneration, glial cell foci, perivascular lymphocyte infiltration, and endothelial cell proliferation in cerebellum, medulla, midbrain, brain stem, and spinal cord;

2. Vascular system: myocarditis, focal myofiber necrosis, and mononuclear cell infiltration;

3. Respiratory system: tracheal and air sac edema, epithelial necrosis and desquamation, heterophilic infiltration, followed by hyperplasia of the epithelium and infiltration of lymphocytes and mononuclear cells;

4. Intestinal apparatus: necrosis and hemorrhages in lymphoid tissue and intestine, as well as hemorrhages in proventriculus associated with necrosis; and

5. Serology: the hemagglutination inhibition test was used, and a red button was formed at the bottom of the cell, as a consequence of the sedimentation of the non-agglutinated erythrocytes, due to the fact that the immunoglobulins in the serum reacted with the antigen inhibiting its capacity to agglutinate erythrocytes.

General objective of the case

To understand the different poultry production systems and their production parameters; to identify the most common diseases in broilers during development/finishing, with special attention to their clinical diagnosis.

Specific objectives of the case

- To understand the objectives and production systems of the Food and Agriculture Organization;

- To understand the five freedoms of animal welfare, good production practices, and the components that make up biosecurity;

- To identify the main epizootiological components to establish a differential and definitive diagnosis;

- To manage the different records used in livestock enterprises; and

- To create an immediate clinical history, as well as the description of the necropsy technique in the species, including the collection and sending of samples for complementary tests.

Curriculum of the case

On Table 1 shows the curriculum of the case.

Box 4

Table 1

Curriculum case: Campaign diseases and mandatory reporting in meat and egg production poultry

Module III Poultry instead: Problem-Based Learning (PBL) Faculty of Veterinary Medicine and Animal Husbandry of the University of Colima	
Knowledge (Animal Husbandry Components)	**Knowledge** (Clinical Components)
Know the origin, breeds, lines, current situation, and importance of poultry production and feeding systems in the national and international context.	Know the procedures for the diagnosis, treatment, control, nd prevention of the primary diseases of domestic fowl.
Know the technical specifications, as well as the biosecurity measures that must be complied with in poultry production facilities.	Recognize the clinical manifestations of birds with respiratory and digestive tract diseases.
Understand the guidelines for the husbandry and processing of meat and egg producing poultry.	Recognize the clinical manifestations of birds with nervous system disorders.
Identify factors affecting poultry health and disease, which serves as a rationale for the implementation of comprehensive health programs.	Recognize the clinical manifestations of birds with immune system disorders.

Case teaching activities: i) discussion and ii) research

1st block of activities

Activities for Discussion

- What are the objectives of the Food and Agriculture Organization?
- Identify the five freedoms of animal welfare and outline good production practices.
- Describe the different production systems, with reference to the Food and Agriculture Organization.
- Explain each of the different epizootiological components.
- What is the *per capita* consumption of eggs, chicken, and turkey meat?
- What is the volume of the national flock of broilers, layers, and turkeys?
- Discuss the locations, production cycles, and strains of Mexican poultry broiler, egg, and turkey production companies.
- Outline the different types of records that should be implemented in poultry companies, and provide an example for each one.
- Identify the names of different poultry scientific forums held in Mexico.
- Define traceability.
- Discuss the requirements for transportation of poultry products and by-products, according to NOM.
- How many countries are members of the World Organization for Animal Health. Is Mexico a member? Where is the permanent headquarters?
- List and describe the website of the global scientific network for Avian Influenza control; and
- What is the World Animal Health Information System?

Research Activities

- Design a comparative chart based on the official NOM for poultry, detailing the minimum required distances between production centers in different categories (parent stock, breeders, broilers, and hatcheries) from one farm to another.
- Create an epizootiological map of Mexico for field diseases, delineating the various animal health statuses by color coding.
- Profile a register of Poultry Production Unit under vaccination scheme for Avian Influenza;
- Prepare a Poultry Production Unit form.
- Using the World Organization for Animal Health website, identify the geographical areas with outbreaks of Highly Pathogenic Avian Influenza in the world, color, in red, the geographical areas of the world where outbreaks are occurring; and
- List the infectious diseases and infestations currently recognized by the World Organization for Animal Health.

2nd block of activities

- The diagnostic methodology for bird diseases is an orderly and systematic process that includes the following steps:

- Clinical history of the farm: Establish a clinical history that is divided into mediate and immediate.
- Clinical examination of the flock: Perform a clinical examination.
- Necropsy examination: Perform a necropsy technique on birds.
- Presumptive clinical diagnosis: Prepare a comparative table including: disease, affected system(s), dissemination, period, etiology, synonymies, signs, lesions, and productive effects; and
- Selection, conservation, and shipment of samples for Newcastle and Avian Influenza: Describe the criteria for selecting live birds for sample collection, and document examples of sample collection and conservation methods for different studies, including the official diagnostic techniques for Newcastle and Avian Influenza.

- Subsequently, as a complement:

- Diagnostic Techniques: What are the most commonly used diagnostic techniques for pathogen identification, including their immunological/biochemical principles?
- Euthanasia Techniques: Identify the main euthanasia techniques used in birds.
- Sample Size Determination: Based on the size of the flock and the NOM for poultry, determine the sample size required to be statistically representative.

Methods, criteria, and instruments for case evaluation

Table 2 shows the methods, criteria, and instruments for case evaluation.

Box 5

Table 2

Evaluation methods, criteria, and instruments. Case: Campaign diseases and mandatory reporting in poultry for meat and egg production

Methodology	**Criteria**	**Instrument**	**Value** (%)
Discussion	Reasoning, independent study, and interaction skills. From discussion activities.	Estimated scale.	10
Portfolio of Evidence	Evidence of introductory activities. Evidence of research activities.	Activity guide with description and value.	40
Integrating Product	Development of a biosafety program. Design of a table of recommendations with prevention, control, and treatment measures, as well as a guide of measures in cases of contingency, in the event of the presence of campaign diseases.	Heading.	30
Examination	Single exam type: National Evaluation Center for Higher Education (CENEVAL), objective, collegiate, sanctioned, and verified by the academy.	Examination questions.	20
		Total	100

About the method used

Examining the tutors' knowledge, based on their experience in teaching PBL to propose and exemplify the design of a "problem" case studies, along with analyzing the context of the profession implied an IA process. This is because the participants reflected on their own educational practice (Tsai *et al.*, 2022; Wang *et al.*, 2023). In addition, this activity was complemented with the application of a focus group guided by a semi-structured survey with the intention of obtaining more in-depth narrative data (Virk *et al.*, 2022; Wondie *et al.*, 2022). Due to the type of study, of a qualitative nature, an intentional and non-probabilistic sample was considered (Chan *et al.*, 2022), made up of 10 tutors representing 90% of teachers who develop PBL on campus and complied with the following inclusion criteria:

- They had more than three years of experience with PBL.

- They participated in the elaboration of cases for the development of the method in the last three years.
- The subjects were VMAH of initial training.
- They had professional and work experience in the academic dimensions of Clinical and Animal Husbandry; and
- Give your informed consent to be recorded from a personal interview.

The research was carried out in July 2022, the focus group was organized, in which the design process of the PBL “problem” case studies that were available was analyzed, subsequently, the knowledge of each tutor was reflected on based on their experience in teaching PBL on campus, to reflect and propose a design structure for these educational resources that would respond to the requirement of teaching the profession (David and Irizarry, 2009; Tarlinton *et al.*, 2011; Putra *et al.*, 2016).

The empirical information that resulted from the implementation of the focus group was systematized through a field diary, this activity gave meaning to the objective of the investigation and helped to build new meanings around the elaboration of PBL “problem” case studies from the experience on the teaching practice of each tutor and the analysis of the context of teaching the profession (Putra *et al*., 2016). Finally, from a narrative that valued the experience of the tutors and that sought to understand their ways of knowing, proposing and suggesting a methodology for the design of PBL “problem” case studies (Virk *et al.*, 2022; Wondie *et al.*, 2022), topics were outlined, related to this phenomenon, to the extent that the information collected was investigated and adjusted, which allowed us to approach a prototype for the elaboration of educational resources for the development of the PBL method.

Discussion and results

Table 3 presents a structure of PBL "problem" case studies as a methodological suggestion for its design, that emerged from the tutors’ reflections during the focus group.

Box 6

Table 3

Structure of PBL "problem" case studies as a methodological suggestion for its design

No.	Structure	Design, writing and content
1	Title of the "problem" case	Name of the disease or definitive diagnosis.
2	General context	Reference framework with key concepts for the development of the case. General ideas as a clinical record. Keywords of the theoretical contents of the case.
3	Animal Husbandry context	Description of Animal Husbandry and/or Animal Management elements e.g., housing conditions, pasture management, genetics of biological material, animal health measures, prophylaxis, productive parameters, etc.
4	Clinical context	Description of Clinical and Pathological elements e.g., general signology, necropsy, complementary laboratory tests, physiological constants, auscultation, forms and types of respiration, diarrhea, psychomotor imbalances, etc.
5	General objective	Statement that indicates the learning, skills or knowledge that the development of the case-problem is intended to achieve in accordance with the curriculum.
6	Specific objectives	Short statements that allow the fulfillment of the general objective.
7	Guiding questions	Questions whose purpose is to guide the construction of learning objectives and the training route in the search for information and construction of learning.
8	Supplementary tests	Cabinet tests and laboratory tests e.g., complete blood counts, blood chemistry, general urinalysis, blood smear, skin scraping, impressions, coproparasitology, necropsy, biopsy, histopathology, PCR, immunofluorescence, immunohistology, etc.
9	Curriculum	You must point out the curricular contents that it includes.
10	Activity system	Learning activities: teaching and research that will be developed during the case and that will give evaluable results or products.
11	Evaluation system	Set of methods, criteria, instruments (qualitative and quantitative) and percentages to achieve a numerical evaluation.
12	Bibliography	Basic and complementary reference literature, as well as web pages and specialized magazines.

The information collected through the focus group allowed us to analyze the tutor's practice in relation to their experience in the preparation of PBL "problem" case studies.

This process mobilized a spectrum of their empirical and conceptual knowledge around the development of this didactic strategy? Achieving with this, an innovative, practical and instrumental design, structured from didactic elements inherent to the two training areas of the VMAH, the Clinical and Animal Husbandry.

Three central findings that must be present in the structuring and design of a PBL "problem" case studies were identified:

i) The Animal Husbandry context must contain descriptive elements of the immediate regional environment e.g., geography, climate, location and the species(s) involved in the case e.g., breed, genetics, production parameters, management, housing conditions (Howell *et al*., 2002; Schoenfeld-Tacher *et al*., 2005). In order to address animal health from an approach that links the environment with the medical perspective;

ii) The Clinical context must include adequate pathological elements and circumscribed to the PBL "problem" case studies to clearly define the disease (Lane, 2008; Schmidt *et al*., 2008). This guiding information will also make it possible to prepare presumptive and differential diagnoses to accurately reach the definitive diagnosis and propose the correct treatment; and

iii) The design of PBL "problem" case studies must be accompanied by a didactic system that clearly shows the formative spectrum of the discipline, the curricular contents, the learning activities and the evaluation criteria (Tarlinton *et al*., 2011; Putra *et al*., 2016). These elements must be inserted in the pedagogical framework of the needs of the profession and the school context, to ensure the achievement of the teaching-learning objectives.

Assess the design of PBL "problem" case studies

In Veterinary education, PBL represents one of the most popular and flexible teaching systems, which cultivates student self-direction skills (Micieli *et al.*, 2022). Its proper application replicates real-life experiences (Wang *et al.*, 2023), that stimulate the integration of knowledge and learning skills required for a Veterinary medical education (Álvarez *et al.*, 2022).

The PBL process has been described as: fun, interesting, motivating, and stimulating by the student body (Alduraibi *et al.*, 2022; Ali *et al.*, 2022a; Ardoin *et al.*, 2022). Its success depends on the careful selection of PBL "problem" case studies (Bains *et al.*, 2022). On the integration of knowledge acquired by students throughout the curriculum (Bisbee *et al.*, 2022), it is said to awaken in students: i) critical thinking, ii) the ability to problem-solve, iii) independent learning, and iv) a holistic approach to a case (Brown, 2022; Bukumiric *et al.*, 2022; Chan *et al.*, 2022).

PBL has long been highlighted as an attractive curricular alternative for Veterinary education (Virk *et al.*, 2022), which is why several Veterinary schools worldwide have integrated PBL into their curricula on a permanent basis (Rivarola and García, 2000; Cox, 2001; Howell *et al.*, 2002; Schoenfeld-Tacher *et al.*, 2005; Lane, 2008; Schmidt *et al.*, 2008; David and Irizarry, 2009; Tarlinton *et al.*, 2011; Putra *et al.*, 2016).

A curriculum based almost entirely on PBL in medical education schools is feasible and could encourage students to improve their autonomous learning skills, acquire adequate knowledge in basic sciences, and experience positive effects on learning clinical medicine (Bai *et al.*, 2023; Sharma *et al.*, 2023; Zhang *et al.*, 2023). However, better preparation of the student body for integrated learning of basic and clinical sciences, and further training of PBL tutors, are still needed to improve the effectiveness of tutorial discussions.

Conclusions

The purpose of this paper was to describe and exemplify a theoretical-methodological proposal for designing case studies used in PBL.

We analyzed the profession and the empirical knowledge of teachers applying this proposal. From this perspective, the structure of the case studies' "problems" was identified as the central characteristic of PBL. The educational context of Veterinary Medicine and Animal Husbandry was examined, highlighting the importance of correctly designing "problems" that reflect real-world contexts in teaching. The primary result described a methodological proposal for the design as an example of case “Campaign diseases and mandatory reporting in poultry for meat and egg production”. With this conceptual approach, it is feasible that the proposal will provide success in other settings, and according to the educational context of the school. It allows teachers to reconsider the didactic system of the method, ultimately enabling the adaptation of the implementation to each specific teaching situation. In conclusion, the design of carefully selected "problem" cases is valued for its role as an active methodology. This approach aims to ensure an efficient process whereby students can engage with the curriculum in a manner that prepares them effectively for their future careers.

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

Lozano-Salmorán, Edgar Fidel: Writing original draft.
Hernández-Rivera, Juan Augusto: Review and correction.
Gómez-Nashiki, Antonio: Data curation.
Silva-del Rio, Noelia: Supervision.

Availability of data and materials

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Abbreviations

FVMAH	Faculty of Veterinary Medicine and Animal Husbandry
IA	Investigation-Action
PBL	Problem-Based Learning
VMAH	Veterinary Medicine and Animal Husbandry

References

Antecedents

Chan, S. C. C., Gondhalekar, A. R., Choa, G., and Rashid, M. A. [2022]. Adoption of Problem-Based Learning in medical schools in non-western countries: a systematic review. Teaching and Learning in Medicine. 1-12.

Sharma, S., Saragih, I. D., Tarihoran, D., and Chou, F. H. [2023]. Outcomes of Problem-Based Learning in nurse education: a systematic review and meta-analysis. Nurse Education Today. 105631.

Trullas, J. C., Blay, C., Sarri, E., and Pujol, R. [2022]. Effectiveness of Problem-Based Learning methodology in undergraduate medical education: a scoping review. BMC Medical Education. 104-109.

Basics

Alduraibi, S. K., Sadik, A. E., Elzainy, A., Alsolai, A., and Alduraibi, A. [2022]. Medical imaging in Problem-Based Learning and impact on the students: a cross-sectional study. Journal of the Pakistan Medical Association. 1731-1735.

Ali, K., Daud, A., Ba Hattab, R., Philip, N., Matoug-Elwerfelli, M., Anweigi, L., Al Khabuli, J., and Du, X. [2022a]. Development of self-regulation amongst dental students in Problem-Based Learning curricula: a qualitative study. European Journal of Dental Education. 1-10.

Ali, K., Du, X., and Lundberg, A. [2022b]. Does Problem-Based Learning facilitate enactment of learner agency in undergraduate dental curricula? a Q study. European Journal of Dental Education. 7-11.

Allert, C., Dellkvist, H., Hjelm, M., and Andersson, E. K. [2022]. Nursing students' experiences of applying Problem-Based Learning to train the core competence teamwork and collaboration: an interview study. Nursing Open. 569-577.

Almulhem, M. A., and Almulhem, J. A. [2022]. Evaluation of Problem-Based Learning implementation in a College of Medicine, Kingdom of Saudi Arabia: a cross sectional comparative study. BMC Medical Education. 311-320.

Alt, D., Weinberger, A., Heinrichs, K., and Naamati-Schneider, L. [2022]. The role of goal orientations and learning approaches in explaining digital concept mapping utilization in Problem-Based Learning. Current Psychology. 1-16.

Álvarez, E., Nichelason, A., Lygo-Baker, S., Olin, S., Whittemore, J., and Ng, Z. [2022]. Virtual clinics: a student-led, Problem-Based Learning approach to supplement veterinary clinical experiences. Journal of Veterinary Medical Education. e202101444.

Ardoin, T. W., Hamer, D., Stumpf, M., and Miles, L. [2022]. Integrating Problem-Based Learning into an internal medicine residency curriculum. Ochsner Journal. 324-343.

Bai, S., Zhang, L., Ye, Z., Yang, D., Wang, T., and Zhang, Y. [2023]. The benefits of using atypical presentations and rare diseases in Problem-Based Learning in undergraduate medical education. BMC Medical Education. 93-104.

Bains, M., Kaliski, D. Z., and Goei, K. A. [2022]. Effect of self-regulated learning and technology-enhanced activities on anatomy learning, engagement, and course outcomes in a Problem-Based Learning program. Advances in Physiology Education. 219-227.

Bisbee, C. A., Vaccaro, M. J., and Awan, O. A. [2022]. Problem-Based Learning in radiology education: benefits and applications. Academic Radiology. 45-52.

Brown, G. [2022]. Proposing Problem-Based Learning for teaching future forensic speech scientists. Science & Justice. 669-675.

Bukumiric, Z., Ilic, A., Pajcin, M., Srebro, D., Milicevic, S., Spaic, D., Markovic, N., and Corac, A. [2022]. Effects of Problem-Based Learning modules within blended learning courses in medical statistics - a randomized controlled pilot study. PLoS One. e0263015.

Chi, M., Wang, N., Wu, Q., Cheng, M., Zhu, C., Wang, X., and Hou, Y. [2022]. Implementation of the Flipped Classroom combined with Problem-Based Learning in a medical nursing course: a quasi-experimental design. Healthcare. 1-10.

Cox, J. E. [2001]. Veterinary education and Problem-Based Learning. The Veterinary Journal. 84-87.

David, J., and Irizarry, K. J. [2009]. Using the PubMatrix literature-mining resource to accelerate student-centered learning in a veterinary Problem-Based Learning curriculum. Journal of Veterinary Medical Education. 202-208.

Farnsworth, C. C. [1997]. Measuring the effects of Problem-Based Learning on the development of veterinary students' clinical expertise. Academic Medicine. 552-554.

Fung, J. T. C., Chan, S. L., Takemura, N., Chiu, H. Y., Huang, H. C., Lee, J. E., Preechawong, S., Hyun, M. Y., Sun, M., Xia, W., Xiao, J., and Lin, C. C. [2023]. Virtual simulation and Problem-Based Learning enhance perceived clinical and cultural competence of nursing students in Asia: a randomized controlled cross-over study. Nurse Education Today. 105721.

Howell, N. E., Lane, I. F., Brace, J. J., and Shull, R. M. [2002]. Integration of Problem-Based Learning in a veterinary medical curriculum: first-year experiences with application-based learning exercises at the University of Tennessee College of Veterinary Medicine. Journal of Veterinary Medical Education. 169-175.

Lane, E. A. [2008]. Problem-Based Learning in veterinary education. Journal of Veterinary Medical Education. 631-636.

Lang, K., and Parkinson, B. [2023]. Problem-Based Learning in nurse education. Evidence-Based Nursing. 10-16.

Lara, V., Ávila, J. and Olivares, S. [2017]. Critical thinking development through the implementation of problem-based learning. Psicologia Escolar e Educacional. 65-77.

Ma, C. W. [2022]. How to advance medical education using journal articles? Insight from Problem-Based Learning. GMS Journal for Medical Education. Doc48.

Micieli, F., Valle, G. D., Del Prete, C., Ciaramella, P., and Guccione, J. [2022]. The use of virtual Problem-Based Learning during COVID-19 pandemic emergency: veterinary students' perception. Veterinary Sciences. 1-12.

Nomura, O., Soma, Y., Kijima, H., and Matsuyama, Y. [2023]. Adapting the motivated strategies for learning questionnaire to the Japanese Problem-Based Learning context: a validation study. Children. 14-21.

Putra, T. A., Hezmee, M. N., Farhana, N. B., Hassim, H. A., Intan, S. A. R., Lokman, I. H., Hamali, A. Y., Salisi, M. S., Ghani, A. A., Shahudin, M. S., Qayyum, M. A., Hafandi, A., Speare, R., and Fenwick, S. G. [2016]. The application of One Health concept to an outdoor Problem-Based Learning activity for veterinary students. Veterinary World. 955-959.

Rand, J. S., and Baglioni, A. J., Jr. [1997]. Subject-based Problem-Based Learning in the veterinary science course at the University of Queensland. Australian Veterinary Journal. 120-125.

Rivarola, V. A., and García, M. B. [2000]. Problem-Based Learning in veterinary medicine: protein metabolism. Biochemical Education. 30-31.

Sarmiento, R. J., Aya, P. P. A., and Perdomo, O. J. [2022]. Proposal of design and innovation in the creation of the Internet of medical things based on the CDIO model through the methodology of Problem-Based Learning. Sensors. 12-22.

Schmeltz, M. T., and Ganesh, C. [2022]. Improving the capacity and diversity of local public health workforce to address climate impacts to health through community partnerships and Problem-Based Learning. Frontiers in Public Health. 1090129.

Schmidt, P. L., Trevejo, R. T., and Tkalcic, S. [2008]. Veterinary public health in a Problem-Based Learning curriculum at the Western University of Health Sciences. Journal of Veterinary Medical Education. 212-218.

Schoenfeld-Tacher, R., Bright, J. M., McConnell, S. L., Marley, W. S., and Kogan, L. R. [2005]. Web-based technology: its effects on small group “Problem-Based Learning" interactions in a professional veterinary medical program. Journal of Veterinary Medical Education. 86-92.

Servos, U., Reiss, B., Stosch, C., Karay, Y., and Matthes, J. [2023]. A simple approach of applying blended learning to Problem-Based Learning is feasible, accepted and does not affect evaluation and exam results-a just pre-pandemic randomised controlled mixed-method study. Naunyn-Schmiedeberg's Archives of Pharmacology. 139-148.

Shad, M. U., Onwuameze, O., Sioson, K., Khan, A. H., Khalid, K., and Glick, I. [2023]. Problem-Based Learning in Psychopharmacology. Academic Psychiatry. 111-112.

Showstark, M., Joosten-Hagye, D., Wiss, A., Resnik, C., Embry, E., Zschaebitz, E., Symoniak, M. R., Maxwell, B., Simmons, A., and Fieten, J. [2023]. Results and lessons learned from a virtual multi-institutional Problem-Based interprofessional Learning approach: The VIPE program. Journal of Interprofessional Care. 164-167.

Staff, P. O. [2023]. Correction: assessing the attitude and Problem-Based Learning in mathematics through PLS-SEM modeling. PLoS One. e0280909.

Sun, M., Chu, F., Gao, C., and Yuan, F. [2022]. Application of the combination of three-dimensional visualization with a Problem-Based Learning mode of teaching to spinal surgery teaching. BMC Medical Education. 840-850.

Tadesse, S. G., Tadesse, D. G., and Dagnaw, E. H. [2022]. Problem-Based Learning approach increases the academic satisfaction of health science students in Ethiopian universities: a comparative cross-sectional study. BMC Medical Education. 334-340.

Tarlinton, R. E., Yon, L., Klisch, K., Totemeyer, S., and Gough, K. C. [2011]. Confidence as a barrier to the use of Problem-Based Learning in veterinary undergraduate students. Journal of Veterinary Medical Education. 305-310.

Tsai, C. L., Chiu, Y. L., Chao, C. T., Lin, M. W., Ho, C. C., Chen, H. L., Sheu, B. C., Hsu, C., and Yang, C. W. [2022]. Effectiveness of tutor shadowing on faculty development in Problem-Based Learning. BMC Medical Education. 564-570.

Virk, A., Mahajan, R., and Singh, T. [2022]. Conceptualizing Problem-Based Learning: an overview. International Journal of Applied and Basic Medical Research. 1-3.

Wang, A., Xiao, R., Zhang, C., Yuan, L., Lin, N., Yan, L., Wang, Y., Yu, J., Huang, Q., Gan, P., Xiong, C., Xu, Q., and Liao, H. [2022]. Effectiveness of a combined Problem-Based Learning and flipped classroom teaching method in ophthalmic clinical skill training. BMC Medical Education. 487-493.

Wang, X., Sun, D., Cheng, G., and Luo, H. [2023]. Key factors predicting Problem-Based Learning in online environments: Evidence from multimodal learning analytics. Frontiers in Psychology. 1080294.

Webster, A., Metcalf, A., Kelly, L., Bisesi, A., Marnik-Said, M., Colbeck, C., Marine, R., Vinces, M., Campbell, A., and Allen, T. [2022]. Undergraduates' lived experience of Project-Problem-based Learning in introductory Biology. Advances in Physiology Education. 162-178.

Wondie, K. Y., Endale, Z. M., Abrahim, A. H., Asefa, A. A., Alamneh, A. A., Berihun, B. K., Adamu, B. K., Selamsew, B. A., Kebede, A. A., and Tsega, N. T. [2022]. Factors affecting knowledge and attitude towards hybrid Problem-Based Learning curriculum among academicians of the University of Gondar, Northwest Ethiopia. Advances in Medical Education and Practice. 685-695.

Wong, F. M. F., and Kan, C. W. Y. [2022]. Online Problem-Based Learning intervention on self-directed learning and problem-solving through group work: a waitlist controlled trial. International Journal of Environmental Research and Public Health. 23-30.

Wormley, M. E., Romney, W., Veneri, D., and Oberlander, A. [2022]. Doctoral physical therapy students' increased confidence following exploration of active video gaming systems in a Problem-Based Learning curriculum in the United States: a pre- and post-intervention study. Journal of Educational Evaluation for Health Professions. 7-16.

Xie, H., Wang, L., Pang, Z., Chen, S., Xu, G., and Wang, S. [2022]. Application of Problem-Based Learning combined with a virtual simulation training platform in clinical biochemistry teaching during the COVID-19 pandemic. Frontiers in Medicine. 985128.

Xu, X., Wang, Y., Zhang, S., and Liu, F. [2022]. Performance of Problem-Based Learning based image teaching in clinical emergency teaching. Frontiers in Genetics. 931640.

Zamir, S., Yang, Z., Wenwu, H., and Sarwar, U. [2022]. Assessing the attitude and Problem-Based Learning in mathematics through PLS-SEM modeling. PLoS One, 17(5), e0266363.

Zhang, F., Wang, H., Bai, Y., and Zhang, H. [2022]. A bibliometric analysis of the landscape of Problem-Based Learning research (1981-2021). Frontiers in Psychology. 828390.

Zhang, X., Zhang, G., Liu, J., Song, X., Li, M., Zhang, Y., Hao, J., Wang, C., and Li, H. [2023]. Cross-sectional study of the quality of randomized control trials on Problem-Based Learning in medical education. Clinical Anatomy. 151-160.

Zheng, B., and Wang, Z. [2022]. Near-peer teaching in Problem-Based Learning: perspectives from tutors and tutees. PLoS One. e0278256.

Zhu, M., and Zhang, K. [2022]. Promote collaborations in online Problem-Based Learning in a user experience design course: educational design research. Education and Information Technologies. 1-19.

Agenda 21 as a reference for the development of sustainable public policies in cities of Brazil (1999-2023)

Agenda 21 como referencia para el desarrollo de políticas públicas sostenibles en ciudades de Brasil (1999-2023)

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Field: Geography
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Key Handbooks

Analyzing the role of Agenda 21 as a framework for guiding the development of sustainable public policies in cities of Brazil over the period from 1999 to 2023. Providing insights into the effectiveness of Agenda 21 in fostering collaboration between government entities, civil society organizations, and the private sector to address environmental challenges and achieve long-term sustainability goals in Brazilian cities. Offering recommendations for enhancing the implementation of Agenda 21 principles and practices in urban policymaking processes, thereby contributing to the advancement of science and technology in the field of sustainable urban development. Interdisciplinary approach, embrace interdisciplinary perspectives to explore diverse fields of knowledge and uncover connections between them. This allows for a holistic understanding of complex phenomena and promotes innovation through the integration of different disciplines. Contextual understanding, recognize the importance of context in shaping knowledge generation. Consider social, cultural, historical, and environmental factors that influence the production and dissemination of knowledge across different communities and regions. Critical thinking, foster critical thinking skills to question assumptions, challenge existing paradigms, and evaluate evidence rigorously. This involves being open-minded, skeptical, and willing to engage with diverse viewpoints to refine and enrich understanding. Communication skills, develop effective communication skills to convey complex ideas, findings, and insights to diverse audiences in clear, accessible, and engaging ways. This facilitates knowledge dissemination and promotes dialogue and collaboration among stakeholders. The main conclusion of this paragraph is that Agenda 21 serves as a reference for the development of public policies in Brazil, aligning economic and social needs with environmental limitations. However, the research reveals a disconnect between this guiding framework and the actual formulation of public policies at the local level in Brazilian cities. This discrepancy is attributed to political fragmentation, lack of systemic vision among public managers, and failure to enforce the City Statute. To address the worsening economic, social, and environmental challenges facing Brazil in the 21st century, effective political coordination across all levels of government is urgently needed. Public managers must commit to developing and implementing policies that align with the principles of Agenda 21 and the Cities Statute to ensure the country's readiness for a paradigm shift towards sustainability

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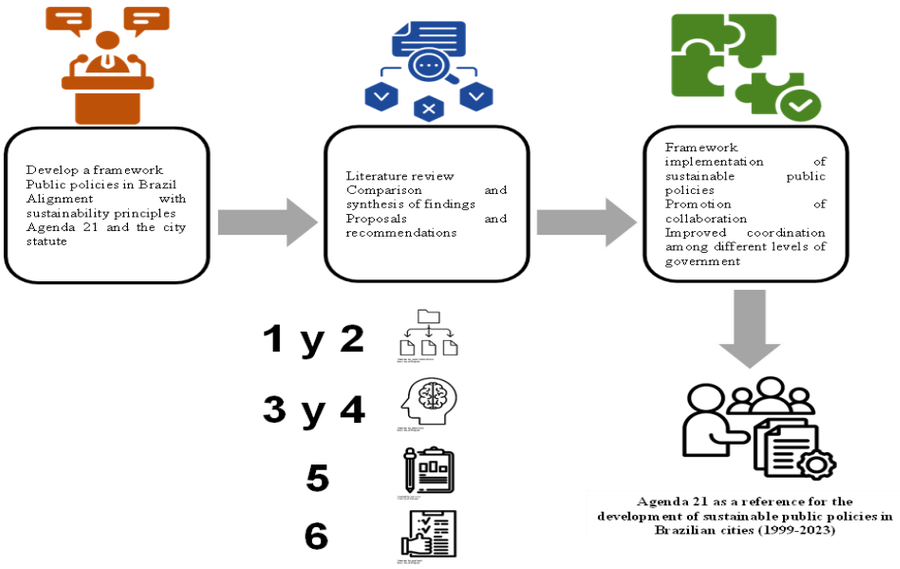
Abstract

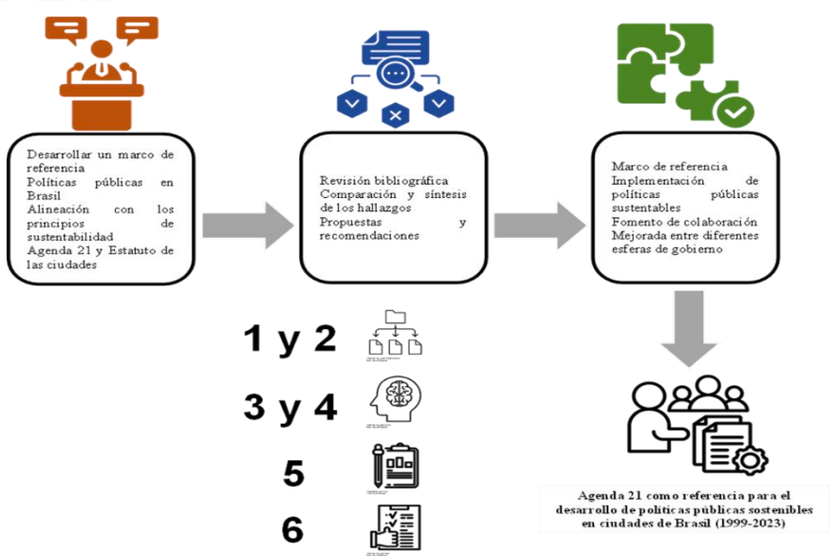
Urban planning in Brazil has faced serious challenges due to Agenda 21. Therefore, the objectives are to develop a reference framework for the effective implementation of public policy in Brazil that aligns with sustainability principles and to succinctly present the application of Agenda 21 and the Statute of Cities in the formulation and execution of public policies in Curitiba and São Paulo. The methodology involved a bibliographic review of literature related to urban sustainability, Agenda 21, and the Statute of Cities, as well as the comparison and synthesis of findings from the bibliographic review, and finally the development of proposals and general recommendations to strengthen the integration of urban sustainability into Brazilian public policies. Results showed that urban planning in Brazil during the 1980s and 1990s was neglected, partly as a rejection of the authoritarian, bureaucratic, and centralizing planning of the military regime, which has changed from 2000 to the present. Conclusions indicate that the principles outlined by Agenda 21 emerge as an option capable of reconciling economic and social needs with the intrinsic limitations of the environment.



COVID-19, Sustainable territorial development, Geography, Urban landscape, Sustainability

Resumen

La planificación urbana en Brasil ha enfrentado serios desafíos por la Agenda 21. De ahí que, los Objetivos son desarrollar un marco de referencia para la implementación efectiva de política pública en Brasil, que estén alineadas a los principios de sustentabilidad y exponer de manera sintetizada la aplicación de la Agenda 21 y el estatuto de las Ciudades en la formulación y ejecución de políticas públicas en Curitiba y Sao Paulo. Metodología, implicó la revisión bibliográfica de literatura relacionada con la sustentabilidad urbana, la Agenda 21, el Estatuto de las Ciudades así como la comparación y síntesis de hallazgos de la revisión bibliográfica y finalmente la elaboración de propuestas y recomendaciones en general para fortalecer la integración de la sustentabilidad urbana en las políticas públicas brasileñas. Resultados, la planificación urbana en Brasil durante las décadas de 1980 y 1990 fue descuidada, en parte como rechazo a la planificación autoritaria, burocrática y centralizadora del régimen military, lo cual a partir del 2000 al presente ha cambiado. Conclusiones, los principios delineados por la Agenda 21 surgen como una opción capaz de reconciliar las necesidades económicas y sociales con las limitaciones intrínsecas del medio ambiente.



COVID-19, Desarrollo territorial sustentable, Geografía, Paisaje urbano, Sustentabilidad

Introduction

In the context of Brazilian cities, the implementation of the Agenda 21 is crucial due to several reasons: I) Brazil is one of the most urbanized countries in the world, with a significant portion of its population residing in cities. Rapid urbanization brings forth challenges such as increased demand for infrastructure, services, and resources, as well as issues related to pollution, congestion, and social inequality. The Agenda 21 provides a framework for addressing these challenges through sustainable urban development strategies (Alcides et al., 2021).

II) Brazil is home to diverse ecosystems, including the Amazon rainforest, the Atlantic Forest, and the Pantanal wetlands, among others. Preserving these ecosystems is not only essential for biodiversity conservation but also for mitigating climate change and ensuring the provision of ecosystem services such as clean water, air, and food. The Agenda 21 promotes sustainable land use practices and the protection of natural resources, which are particularly relevant for Brazilian cities facing pressures from urban expansion and infrastructure development (Beck et al., 2023).

III) Inequality is a significant issue in Brazilian cities, with disparities in access to basic services, housing, education, and healthcare as in Acapulco, Mexico (Niño-Gutiérrez, 2022b). The Agenda 21 emphasizes the importance of social equity and inclusion in sustainable development efforts, advocating for participatory decision-making processes that involve marginalized communities and address their needs and priorities. By promoting inclusive policies and initiatives, Agenda 21 can contribute to building more equitable and resilient cities in Brazil (Dávalos & Romo, 2017).

IV) Adopting sustainable practices in cities can also create economic opportunities by fostering innovation, green technologies, and sustainable businesses. Brazilian cities have the potential to become hubs for sustainable urban development, attracting investment, generating employment, and driving economic growth while reducing environmental impacts. The Agenda 21 provides a framework for harnessing these opportunities and promoting green growth strategies that benefit both people and the planet (Guzmán, 2020).

V) Agenda 21: Refers to a comprehensive action plan developed by the United Nations at the Earth Summit in Rio de Janeiro in 1992. It outlines principles and guidelines for sustainable development across various sectors, including environmental protection, social equity, and economic prosperity (Perea Palomino, 2020).

Reference for the development of sustainable public policies: This highlights the role of Agenda 21 as a guiding framework or reference point for the formulation and implementation of sustainable public policies in different areas such as urban planning, transportation, waste management (Brasil, 2001), and environmental conservation. In cities of Brazil: This specifies the geographical focus of the study, emphasizing that the application of Agenda 21 principles and sustainable public policies is particularly relevant to urban areas in Brazil. Brazilian cities face unique challenges related to rapid urbanization, environmental degradation, social inequality, and economic development, making them important contexts for the implementation of sustainable initiatives (Duque, 2021).

The problem: to be solved revolves around the urgent need to address sustainability challenges in Brazilian cities. These cities are facing a multitude of interconnected issues including environmental degradation, social inequality, inadequate infrastructure, urban sprawl, and economic disparities. Rapid urbanization, population growth, and unsustainable resource consumption exacerbate these challenges, posing significant threats to the well-being of urban residents and the environment.

The central question that the agenda 21 seeks to address in Brazilian cities is how to achieve sustainable development that balances environmental protection, social equity, and economic prosperity. Specifically, it aims to find solutions to the following key issues:

Environmental degradation: Brazilian cities are grappling with pollution, deforestation, loss of biodiversity, and depletion of natural resources. The central question is how to promote environmental conservation and minimize environmental impacts while meeting the needs of urban populations (Ariza & Moreno, 2017).

Social inequality: There is a stark divide between affluent and marginalized communities in Brazilian cities, with disparities in access to basic services, housing, education, healthcare, and employment opportunities. The central question is how to promote social inclusion and ensure that all residents have equitable access to resources and opportunities for a decent quality of life (Oliveira et al., 2020).

Inadequate infrastructure: Many Brazilian cities suffer from inadequate infrastructure, including transportation systems, sanitation facilities, and housing something similar happens in other Latin American countries like Mexico where the effects of climate change are even present (Niño-Gutiérrez, 2022a). The central question is how to improve infrastructure to enhance urban mobility, public services, and living conditions while minimizing negative environmental impacts.

Urban sprawl and land use: Unplanned urban expansion and land use changes are contributing to the loss of green spaces, increased traffic congestion, and environmental degradation. The central question is how to promote compact, efficient, and sustainable urban development patterns that optimize land use, preserve natural habitats, and promote walkability and accessibility (Marques et al., 2021).

Economic development: Economic disparities and uneven distribution of wealth are persistent challenges in Brazilian cities. The central question is how to foster inclusive economic growth that generates employment, reduces poverty, and promotes prosperity for all while ensuring environmental sustainability and social equity (Parode & Bentz, 2014). In summary, the central question addressed by the agenda 21 in Brazilian cities is how to achieve sustainable development by addressing environmental, social, and economic challenges in an integrated and holistic manner. It seeks to find solutions that promote the well-being of current and future generations while preserving natural resources and protecting the environment on continent as well as on the islands of the world and even Mexico (Niño-Gutiérrez, et al., 2023a).

The sections chapter, the introduction sets the stage for the paper by providing background information on the topic, including the importance of sustainable development in Brazilian cities and the relevance of Agenda 21 as a framework for addressing urban challenges. It may include a brief overview of the current state of Brazilian cities, highlighting key issues such as environmental degradation, social inequality, and inadequate infrastructure. The introduction typically concludes with a statement of the research problem or question that the paper seeks to address, as well as an outline of the paper's objectives and structure.

The objective section explicitly states the main goals or aims of the research. It clarifies what the study seeks to achieve, such as identifying the impact of Agenda 21 on urban sustainability in Brazilian cities, assessing the effectiveness of sustainable policies, or exploring best practices for implementation. Objectives should be specific, measurable, achievable, relevant, and time-bound (SMART) to provide clear guidance for the research process even in other Latin American countries such as the southern states of Mexico (Niño-Gutiérrez et al., 2023b).

Methodology section describes the overall approach and research design used in the study. It outlines the methods and techniques employed to collect and analyze data, such as literature review, case studies, surveys, interviews, or statistical analysis. Methodological considerations such as sampling strategy, data collection procedures, and data analysis techniques are discussed in this section. The methodology should be appropriate for addressing the research objectives and generating reliable findings.

The method section provides detailed information on how the research was conducted. It includes step-by-step descriptions of data collection procedures, including sources of data, sampling methods, data collection instruments, and data analysis techniques. Any ethical considerations or limitations associated with the research process should also be addressed in this section. The method section should be sufficiently detailed to allow other researchers to replicate the study if desired.

The results section presents the findings of the study based on the data collected and analyzed. It typically includes tables, figures, charts, or narrative descriptions of key findings, organized according to the research objectives or themes. Results should be presented objectively and clearly, with appropriate

interpretation and discussion of their significance. Any unexpected or noteworthy findings should be highlighted, along with their implications for theory, practice, or policy.

The conclusion section summarizes the main findings of the study and their implications. It restates the research objectives and discusses how well they were achieved based on the results obtained. The conclusion may also offer recommendations for future research, policy implications, or practical applications based on the findings. It provides closure to the paper by reinforcing the significance of the research and highlighting its contribution to the field.

Objective of the Study: general objective, to assess the utilization of Agenda 21 as a guiding framework for the formulation and implementation of sustainable public policies in Brazilian cities from 1999 to 2023 and specific objective, analyze the adoption and integration of Agenda 21 principles into the policymaking processes of selected Brazilian cities over the specified period. This article proposes an evolutionary analysis of the debate surrounding sustainable development, highlighting how the principles established by Agenda 21 and the Statute of Cities can guide the formulation of public policies aimed at urban sustainability in Brazil. The central question of this study lies in investigating the feasibility and effectiveness of Agenda 21 as a reference for the design of public policies in the Brazilian context (Author's surname, year).

Research question, what are three central ideas about the implementation of Agenda 21 and its relevance for the near future in Brazilian cities in terms of sustainable development and quality of life?

Methodology, methodological steps: *a)* Literature review, conducting a comprehensive review of academic and technical literature related to the implementation of Agenda 21 and sustainable development in Brazilian cities. This involved accessing academic databases, specialized journals, books, and other relevant resources such as previous studies, government reports, public policy documents, and other sources addressing the topic in the Brazilian context; *b)* Analyze the collected information to identify trends, challenges, and opportunities in the implementation of Agenda 21 in Brazilian cities. *c)* Synthesize the findings obtained from the literature to identify three central ideas about the implementation of Agenda 21 and its relevance for the near future in Brazilian cities and *d)* Formulate conclusions and recommendations based on the study's findings, highlighting implications for public policy formulation and urban planning in Brazil. This integrated methodology allows for a comprehensive and multifaceted understanding of the implementation of Agenda 21 and sustainable development in Brazilian cities, as well as identifying central ideas and recommendations for the near future.

The method used in this research is qualitative, suitable when the object of study is complex, social in nature and not susceptible to quantification, according to Liebscher (1998). The qualitative approach is essential to understand the social and cultural context underlying the theme of urban sustainability. To achieve the purpose of this research, a bibliographic survey was conducted in the databases of the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), Ministry of Cities, United Nations Environment Program and Folha de São Paulo. Furthermore, the works of renowned authors in the area of urban sustainability were explored, including Pedro Jacobi.

Data collection was carried out online, between March and August 2011. The research involved the use of keywords such as "cities", "public policies", "sustainable development" and "urban sustainability" to identify and evaluate the most relevant articles on the topic, based on the analysis of bibliographic references and summaries of relevant articles. It's possible to interpret and contextualize complex information, taking into account cultural, historical, and socioeconomic factors specific to Brazilian cities. This contextual understanding helps in identifying patterns, trends, and correlations that may not be evident through traditional analytical methods alone.

Contributions, some of the contributions include: providing an overview of how Agenda 21 influenced the development of certain sustainable public policies implemented in Brazilian cities such as Curitiba and São Paulo over a period of 24 years. Another contribution involves identifying specific challenges encountered in selected Brazilian cities where the implementation of public policies based on the principles of Agenda 21 holds international significance and it provides practical recommendations to enhance the effectiveness of implementing sustainable policies in Brazilian cities, based on lessons learned from the implementation experience of Agenda 21.

Results

At the end of the 20th century, sustainability assumed a preponderant role in discussions about the current economic development model, considering its social and environmental impacts, both regionally and globally. The concept of sustainable development emerged as a response to the emerging ecological crisis, giving rise to two schools of thought for the formulation and debate of new development proposals. The report "The Limits of Growth", published by the Club of Rome in 1972, warned about the limits of humanity's growth in the context of the economic model then practiced, pointing out the need to freeze global population growth and of industrial capital. The document emphasized the scarcity of natural resources, reflecting a Malthusian approach (IBAMA, 2009).

The Stockholm Conference, in 1972, marked itself as the first global conference focused on the environment, representing a significant international political milestone. This conference gave rise to 25 fundamental principles that guided international actions, recognizing the importance of man as an agent for transforming the environment, emphasizing the need for balance between social progress, wealth creation, scientific advances and environmental preservation (Passos, 2009; IBAMA, 2009).

The Bruntland Report, titled "Our Common Future" and prepared by the UN Commission on Environment and Development in 1987, addressed social issues related to land use, housing, access to water, social, educational and health services. It also dealt with the management of urban growth (Barbosa, 2009).

Twenty years after the Stockholm Conference, Eco 92 took place in Rio de Janeiro, bringing together heads of state to address development inequalities between nations and environmental preservation. This event introduced the concept of sustainable development, a model that integrates economic growth, environmental preservation and social inclusion. Among the international agreements resulting from Eco 92, the Climate Convention, Agenda 21, Biodiversity Convention and the Rio Declaration stand out, influencing environmental regulations in several countries (Folha Online, 2002).

Rio + 10, held in Johannesburg ten years after Eco 92, reaffirmed previous commitments and the challenges faced by nations, committing to sustainable development and democratic multilateralism. This conference highlighted the importance of joint actions to achieve the proposed objectives (Public Management Quality Committee, 2002).

The concept of sustainable development, according to the Brundtland Report (1991), aims to meet current needs without compromising the ability of future generations to meet their own needs, maintaining an adequate level of social, economic, human and cultural development, in addition to ensuring the rational use of natural resources and the preservation of habitats and species.

To make commitments made in international forums viable, the State plays a crucial role in supporting sustainable development through economic and legal instruments, regulation, management of social contracts and promotion of policies that induce planned strategies (Bird, 1997; Bursztyn, 2001).

Sustainable development, as a driver of public policies, requires a national development plan and the consideration of a wide range of social actors and interests, which can represent a challenge for public policies that seek the intersection between economic, social and social development. environmental preservation (Bezerra & Bursztyn, 2000).

Urban sustainability demands a reassessment of development models and social, environmental and economic relations in cities. This approach aims to maintain environmental health, reduce social inequalities, provide a healthy built environment and establish political pacts and citizenship actions to face present and future challenges (Silva, 2003).

In the context of public policies, they are understood as government action programs that coordinate state means and private activities to achieve objectives relevant to society (Bucci, 2002; Muller & Surel, 1998). Cities, in turn, play a fundamental role in the construction of public policies that cover the social, environmental and economic pillars of sustainability.

From the 1960s onwards, Brazil witnessed an intense urbanization process, whose lack of adequate planning resulted in a series of socio-environmental and economic problems. Rapid urban growth has generated issues such as more frequent floods, inadequate disposal of solid waste, irregular occupation of environmentally sensitive areas, such as slopes and floodable areas, in addition to precarious settlements characterized by social exclusion and unequal access to public investments (Romualdo & Souza, 2009; Costa & Braga, 2004).

Jacobi (2006) highlights a continuous worsening of these problems in large Brazilian cities. This scenario reflects a model of urban occupation that amplifies socioeconomic disparities, highlighting the ineffectiveness of public policies in identifying, correcting and proposing measures to organize urban space and improve the quality of life of all citizens.

The environmental crisis resulting from these inadequate administrative practices, together with the delay in implementing public policies, is associated with crucial issues.

Reduction of green areas, soil sealing and increase in areas susceptible to flooding negatively impact the urban structure and generate significant environmental, social and economic consequences (Jacobi, 2006).

Furthermore, the lack of measures to control air pollution, expand the public transport system and improve the sewage network contributes to the contamination of urban water sources and rivers, in addition to the exhaustion of conventional waste disposal methods, resulting in problems public health and worsening the precarious housing conditions of part of the population, often in risk areas (Jacobi, 2006).

Brazilian urban planning, especially in the 1980s and 1990s, was neglected, partly as a rejection of the authoritarian, bureaucratic and centralizing planning practiced during the military regime. This stance resulted in serious urban problems. When urban growth is not accompanied by equitable investments in infrastructure and democratic access to urban services, socio-spatial inequalities are accentuated (Guerra & Cunha, 2006). In this context, cities and metropolitan regions reveal significant disparities in income distribution, as confirmed by Jacobi (2006). Thus, reducing poverty and combating urban violence require a coordinated approach through effective public policies that meet these needs, reinforcing the need for intersectoral action at the municipal and regional levels.

Sustainable urban mobility: Expansion of public transportation: São Paulo can implement policies to expand and improve its public transportation system, including the extension of metro lines, integration of different modes of transportation (metro, bus, light rail, bicycle), and creation of exclusive bus lanes (Figure 1).

Box 1

Figure 1

Bus in Ribeirao, Brazil

Source: Taken by the authors

Incentives for active mobility: Programs and policies can be established to promote cycling and walking, such as creating safe bike lanes, implementing bike-sharing systems, and pedestrianizing certain urban areas; traffic management and vehicle restrictions, traffic management policies can help reduce congestion and emissions of polluting gases by implementing urban tolls, vehicle circulation restrictions based on the day of the week or license plate, and promoting shared transportation systems.

Integrated waste management: Recycling and source separation: São Paulo can implement more effective recycling programs, including source separation and differential waste collection, as well as creating recycling centers and clean points for the proper disposal of recyclable materials; reduction of food waste: Public policies can encourage the reduction of food waste in the city through awareness campaigns, support for food donation initiatives, and promotion of more conscious and sustainable consumption practices and treatment and proper disposal of waste: São Paulo can work on improving the infrastructure for solid waste treatment, including the construction of composting plants and organic waste treatment facilities, as well as promoting environmentally safe disposal practices (Figure 2).

Box 2

Figure 2

Waste management in Ribeirao, Brazil

Source: Taken by the authors

Conservation and recovery of green spaces: Expansion of green areas and urban parks: São Paulo can develop policies to expand and improve accessibility to green areas and urban parks, creating new green spaces and enhancing the infrastructure of existing ones to promote outdoor recreation and urban biodiversity; restoration of degraded areas: Public policies can drive the restoration of degraded areas in the city, such as rivers and watercourses, through the implementation of renaturalization and reforestation projects, as well as the creation of biological corridors to connect fragmented habitats and promotion of urban agriculture and biodiversity: São Paulo can promote urban agriculture and biodiversity conservation in the city by encouraging community gardens, protecting areas of ecological value, and creating policies for the conservation of native fauna and flora.

Public policies and the status of cities, the search for sustainability in Brazilian cities, as discussed in chapter 2, represents a significant challenge in the context of the formulation and implementation of public policies. The effort to make cities sustainable requires the adoption of public policies that rethink the development model, promoting an interrelationship between social justice, quality of life, environmental balance and economic growth (Silva, T., 2003; Jacobi, 2006).

In this context, municipal policies face the challenge of integrating sustainability as a guiding guideline, aligned with the principles of Agenda 21, which advocates a vital connection between social equity, improved quality of life and development in line with the support capacity and community participation (Jacobi, 2006).

The role of the legislative branch is crucial in formulating public policies, while the executive branch assumes responsibility for their implementation. In case of omissions by the Public Power in the implementation of policies aimed at sustainable development, the judiciary has the role of demanding, through legal actions, that the executive complies with such measures.

Law Number 10 257, known as the Cities Statute, enacted on July 10, 2001, establishes the right of citizens to sustainable cities, covering urban land, housing, environmental sanitation, infrastructure, transport, public services, work and leisure, for current and future generations. Furthermore, it obliges municipalities to develop public policies that meet this right (Jacobi, 2006).

Silva, T. (2003, p. 8) highlights the Cities Statute as legislation that enshrines the guidelines of urban policy, guaranteeing the right to sustainable cities. This right covers several dimensions, from housing conditions to environmental preservation, representing a collective right to dignified urban life and access to a balanced environment and quality public services.

The statute of cities and Agenda 21, "Agenda 21", a document approved at Rio 92, outlines an action plan to be adopted globally, nationally and locally, aiming to establish guidelines for a change in the pattern of development in the 21st century. This document aspires to promote a new development model that harmonizes environmental protection, social justice and economic development (Silva, M., 2003).

Silva, M. (2003, p. 1) defines Agenda 21 as a participatory planning process that assesses the current situation and plans the future in a sustainable way, involving the whole of society in the discussion of the main problems and in the formulation of partnerships for the short-, medium- and long-term solution. This process requires an integrated approach to the economic, social, environmental and political-institutional dimensions, generating social insertion and opportunities to define priorities in public policies.

Chapter 28 of the global Agenda 21 proposes that each country develop a local Agenda 21, “based on economic, social and environmental development, establishing local environmental policies and supporting the implementation of national environmental policies” (Silva, 2003, p. 3).

The Cities Statute, aligned with the principles of Agenda 21, defends the implementation of local agendas to change unsustainable development patterns. The importance of the local level in implementing sustainable public policies is recognized.

According to Silva, T. (2003), for Brazilian cities to adapt to the ideals of Agenda 21 and the Statute of Cities, transformations are necessary in production and consumption patterns, which have degraded natural resources and affected the quality of life urban.

Strategic urban sustainability proposals for Brazilian cities include land use regulation, strengthening democratic management, changes in the production and consumption model, generation of sustainable jobs, application of economic mechanisms for the management of natural resources, among others.

Brazilian society, predominantly urban, plays and will play an increasingly important role in the formulation of public policies, seeking a balance between social, economic and environmental dimensions. The objective is to guarantee decent living conditions for everyone, promoting socioeconomic and environmental balance (*Ibídem*, 2003).

The alignment of the principles of Agenda 21 and the Statute of Cities, added to extensive research on Brazilian urban problems, becomes essential for the three powers (Executive, Legislative and Judiciary) in the elaboration, execution and supervision of sustainable public policies that address urban spaces and promote economic, social and environmental balance (Figure 3).

Box 3

Figure 3

Geographical situation of Brazil.

Source: IBGE, 2016.

The Agenda 21 in São Paulo and Curitiba

Efficient and sustainable public transportation: São Paulo, Implementation of measures to improve the quality and efficiency of public transportation, such as expanding the metro and suburban train network, optimizing bus routes, and promoting non-motorized transportation systems like bicycles and electric scooters.

Curitiba: Continuation and improvement of the innovative public transportation system known as "Bus Rapid Transit" (BRT), with the expansion of routes and integration with other modes of transportation, as well as promoting bicycle use by expanding the network of bike lanes and public bike stations.

Integrated waste management and promotion of recycling:

São Paulo: Implementation of waste separation programs at the source and expansion of the recycling point network, as well as promoting the circular economy through material reuse and waste reduction (Ferraresi de Araujo & Niño-Castillo, 2021).

Curitiba: Continuation and strengthening of the successful selective waste collection program, with active participation from the population in separating recyclable materials and expanding recycling infrastructure in the city.

Development of green spaces and environmental recovery: São Paulo, creation and restoration of urban parks and green areas, as well as protection of remnants of native vegetation, with the aim of improving air quality, providing recreation spaces, and promoting biodiversity in the city (Da Silva et al., 2019).

Curitiba: Continuation of the green area preservation and expansion program, including linear parks and urban forests, with the restoration of degraded areas and promotion of native fauna and flora conservation.

These central ideas reflect some of the key aspects of Agenda 21 implementation in the cities of São Paulo and Curitiba, highlighting key measures to promote sustainable development, improve the quality of life for residents, and protect the environment.

Some findings are related to: Strengthening sustainable transportation infrastructure: Implementing additional measures to improve and expand sustainable transportation infrastructure, such as expanding exclusive bus lane networks, building more bike lanes, and integrating public transportation systems to facilitate population mobility.

Promotion of active citizen participation: Developing programs and strategies to encourage active citizen participation in decision-making related to urban planning and environmental management, including awareness campaigns, digital participation platforms, and the creation of advisory councils representing various sectors of society (Scarpeline de Castro et al., 2019).

Investment in waste management technologies and programs: Allocating economic and technical resources to improve solid waste management systems, through the implementation of innovative recycling and waste treatment technologies, formalization of recycling cooperatives, and implementation of educational programs promoting responsible consumption practices and waste separation at the source (Oh & Hettiarachchi, 2020).

Agenda 21 and the near future, transition towards sustainable mobility: Expansion of public transportation: Implementing policies to expand and improve public transportation, including expanding metro networks, integrating different modes of transportation, and promoting electric transportation systems.

Promotion of active mobility: Encouraging the use of bicycles and walking by creating safe infrastructure such as bike lanes and pedestrian trails, as well as implementing bike-sharing systems.

Reduction of vehicle emissions: Implementing measures to reduce vehicle emissions, such as promoting electric vehicles, introducing stricter emission standards, and adopting cleaner transportation technologies.

Integrated waste management: Promotion of recycling and circular economy: Implementing policies to encourage recycling and material reuse, including source separation, establishment of recycling centers, and incentivizing the recycling industry (Almeida et al., 2023).

Reduction of food waste: Developing strategies to reduce food waste throughout the supply chain, including awareness campaigns, support for food banks, and surplus redistribution programs (Vaz Sales et al., 2023).

Improvement of waste management: Modernizing waste management infrastructure, including the construction of treatment and composting plants, as well as implementing innovative technologies for waste handling (Koetz et al., 2023).

Development of green and resilient spaces: Expansion of urban green areas: Promoting the creation and conservation of parks and green areas within cities to improve the quality of life for inhabitants and foster urban biodiversity (Delgado da Silva et al., 2024).

Adaptation to climate change: Developing strategies for climate change adaptation, including the creation of resilient infrastructures, disaster risk management, and the promotion of urban agriculture and green spaces as mitigation measures (Araújo et al., 2024).

Construction of more sustainable cities: Integrating sustainability principles into urban development, including land use planning, promoting energy efficiency in buildings, and sustainable water management (Stefani, et al., 2024).

These core ideas reflect the importance of addressing key issues such as sustainable mobility, integrated waste management, and the development of green spaces to ensure a more sustainable future in Brazilian cities, in line with the principles of Agenda 21. Some recommendations for the effective implementation of Agenda 21 in Latin American cities: *i)* Engage the local community: Foster active participation of the community in planning, implementing, and monitoring policies related to Agenda 21 in island areas (Niño-Gutiérrez et al., 2023a).

This can be achieved through creating spaces for dialogue and citizen consultation, as well as promoting environmental education and awareness about the importance of sustainable development; *ii)* Establish clear goals and objectives: Define concrete and achievable goals and objectives to guide the implementation of Agenda 21 in each city. These goals should be Specific, Measurable, Attainable, Relevant, and Time-bound (SMART), and should reflect the local needs and priorities in terms of sustainable development.

iii) Promote intersectoral integration: Encourage collaboration and coordination among different sectors and stakeholders, including local governments, civil society, the private sector, and academia. This can facilitate the implementation of comprehensive and multisectoral approaches to effectively address environmental, social, and economic challenges;

iv) Adopt sustainable urban planning approaches: Incorporate principles of sustainable urban planning into urban design and development processes, such as promoting urban densification, protecting green areas, and creating accessible and safe public spaces. Additionally, it is important to consider the integration of green and blue infrastructure in urban design to enhance resilience to climate change.

v) Implement sustainable mobility policies: Prioritize the development of efficient, safe, and accessible public transportation systems, as well as encourage the use of non-motorized modes of transportation, such as walking and cycling. Promoting sustainable mobility can help reduce traffic congestion, improve air quality, and encourage a more active and healthier lifestyle and *vi)* Strengthen waste and natural resource management: Implement policies and programs to improve solid waste management, promote recycling and material reuse, as well as encourage sustainable management of natural resources, such as water and energy. This can help reduce environmental pollution, minimize resource waste, and promote a more sustainable circular economy.

Conclusions

The core of this article was to answer the question: does Agenda 21 serve as a reference for the elaboration of public policies in Brazil?

The literature review carried out affirmatively corroborates this issue, considering the exhaustion of the current model of production and development that results in global socio-environmental impacts, such as the greenhouse effect, the destruction of the ozone layer, the devastation of native forests, desertification and pockets of poverty in different regions of the world. At a regional level, there are problems such as violence, construction in risk areas, inadequate transport systems, deficiencies in sanitation, education and health, as well as environmental phenomena such as acid rain, floods, thermal inversions and heat islands (Niño-Gutiérrez, 2023).

In this context, the principles outlined by agenda 21 emerge as an alternative capable of reconciling economic and social needs with the intrinsic limitations of the environment. However, the definition of public policies as government action programs aimed at coordinating state resources and private activities to achieve socially relevant and politically determined objectives reveals a misalignment. It can be seen, based on the theoretical references presented in chapter 2 of this study, that the majority of public policies at the local level in Brazilian cities are not guided by either Agenda 21 or the Statute of Cities.

This reality is justified, in large part, by the lack of political articulation between the ministerial, federal, state and municipal spheres, by the absence of a systemic vision of public managers in relation to the main urban problems in Brazil and by the failure of the judiciary to do comply with the City Statute, despite its legal force. For Brazil to adapt to the inevitable transformations of the 21st century, marked by worsening economic, social and environmental scenarios on a global scale, the need for effective political articulation in the three spheres of power becomes urgent.

It is essential that public managers are committed to the development and execution of public policies aligned with the principles of Agenda 21 and in line with the Cities Statute. Only in this way will Brazilian cities and the country as a whole be prepared for the change in development paradigm towards sustainability and even other Latin American countries such as Mexico (Niño-Gutiérrez, 2022c).

Recommendations

Promotion of sustainable transportation infrastructure: Brazil can prioritize investment in sustainable transportation infrastructure in its cities, drawing from successful policies implemented in São Paulo and Curitiba. This would entail expanding efficient public transportation systems, constructing safe bike lanes, and implementing exclusive bus lanes. By enhancing the accessibility and efficiency of public transportation, car dependency can be reduced, leading to a decrease in greenhouse gas emissions.

Strengthening citizen participation and inclusive governance: Actively involving the community in decision-making related to urban development and environmental protection is crucial. Brazilian cities can implement effective mechanisms to promote citizen participation, such as public hearings, advisory councils, and digital participation platforms.

Additionally, fostering collaboration among local government, civil society, and the private sector will ensure more inclusive and transparent governance. Improvement of waste management: Brazil can address persistent challenges in solid waste management by adopting comprehensive and sustainable strategies. This would involve investing in modern recycling and waste treatment technologies, promoting source separation of waste, and supporting community recycling initiatives. Moreover, it is essential to implement environmental education campaigns to raise awareness about the importance of waste reduction, reuse, and recycling, thereby contributing to the creation of cleaner and more sustainable cities.

According to the exposition in this chapter, the interrelation between sustainable territorial development and the transformation of urban landscapes in the post-COVID-19 era is explored. The impact of the pandemic on urban planning and development is examined in detail, emphasizing the urgency of adopting resilient and adaptable strategies to address the challenges presented by this crisis. Regarding sustainable public policies in Brazil, their relevance and effectiveness in the current context are analyzed, identifying areas for improvement and opportunities to strengthen their implementation. The paper particularly highlights the mobility situation in transportation in cities like Curitiba and Sao Paulo, showcasing innovative and successful models that have been implemented, as well as the challenges that still persist in this area. The importance of promoting efficient, accessible, and sustainable public transportation systems to improve the quality of life of residents and reduce environmental impact is emphasized. As for ideas to be implemented in the near future, it is suggested: a) implement integrated urban mobility policies that promote the use of public and non-motorized transportation, encouraging a reduction in the use of private cars; b) encourage investment in green infrastructure and clean technologies in public transportation, such as electric buses and renewable energy systems and c) foster citizen participation in decision-making related to urban planning and transportation, ensuring greater inclusion and representation of different sectors of society in the search for sustainable solutions for cities.

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

Ferraresi-De Araujo, Geraldo Jose: Conducted primary research, collected data, and drafted sections related to sustainable public policies in cities of Brazil.

Niño-Castillo, Isaías Naú: Focused the preliminary draft review was conducted, gathering relevant literature, and synthesizing findings.

Abdel-Wahabsherif, Sherif Ibrahim: Contributed with the English writing of the paper.

Availability of data and materials

Availability of data: The collected data as well as supplementary materials accompanying the publication of this research are accessible to other users. Through request to the authors.

Availability of materials: The authors specify that the materials are freely available for other users to use without any restrictions or conditions associated with access to them. This means that the materials, such as data sets, experimental protocols, software code, or other resources, can be accessed and utilized by anyone interested in the research without requiring permission or facing any limitations. This commitment to open access promotes transparency, reproducibility, and collaboration in research, allowing others to verify findings, replicate experiments, or build upon the work without barriers.

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Abbreviations

BRT: Bus Rapid Transit
IBAMA: Brazilian Institute of the Environment and Renewable Natural Resources
IGBE: Brazilian Institute of Geography and Statistics
SMART: Specific, Measurable, Attainable, Relevant, and Time-bound

References

Background

Bezerra, M. do C. L., & Bursztyn, M. (2000). *Ciência e Tecnologia para o desenvolvimento sustentável.* Brasília: Ministério do Meio Ambiente e dos Recursos Naturais Renováveis: Consórcio CDS/ UNB/ Abipti.

Bird. (1997). *World development Report 1997. The state in a changing world*. Washington, DC: The World Bank/Oxford University Press.

Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) (2009). Ministry of Environment.

Brasil. (2001). Lei n. 10.257, de 10 de julho de 2001. Institui normas regras para o desporto e da outras providências. *Diário Oficial da União,* 11 jul.

Comite de Qualidade da Gestão Publica. (2002). *Declaração de Joanesburgo sobre Desenvolvimento Sustentável.*

Costa, H., & Braga, T. (2004). Entre a conciliação e o conflito: dilemas para o planejamento e a gestão urbana e ambiental. In H. Acselrad (Org.), *Conflitos Ambientais no Brasil* (pp. 195-216). Rio de Janeiro: Relume Dumará.

Folha Online. (2002). *Saiba o que é a Rio + 10.*

Liebscher, P. (1998). Quantity with quality? Teaching quantitative and qualitative methods in a LIS Master's program. *Library Trends*, *46*(4), 668-680.

Muller, P., & Surel, Y. (1998). *L'Analyse des Politiques Publiques*. Paris: Montchrestien.

Parode, F. & Bentz, I. (2014). El Desarrollo sustentable en Brasil: cultura, medio ambiente y diseño. *Cuaderno 49*(1), 209-217.
Silva, S. T. (2003). Políticas públicas e estratégias de sustentabilidade urbana. *Hiléia*, *1* (1), 121-137.

Silva, M. (2003). *Agenda 21. Ministério do Meio Ambiente.*

Basics

Alcides, D.; Ferreira, R. V. & Feijó de Almeida, G. G. (2021). Gestão integrada do transporte público coletivo e relações com cidade digital estratégica: Curitiba e região metropolitana.

Ariza, D. M. & Moreno, J. C. (2017). Análisis comparative sobre compensaciones ambientales por pérdida de biodiversidad en el contexto nacional e internacional. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt y Universidad Distrital Francisco José de Caldas. Bogotá, D. C.

Barbosa, G. S. (2008). O desafio do desenvolvimento sustentável. *Revista Visões, 1*(4), 1-11.

Bucci, M. P. D. (2002). *Direito administrativo e políticas públicas*. São Paulo: Saraiva.

Passos, P. N. C. (2009). A Conferência de Estocolmo como ponto de partida para a proteção internacional do meio ambiente. *Revista Direitos Fundamentais e Democracia, 6* (6), 1-25.

Romualdo, S. dos S., & Souza, G. M. (2009). Inundações urbanas: A percepção sobre a problemática sócio ambiental pela comunidade do bairro Jardim Natal – Juiz de Fora (MG). In Simpósio Brasileiro de Geografia Física e Aplicada da UFV. *Anais eletrônicos*.

Support

Beck, D.; Teixeira, M.; Maróstica, J. & Ferasso, M. (2023). Quality perception of Sao Paulo transportation services: A sentiment analysis of citizens' satisfaction regarding bus terminuses. *Revista de Gestao Ambiental e Sustentabilidade*.

Brundtland, G. H. (1991). *Nosso futuro comum: Comissão mundial sobre meio ambiente e desenvolvimento*. (2ª ed.). Rio de Janeiro: Fundação Getúlio Vargas.

Bursztyn, M. (2001). Políticas públicas para o desenvolvimento sustentável. In: *A difícil sustentabilidade. Política energética e conflitos ambientais*. Rio de Janeiro: Ed. Garamond.

Guerra, A. J. T., & Cunha, S. B. (2006). *Impactos Ambientais Urbanos no Brasil* (4ª ed.). Rio de Janeiro: Bertrand Brasil.

Jacobi, P. (2006). Dilemas Socioambientais na gestão metropolitana: Do risco a busca da sustentabilidade urbana. *Política e Trabalho*, 25, 115-134.

Oliveira, S. M.; Araújo, S. & Arguello, S. B. (2020). *Agudización ultra neoliberal, educación y formación docente en Brasil y Argentina*.

Discussion

Almeida, Y. S.; Arantes, F. & Carneiro, M. L. (2023). Development of waste-to-energy through integrated sustainable waste management: the case of ABREN WtERT Brazil towards changing status quo in Brazil. *Waste Disposal& Sustainable Energy*, 5, 295-308.

Araújo, M. L. S. d-; Rufino, I. A. A.; Silva, F. B.; Brito, H. C. d.; Santos, J. R. N. (2024). The relationship between climate, agriculture and land cover in Matopiba, Brazil (1985-2020). Sustainability, 16, 2670.

Da Silva, F. L.; Severino, M.; Seteio, W. Da Cunha-Santino, M. B. And Bianchini, I. (2021). The municipality role in Brazilian wetlands conservation: establishment of connections among the Master Plan, the National Hydric Resources Policy and two internationals strategic plans. *Revista Brasileira de Geografia Fisica, 12*(6), 2193-2203.

Dávalos, J. & Romo, A. (2017). Ciudades sostenibles, inclusivas y resilientes: gobiernos locales y participación ciudadana en la implementación de las agendas globalees para el Desarrollo. *Revista de la Universidad Internacional del Ecuador, 2*(10), 116-131.

Delgado da Silva, B. M.; Bacay, E. K. & Batista de Morais, M. (2024). Safety in public open green spaces in Fortaleza, Brazil: A data analysis. *Sustainability*, 16, 539.

Duque, I. (2021). Las smart cities en la agenda del planeamiento y la gobernanza urbana en América Latina. *Cuadernos de Geografía: Revista Colombiana de Geografía,30*(2), 280-296.

Ferraresi de Araujo, G. J. & Niño-Castillo, I. N. (2021). Chapter 4. Territory and sustainability from municipal waste management programs: Piracicaba case, Sao Paulo, Brazil (pp. 65-79). In Niño, N.; Valencia, M. And García, M. (coords). *Productive system, territory and sustainability*. *Handbooks-TIII-ECORFAN-México*.

Guzmán, J. (2020). Medical tourism business ecosystem in Mexico and Brazil. *El Periplo Sustentable*, 41.

Koetz, G.M.; celimar, A.; Hernández, H. G.; Dick, D. & Selbach, P. (2023). *Characterization of humic substances developed during the composting of class II A organic solid waste: a case study in a composting plant in Montenegro, Brazil*.

Marques, M. L.; Muller-Pessoa, V.; Camargo, D. & Cecagno, C. (2021). Simulacao de cenários urbanos por automato celular para modelagem do crescimento de campinas-SP, Brasil. *EURE, 47*(142), 207-227.

Niño-Gutiérrez, N. S. (2023). Resilience in Adversity: Acapulco and the aftermath of Otis Hurricane Category 5 of October 25, 2023. *South Asian Journal of Social Studies and Economics, 20*(4), 209-224.

Niño-Gutiérrez, Naú Silverio; Niño-Castillo, Jacob Elías and Niño-Castillo, Isaías Naú. (2023a). Natural treasure of Acapulco: preserving the magic of Roqueta Island. *ECORFAN Journal-Ecuador. 10*(19), 1-8.

Niño-Gutiérrez, Naú Silverio; Niño-Castillo, Jacob Elías and Niño-Castillo, Isaías Naú. (2023b). Transforming landscapes: Effects of residential tourism on the urban and natural sustainability of the La Sabana river area, Acapulco, Mexico. *Journal of Microfinance Planning and Control, 9*(23), 22-37.

Niño-Gutiérrez, Naú Silverio (2022a). Keys to understanding the EL Niño-Oscillation phenomenon in south Mexico. ECORFAN Journal-Mexico, 13(28), 11-19.

Niño-Gutiérrez, N. S. (2022b). Geographical synthesis of the landscape in Vista Hermosa, Acapulco. *ECORFAN Journal-Republic of Cameroon, 8*(15), 7-13.

Niño-Gutiérrez, N. S. (2022c). Rurality, tourism and strategic management for sustainability in the El Zapotal Restaurant-Spa, Tierra Colorada, Mexico. *Journal-Labor and Demographic Economic, 6*(11), 21-31.

Oh, J. & Hettiariachchi, H. (2020). Collective action in waste management: A comparative study of recycling and recovery initiatives from Brazil, Indonesia, and Nigeria using the institutional analysis and development framework. *Recycling, 5*(4), 2-16.

Perea Palomino, D. M. (2020). Approaches to the analysis of the Stockholm and Rio summits discourse: Its influence on Colombian legislation and its relationship with environmental education during the late Twentieth Century. *Entorno Geográfico*, 20, 127-141.

Scarpeline de Castro, B.; Nogueira, L. de A.; & Frickmann, C. E. (2019). Citizen participation and local public management the case of municipal environmental councils in Brazil. *Revista de Gestion Pública, 8*(2), 211-228.

Stefani, S. R.; Sequeira, J.P. S.; Da Costa Santos, P. C.; Chiusoli, C. L. & Ribeiro, C. S. (2024). ISO 37120 Indicators sustainable cities: Brazil and Portugal. *Revista de Gestão e Ambiental, 18*(4), 1-21.

Vaz Sales, F. C.; De Souza, M.; Reni, L.; Medeiros, G.; Borchardt, M. & Sperandio, G. (2023). Food waste in distribution: Causes and gaps to be filled. *Sustainability*, 15, 3598.

Navigating the intersection: Sustainable territorial development and the transformation of the urban landscape in the Post-COVID-19 Era

Navegando en la intersección: Desarrollo territorial sustentable y la transformación del paisaje urbano en la Era Post-COVID-19

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Key Handbooks

The main contributions to generating Science and Technology in this research include: a systematic review on sustainable territorial development and territory concepts, bibliographic consultation on the impacts of Hurricane Otis, synthesis of the transformation of the urban landscape in Acapulco after the hurricane, development of a comprehensive map illustrating historical impacts on Acapulco, and creation of a comparative analysis of hurricane impacts. Additionally, the analysis of sustainable territorial development dimensions and the identification of similar challenges faced by populations in Brazilian and Mexican cities contribute to understanding the intersection of geographical, political, economic, cultural, and social factors in urban development and sustainability. Comprehensive Research: The paper likely involves comprehensive research on sustainable territorial development and the transformation of urban landscapes, considering various factors such as geographical, political, economic, cultural, and social aspects. Interdisciplinary Perspective: Given the broad scope of the topic, the paper may incorporate insights from multiple disciplines such as geography, urban planning, environmental studies, public policy, and sociology to provide a holistic understanding of the subject. Methodological Rigor: It is essential for the paper to adhere to rigorous research methodologies, employing systematic approaches to data collection, analysis, and interpretation to ensure the reliability and validity of its findings. Ethical Considerations: The paper should uphold ethical principles in conducting research, respecting the rights and privacy of individuals and communities involved, and ensuring transparency and integrity in reporting results. Critical Analysis: The paper likely involves critical analysis of existing literature, policies, and practices related to sustainable territorial development and urban transformation and opportunities for future research and action. Effective Communication: Clear and effective communication of research findings is crucial to ensure that the insights generated are accessible and understandable to various stakeholders, including policymakers, urban planners, community members, and researchers from different backgrounds.Continuous Learning: Given the dynamic nature of the topic, the paper may acknowledge the need for continuous learning and adaptation to new developments and challenges in the post-COVID-19 era, emphasizing the importance of ongoing research, collaboration, and knowledge exchange. By embodying these key aspects, the paper can contribute to the generation of universal knowledge that informs sustainable development practices and policies in urban areas worldwide, transcending geographical and cultural boundaries. The paper underscores the necessity of an interdisciplinary approach, integrating geography, politics, economics, culture, and society to comprehend sustainable territorial development and urban landscape transformation. It illuminates the shared challenges encountered by populations in Brazilian and Mexican cities, revealing the universal nature of sustainable territorial development and urban landscape issues. Through systematic review and comparative analysis, the paper delivers a comprehensive examination of sustainable territorial development, providing insights into the multifaceted dynamics shaping urban environments.

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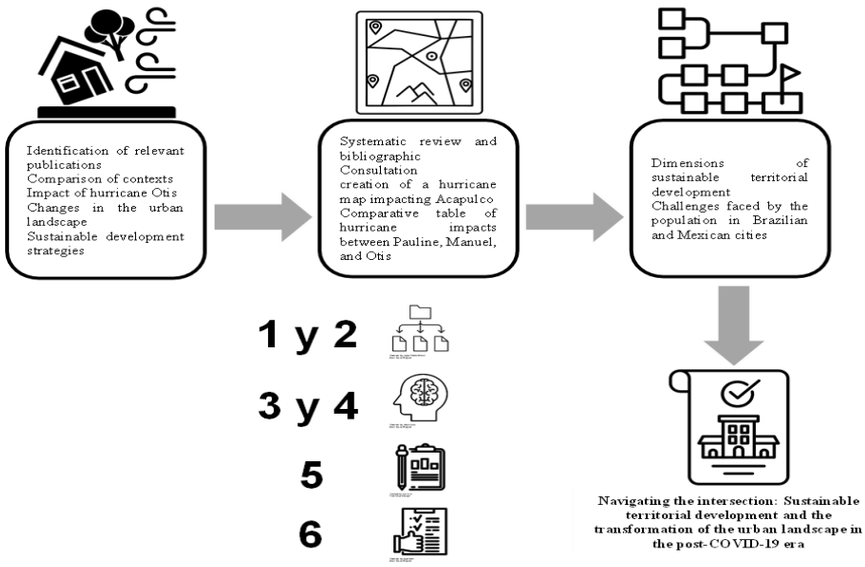
Abstract

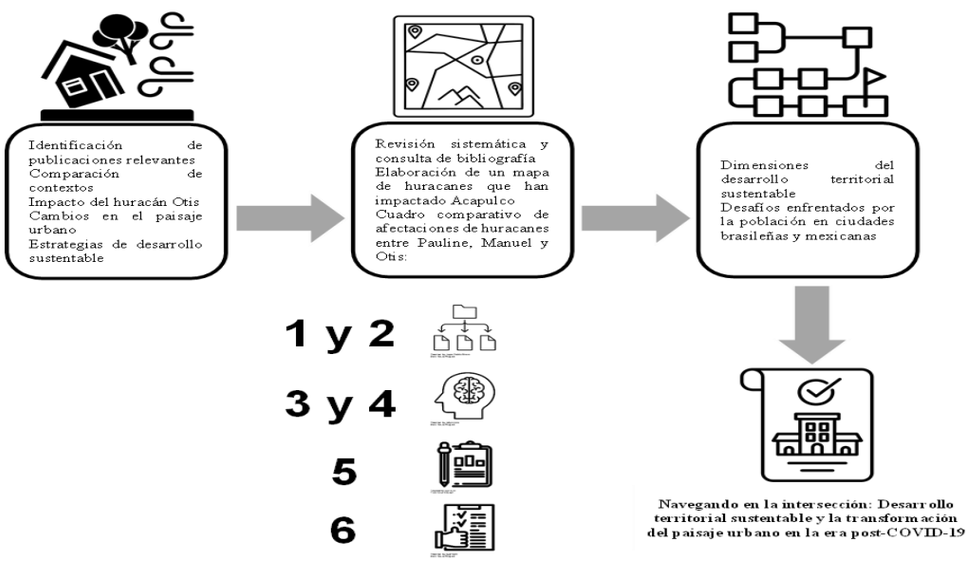
In the context of the nature-society relationship in Brazil, it is similar to the characteristics of sustainable territorial development in Mexico, and for this, the case of the municipality of Acapulco, Guerrero will be exemplified. Objectives: To identify and compare six publications on sustainable territorial development in Brazil and Mexico. Additionally, to synthesize the transformation of the urban landscape in the case of Acapulco, Guerrero after Hurricane Otis in October 2023. Methodology: It consisted of a systematic review of the concept of sustainable territorial development and territory; consultation of literature on Hurricane Otis; creation of a map showing the impact on Acapulco between 1921-2023; and creation of a comparative table of hurricane impacts between Pauline-Manuel-Otis. Results: The approach facilitated the identification of impacts occurring in the stages of solid waste management across various geoeconomic activities within society, namely: extraction of inputs/raw materials, transformation/industrialization of inputs/materials, commercialization and distribution of industrialized goods, and respective services. Conclusions: It advocated for the articulation between hegemonic socio-economic structures and other actors in territorial development, emphasizing natural diversity, local cultures, and community participation as key elements for sustainable territorial development



COVID-19, Sustainable territorial development, Geography, Urban landscape, Sustainability

Resumen

En el contexto de la relación naturaleza-sociedad en Brasil, es similar a las características del desarrollo territorial sostenible en México, y para ello se ejmeplificará con el caso del municipio de Acapulco, Guerrero. Objetivos: Identificar y comparar seis publicaciones sobre desarrollo territorial sustentable en Brasil y México. Además de, sintetizar la transformación del paisaje urbano en el caso de Acapulco, Guerrero después del huracán Otis de Octubre del 2023. Metodología: Consistió en revisión sistemática sobre el concepto de desarrollo territorial sustentable y territorio; consulta de bibliografía sobre el huracán Otis; elaboración de un mapa que han impactado Acapulco entre 1921-2023 y elaboración de un cuadro comparativo de afectaciones de huracanes entre: Pauline-Manuel-Otis. Resultados: El enfoque facilitó la identificación de los impactos que ocurren en las etapas de la gestion de residuos sólidos a través de diversas actividades geoeconómicas dentro de la sociedad, a saber: extracción de insumos/materias primas, transformación/industrialización de insumos/materiales, comercialización y distribución de bienes industrializados y los respectivos servicios. Conclusiones: Se abogó por la articulación entre las estructuras socioeconómicas hegemónicas y otros actores en el desarrollo territorial, enfatizando la diversidad natural, las cultural locales y la participación comunitaria como elementos clave para el desarrollo territorial sostenible.



COVID-19, Desarrollo territorial sustentable, geografía, paisaje urbano, sustentabilidad

Introduction

In the preparation of this work, publications addressing conceptual aspects and territorial sustainability in Brazil were consulted. Consequently, a simplified understanding of territorial characteristics and the concept of sustainable territorial development was acquired, along with insights into the dynamics, socio-economic impacts, and effects of territorial public policy. This exploration aimed to identify potential successful strategies for sustainability.

In this context, studies and relevant proposals on the subject were selected, theoretical contributions regarding territoriality, development, and sustainability. These contributions served to enhance comprehension of sustainable territorial development. The presented results contribute to knowledge by emphasizing the imperative of achieving sustainable development in territories where individuals interact with each other and with nature, particularly within the current mode of production and consumption of goods.

A retrospective analysis of bibliographic sources revealed that a plausible definition of the concept of Territorial Sustainable Development (TSD) involves addressing the territory at the local, regional, and/or national levels through the lens of sustainability principles in environmental, geoeconomic, political, and social domains. This definition underscores the importance of considering multiple dimensions to attain truly sustainable development across various territorial levels.

It is crucial to underscore that, on certain occasions, lower-income classes are excluded from the dynamics of the production and consumption mode within the context of the social sustainability principle. This exclusion arises from the system's failure to consistently account for their processes of continued reproduction and to grant prominence to this social category in production and consumption activities.

In this context, the reflections of Barcellos et al. (2018) and the methodological approaches of Geography are essential for comprehending the dynamics of the mode of production and consumption and its impact on the environment. These considerations enable the identification of the cause-and-effect relationship between the performance of the economic system and changes in the original geo-environmental conditions of territories. In other words, they emphasize the existing imbalance in the interaction between human activities and the natural environment, underscoring the importance of an interdisciplinary perspective to address the challenges of environmental sustainability.

It is important to bear in mind that the concept of the mode of production and consumption, as used here, has one of its possible definitions as the predominant socio-economic, spatial, and environmental system in human relations with nature. This system can be subdivided into various interdependent stages, with its current version characterized by the intensive use of financial capital and the perpetual creation of consumption needs for the population. The environmental consumption of natural space by this system takes shape from the extraction stage of raw materials and/or agricultural and livestock products, along with their respective processing. It extends to the manufacturing of products, durable or not, for various purposes, often influenced by numerous innovation and marketing strategies, where continuous and growing consumption becomes inherent to human nature, even when constrained by individuals' purchasing power (Baltazar & Ferreira, 2020).

On the other hand, the relationship between the urban landscape and solid waste aims to contribute to the creation or improvement of strategies for managing urban landscape components (Rodríguez et al., 1995), including solid waste generated by human activities. Moreover, it calls attention to the need for deeper reflections on the topic, both in academic and professional contexts, and in the business and implementation of public policies addressing urban space organization. Therefore, upon reviewing the considerations of these authors, it appears that the use of the Geography approach in this study was a fitting choice. This scientific discipline provides methods and techniques to demonstrate the cause-and-effect relationship between the operational forms of the production and consumption system and the various environmental impacts, sometimes negative, at various scales of geographic space. Additionally, the geographical approach allows for pinpointing the successive and continuous occurrence of such impacts in the resource management stages, whether in the primary (extraction of inputs/raw materials), secondary (transformation/industrialization of inputs/materials), or tertiary (marketing and distribution of industrialized goods and respective services) sectors of geoeconomics.

It is worth noting, however, that despite the crucial nature of demonstrating the cause-and-effect relationship between the operations of production and consumption systems in the phases of natural resource management, from extraction to disposal and subsequent consumption, this focus is beyond the scope of the present study. Therefore, it is pertinent to clarify that this study also incorporated an excerpt from the academic article titled Sustainable territorial development of the winegrowing territories of the brazilian state of Rio Grande do Sul.

In a non-exhaustive analysis of this excerpt, it was deduced that the current civilizational stage of territorial valorization would follow a reaction to the constant expansion of productivity and standardization of products by raw material extraction chains, materials, and industrial production on a global scale.

In this same study, it was found that the phenomenon in question is characterized by the term globalization, i.e., the interaction and/or integration of markets, generating a socio-spatial and geoeconomic impact of an environmental nature, as mentioned, both at the local and global levels. Faced with this, it was observed that several Brazilian states have created spaces for discussion, exchange, and coordination of local actions for the formulation, implementation, and evaluation of territorial policies under different dimensions and among institutions of interest.

Regarding public policies to address the issue of sustainable territorial development, the consulted literature (Costa et al., 2021) allows us to assert that it is necessary to integrate both the territorial and sustainability dimensions into development practices. Similarly, it is imperative to bring this new approach to the topic through the academic sphere and other forms of knowledge production to create mechanisms for its dissemination to society as a whole. From this perspective, deficiencies in the local, regional, and national governance of the Brazilian territory can be perceived, as long as the topic is not widely conveyed through the academic sphere and other forms of knowledge production, environmental damages will persist to the detriment of society in general.

Environmental governance of municipal solid waste is of utmost importance in both the current context and the future, driven by several key factors: *a)* Environmental and health impact: Inadequate management of municipal solid waste can have severe environmental and health consequences. Improperly managed landfill waste can contaminate soil, water, and air, adversely affecting human health and the environment (ABNT, 2004); *b)* Resource scarcity: Municipal solid waste contains valuable resources that can be recovered and recycled, such as metals, plastics, and organic materials. Proper waste management can contribute to the conservation of natural resources and reduce dependence on virgin raw materials; *c)* Climate change: Solid waste management is also linked to climate change. Poorly managed landfills are a significant source of greenhouse gas emissions, such as methane. Adopting more sustainable waste management practices, such as composting and recycling, can help reduce these emissions and mitigate climate change (Morita et al, 2021).

d) Circular economy: Effective management of municipal solid waste is crucial for progressing towards a circular economy. Implementing policies and practices that encourage waste reduction, reuse, and recycling can promote the transition to a more sustainable and resilient economic model (Hentges et al, 2021) and *e)* Waste crisis risk: With the increase in population and consumption, the generation of municipal solid waste is constantly rising. If not addressed properly, this can lead to waste crises, with overflowing landfills and public health problems. Effective environmental governance is crucial for preventing and managing these risks (Couto et al., 2022).

The lack of respect for human beings, especially in the current mode of production and consumption, which includes a significant portion of national and global governance, transcends natural boundaries and ecosystems. It is timely to emphasize the urgency of implementing, improving, and/or expanding the impact of public policies for sustainable territorial development from now on (2024). This aims not only to act as a contributing factor for preventing or reducing the negative environmental impacts of the production and consumption mode, as enumerated above but also to mitigate the occurrence of social tension manifested by the persistent increase in fuel prices, other goods and services, and primarily, the basic food items for a significant portion of the low-income population in Brazil and other parts of the world. This can potentially escalate the geographical scale of famine.

On the other hand, it is important to highlight that, to manage the methodology for addressing the discussed topic, as utilized in the aforementioned article. In this reflection, the terms "environment" and "sustainability," which guide the construction of the term "environmental sustainability," are considered metaphors formulated in international institutions. These terms, laden with political significance and lacking geographical support, would constitute contradictory elements to the socio-spatial reproduction of the mentioned mode of production and consumption.

It is necessary to clarify, therefore, that the term environmental sustainability, classified as a metaphor due to the absence of a conceptual theoretical foundation in Geography, is used here in the context of the society-nature relationship, whose theoretical foundation is well-developed in this discipline. The use of this term is justified by the meaning of the word metaphor, according to DICIO (2021), which denotes a rhetorical figure in which there is a transfer of the meaning from one word to another through an explicit non-comparison. Therefore, it is assumed that the term environmental sustainability would have been coined for didactic purposes, expressing a meaning more in line with the capitalist need to consider the limitations of nature in its development process than the society-nature concept validated methodologically by Geography.

In the context of the nature-society relationship in Brazil is similar to the characteristics of sustainable territorial development in Mexico, and for this, it will be exemplified with the case of the municipality of Acapulco, Guerrero. With these considerations in mind, the problem at hand can now be characterized by the following question: What are the contributions of the approaches used in the summaries and conclusions of the publications studied in this work, where the development of the territory is related to sustainability, ¿to promote discussion on the topic?

The central objective was to conduct an analysis of academic literature and relevant documents published between 1973 and 2023 to identify trends with a geographical focus related to sustainable territorial development and the transformation of the urban landscape. This includes the examination of a case in a subdivision in Acapulco, Guerrero, Mexico (Figure 1).

Box 1

Figure 1

Hurricane Otis and its impact on a site in Acapulco Diamante

Source: Own photograph

The methodology employed was as follows:

a) Specific criteria were established for the selection of academic literature and relevant documents. This involved utilizing keywords related to sustainable territorial development, urban landscape transformation, and specific geographical terms such as "Acapulco, Guerrero, Mexico." Academic databases and virtual libraries were utilized to access pertinent information.

b) Literature and document collection: A comprehensive search was conducted using the established criteria in databases such as Google Scholar, Dimension, Web of Science, Scopus, and other relevant sources. Both academic articles and technical documents, government reports, and other pertinent materials were gathered.

c) The search results were reviewed to identify studies and documents that met the inclusion criteria. Those not directly related to the topic of interest or lacking relevant information for analysis were excluded.

d) Critical analysis of the selected studies and documents was undertaken, identifying trends, approaches, and relevant findings related to sustainable territorial development and urban landscape transformation. Syntheses of the collected information were performed to identify recurring patterns and themes.

e) A detailed study of the La Sabana river area in Acapulco, Guerrero, Mexico, was conducted. This involved gathering specific information about the area, including demographic data, urban landscape characteristics, urban development policies, and any other aspects relevant to understanding the particular situation of the case.

f) Findings from the literature review were compared with the data obtained from the case study in Acapulco. Efforts were made to identify similarities, differences, and lessons learned that could contribute to a broader understanding of the challenges and opportunities related to sustainable territorial development and urban landscape transformation.

g) Conclusions were drawn based on the analysis of the literature and the case study, highlighting key findings, trends, challenges, and opportunities identified. Recommendations for future research and practical actions in the field of sustainable territorial development and urban planning were provided.

The research question to be addressed pertains to how the relationship between sustainable territorial development and the transformation of the urban landscape has manifested in the southeastern context, specifically within the vicinity of Acapulco Bay, Guerrero, Mexico, from 1991 to 2023. Furthermore, what lessons have been gleaned from this exploration?

The geographical method was employed, encompassing geographical location, identification based on geographic coordinates, and the discernment of patterns such as road infrastructure, green areas, and residential zones, among others.

Additionally, a rapid assessment of the environmental vulnerability of the study area was conducted, taking into consideration factors such as exposure to natural risks (e.g., floods, landslides) and the community's capacity for response and adaptation. All these facets were undertaken with the aim of attaining a comprehensive and enriching understanding of the nexus between sustainable territorial development and the transformation of the urban landscape in the southeastern region of Acapulco, Guerrero, Mexico, within the specified study period.

Theoretical framework

The theory of ecosystem resilience, developed by C. S. Holling, constitutes a fundamental tool for comprehending how natural systems respond to disturbances and changes. Applied to sustainable development in contemporary urban landscapes, resilience theory provides a conceptual framework for designing policies and practices that foster adaptability and long-term sustainability (Holling et al., 1998).

The concept of resilience refers to a system's capacity to absorb disturbances, adapt, and reorganize in a manner that preserves its fundamental functions and structures. In the context of urban landscapes, this entails the ability of cities and their natural environments to withstand and recover from events such as climate change, pollution, biodiversity loss, and other adverse impacts (Holling, 1986).

The theory advocates for identifying key components of the system, recognizing that socioecological systems are complex and composed of interconnected elements, including both natural and human elements. In the urban context, this implies considering both natural aspects (such as local ecosystems, biodiversity, water cycles) and social aspects (such as infrastructure, urban planning, human activities) (Raeyze et al., 2022).

Two situations can arise in urban landscapes: adaptability and transformability. Holling distinguishes between two types of resilience: adaptability, referring to a city's ability to withstand changes without losing its function, and transformability, referring to a city's capacity to fundamentally reorganize in response to major changes, whether natural or anthropogenic. In the urban context, this involves designing cities that can adapt to minor environmental and social changes while being prepared for deeper transformations when necessary (Holling, 1973).

Adaptive management is an approach recommended by resilience theory, acknowledging the uncertainty and complexity of socioecological systems in cities. This involves experimentation, continuous learning, and flexibility in decision-making. In the urban context, it could translate into policies and practices that encourage collaboration among various stakeholders, the integration of scientific and local knowledge, and capacity-building to address environmental and social challenges. Resilience theory suggests that diversity and redundancy are fundamental for system resilience. In the urban context, this implies promoting diversity in land use, biodiversity in urban green spaces, cultural and economic diversity, as well as ensuring redundancy in urban infrastructure and services to prevent excessive reliance on a single resource or system.

The theory of ecosystem resilience provides a valuable conceptual framework for addressing the challenges of sustainable development in contemporary urban landscapes. By focusing on the capacity of socioecological systems to adapt and transform, this theory can guide the planning and management of more sustainable, resilient, and equitable cities. These authors are also relevant in the context of Latin America and have influenced the theory and practice of sustainable development in urban landscapes in the region. Although none of the three mentioned authors specifically originated in Latin America, their ideas and concepts have been applied and adapted by professionals, academics, and urban planners in Latin American countries. It is crucial to recognize that, while there are Latin American authors who have made significant contributions to the development of the theory of sustainable development in urban landscapes in the region, the global influence of the aforementioned authors has also been notable in Latin America. Their ideas have been adapted and contextualized to address the specific challenges faced by Latin American cities in terms of urban growth, socioeconomic inequality, climate change, and sustainable development (Sánchez, 2016).

This adaptation of global concepts to local contexts enables a deeper understanding and application of sustainable principles in Latin American urban development. The amalgamation of ideas stemming from both local authors and renowned international experts contributes to a comprehensive and contextualized approach to tackling the complex challenges faced by cities in the region.

Conceptual framework

Concerning the methodology, the study utilized the consultation of indirectly available documentation on Internet sites to select the content used in the present research. It is essential to note that the concepts of public policy and environmental sustainability used in this study are defined as follows:

1. Public policies: These refer to the actions of the State aimed at meeting the social demands of societies (Höfling, 2001).

2. Urban solid waste management: Encompassing a set of actions addressing how waste is utilized, collected, transported, stored, treated, disposed of, and other steps related to waste from a company or residence, with the goal of minimizing its impact on the environment.

3. Circular economy: Refers to an economic system that replaces the traditional linear production model, specifically focusing on regenerative systems where the consumption of resources, waste, emissions, and energy dissipation is minimized.

Regarding the methodology, during the development stage of this study, the most relevant facts listed in the abstract and/or in the conclusions and recommendations of each selected publication addressing the relationship between territorial development and public policy for environmental sustainability were highlighted. The data were presented, either verbatim or with adaptations, from the relevant facts of the original publication, following the sequence of the study's development. Let's now delve into the details below:

Results

The findings presented in the aforementioned publications addressed facts that can positively contribute to sustainable territorial development, emphasizing the importance of coordination between hegemonic socioeconomic structures and other stakeholders involved in territorial development. Implicitly underscored is the notion that the success of this coordination depends on considering the inherent specificities of the territory, such as natural diversity and local/regional cultural manifestations (Niño-Gutiérrez, 2023). The contributions of the approaches used in the summaries and/or conclusions of the studied publications stand out, establishing connections between territorial development, environmental sustainability, and the coordination between hegemonic geo-economic structures and other actors interacting in the territory. In summary, these publications propose measures to advance sustainable territorial development, emphasizing the need to reconstruct the relationship between society and its mode of production and consumption with nature.

This process involves respecting natural ecosystems, adopting sustainability measures in both urban and rural environments, and coordinating action among hegemonic socio-economic structures and other actors in territorial development. Likewise, it seeks to reduce inequalities and address segregation among people. These strategies pave the way for future research to delve deeper into the subject, fostering the creation of new articles that more effectively and comprehensively disseminate the content of sustainable territorial development for all individuals, without distinction. For example, a recent diagnosis reveals that deforestation in Vista Hermosa, Acapulco, increases year after year, and the problem of solid waste persists (Niño-Gutiérrez, 2022).

The significance of satisfying society's consumption needs worldwide, as well as the detrimental effects on the urban landscape caused by the improper handling of solid waste generated in the mode of production and consumption in question, must always be considered. The use of a geographical approach emerges as a viable option, as the overall landscape and the urban landscape, in particular, foundational aspects of this scientific field, can demonstrate the cause-and-effect relationship between the operational forms of the production and consumption system and various environmental impacts, sometimes negative, caused by poorly managed urban solid waste. This approach facilitated the identification of impacts occurring in the stages of solid waste management across various geoeconomic activities within society, namely: extraction of inputs/raw materials, transformation/industrialization of inputs/materials, commercialization and distribution of industrialized goods, and respective services. Consequently, it can be inferred that the constant increase in productivity of geoeconomic activities at the local and global scale results in the escalation of solid waste generation, among other consequences. If mismanaged, these wastes can adversely affect the urban landscape. This phenomenon may be exacerbated by globalization, defined as the interaction and/or integration of markets, which can generate even more improperly managed solid waste and, consequently, further negative impacts on the urban landscape, both at the local and global levels. A growing concern is observed among academic, business, and governmental institutions in various countries, seeking ways to develop and improve public policies to reduce the generation and improper management of solid waste, thereby mitigating their negative impacts on the urban landscape.

The circular economy can be realized in the urban system through new business models that promote reuse, remanufacturing, recycling, durable design, the development of biodegradable materials and packaging, and material recovery in the production, distribution, and consumption phases. A commitment among entrepreneurs, manufacturers, distributors, consumers, and governments is essential to achieving sustainable development and promoting benefits for current and future generations (Uhlig et al., 2022).

Key principles of the circular economy: *a)* Promoting the design of products and systems that minimize resource usage, are durable, repairable, and recyclable, and can be safely reintegrated into the biosphere or supply chain; *b)* Maintenance of products and components in use: Extending the lifespan of products through reuse, repair, and remanufacturing is encouraged. This involves keeping products and components in the economy for as long as possible, avoiding premature disposal as waste; *c)* Encouraging recovery and recycling of materials at the end of their lifespan for reintegration into the supply chain as secondary raw materials. This reduces dependence on virgin resources and decreases waste generation and *d)* Optimization of production and consumption systems: Seeking to optimize production and consumption systems to reduce the quantity of resources used, energy consumed, and waste generated.

This includes practices such as energy efficiency, demand management, and the promotion of more sustainable lifestyles. From this perspective, a deficiency in governance applied to solid waste management and its relationship with the impact on the urban landscape is evident, as well as a lack of effective public policy applied in preventing the spread of contagions and impacts of the COVID-19 virus (SARS-CoV-2 and its variants) (Auerach et al., 2021). It is timely to emphasize the urgency of implementing, improving, and/or expanding the impact of public policy on public health and the enumerated mode of production and consumption. The sense of perplexity observed at all levels of (mis)global governance in the face of the reality of risk and suffering caused by COVID-19 highlights the need to rethink the geoeconomic model of production and consumption (Morillo & Van Roekel, 2022).

In geography, this geoeconomic system can also be simply designated as a type of socio-spatial formation based on the continuous and increasing pursuit of the excessive concentration of material goods, economic, ideological, political, and cultural management in the hands of a few individuals, corporations, and/or countries. It is essential to note that often, these entities concentrating material goods and means of management are labeled by university researchers from different subject areas as hegemonic actors due to their decision-making power to influence their counterparts. An example of the increase in municipal solid waste, which surpasses sustainable territorial development and the transformation of the urban landscape in many Latin American cities, is the aftermath of hurricanes, cyclones, and torrential storms, as demonstrated over the last 102 years in the municipality of Acapulco, Guerrero, Mexico (Niño-Gutiérrez, 2023) (Figure 2).

Box 2

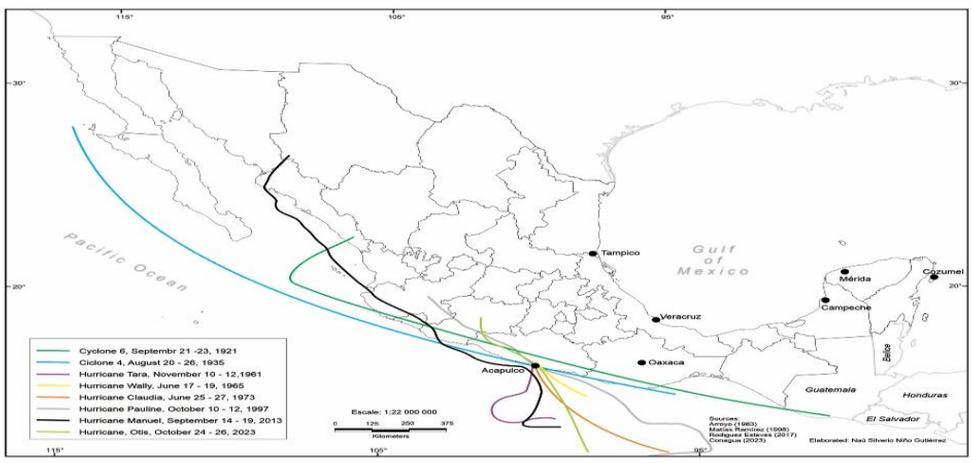


Figure 2

Hurricanes that have impacted Acapulco, Guerrero 1921-2023

Source: Matías (1998); Rodríguez (2017) & National Meteorological Service-Conagua (2023)

On the other hand, it is possible that they envision maintaining this hierarchical position because they have succeeded in the face of successive advancements in telematics, warfare technologies, aerospace programs, intercontinental transport routes, including railways. As if that were not enough, they are also on the list of successful achievements of this system, now under the control of COVID-19, such as luxurious architectural buildings, electronically-driven cities, sophisticated devices for virtual gains, as well as the rise of speculative money (Ruggerio, 2021).

However, the direct beneficiaries of the system now under discussion have demonstrated their myopia, to say the least, in how they view the world as a human construction, of all and for all, at various other moments, including recent demonstrations of armed force and the military intelligence system to maintain hegemony over the control of material goods. For this reason, it is inferred that the scale of change in socio-spatial conditions, including health and geoeconomic conditions, for the majority of the population to become protagonists of the new post-COVID-19 world, which will undoubtedly come, sooner rather than later, is directly related to the degree of social mobilization for this agenda (Tae-Woo & Song, 2023).

To address this situation, identifying the causes of COVID-19, as the initial content of the agenda for changes in the dominant geoeconomic model of production and consumption so far, is a suggestion to consider due to the scope of the impact of this disease on the world. In the aforementioned case, misguided policies to manage public interest in favor of the minority holders of the geography of extraction, production, reproduction, and distribution of material and financial goods can be highlighted. Among the misguided public policies, striking ones include the unsustainable model of production and consumption of goods, housing deficits, income shortages for a large portion of the population, the increase in family and urban violence, and deficiencies in public services such as drinking water, sewerage, stormwater drainage, waste management, and healthcare (Trajanoska et al., 2022).

It is important to note that the health crisis and its global geographical effects at all socio-spatial scales, caused by COVID-19, clearly exposed the lack of preparation by the governments of countries, including those called "world giants", to efficiently and collaboratively address diseases ranging from endemic to pandemics. This lack of preparedness to handle the current pandemic was also evidenced by the industrial concentration of the production of strategic health inputs, especially in China. Undoubtedly, this was a blatant geoeconomic error in global governance with the acceptance of society as a whole. Faced with this unfortunate reality, an unquestionable truth can be stated: the world before COVID-19 was one, and what will come will be very different because it will no longer be possible to live with these numerous socio-spatial problems of environmental, cultural, geoeconomic, political, health, etc., nature that make the lives of the majority of the population suffer indignity (Li et al., 2022).

It is worth noting that, paradoxically, the solution to these problems responsible for the recurring deprivation of material and financial assets from the majority of the world's population to live with dignity is also an intelligent solution to the worsening economic depression caused by COVID-19, with a positive cost-benefit for micro and macroeconomics. In other words, the solution to the aforementioned socio-spatial problems constitutes one of the ways to restructure and activate various national economic sectors of production and consumption affected by the crisis imposed by the pandemic, while promoting socio-economic justice and public health in the countries (Auerach et al., 2021).

Therefore, communication through the Internet, in its various forms, can be an important tool in disseminating data for the formation and mobilization of global public opinion, including public authorities and industrial, financial, technological corporations, etc., with the aim of initiating the process of consensual construction of the new world that is for everyone and by everyone.

For these reasons, it is emphasized that the proposal for the consensual construction of a new world, although absolutely necessary, is not only utopian but also extremely complex, as well as arduous and long-term in its application. The analysis of COVID-19 was related to the relationship between the pandemic, political, institutional, environmental, social, and economic factors of the population with certain marginalization in the cities of Brazil and the south of Mexico (Niño-Gutiérrez, 2021).

It is important to highlight that one of the reasons for the complexity of implementing the proposal to build a new world for everyone is the fact that the mode of production and consumption before COVID-19 is part of the culture of several generations, including those not benefited by it but aspiring to it during their lives. It should also be considered that a proposal with this objective has never been more timely than it is now in the context of COVID-19. Therefore, it is worth spreading this public call to mobilize world society with the aim of starting to discuss the foundations of the new world now in gestation (Dey et al., 2022).

A transcendent issue in healthcare services anywhere in the world is hospitals, as complex organizations that produce and offer healthcare services to the general population. Their organization follows a 21st-century model that functions hierarchically, integrating various clinical services, namely: internal medicine, general surgery, orthopedic surgery, pulmonology (highly demanded between 2020-2022), cardiology, pediatrics, psychiatry, rehabilitation and physiotherapy, emergency care, pharmacy, among others. Additionally, there are complementary non-clinical services such as administrative and logistical support.

Conclusions

In summary, this work advocates for the articulation between hegemonic socio-economic structures and other actors in territorial development, emphasizing natural diversity, local cultures, and community participation as key elements for sustainable territorial development. The implementation and expansion of public policy in this area are presented as a priority measure to prevent socio-spatial, geoeconomic, and socio-environmental damages. Contributions related to urban landscapes and solid waste management are based on an environmental approach, highlighting how inadequate municipal solid waste management can have negative impacts on the urban landscape. The separation of urban solid waste is presented as a cultural element and beneficial practice, enhancing the urban landscape from aesthetic, sanitary, and public health perspectives. Proper management of municipal solid waste, focusing on selective collection and the use of recyclable and reusable materials, is crucial. The study emphasizes the importance of implementing these practices and how they can contribute to deeper reflections, the production of new studies, and the publication of academic articles. Furthermore, the relevance of these issues in reshaping governance and public policies at the local and global levels is highlighted.

The literature review evidenced the importance of addressing geoeconomic development and territorial sustainability from a multidisciplinary perspective, considering both socio-economic and environmental factors. This comprehensive review emphasizes the vital significance of adopting a multidisciplinary approach when tackling geoeconomic development and territorial sustainability. This approach entails integrating various disciplines, such as geography, economics, sociology, and ecology, among others, to fully understand the complex challenges faced by territorial development. By considering socio-economic and environmental factors jointly, the interdependence between human well-being, economic growth, and environmental health is recognized. This broad perspective allows for the more effective identification and addressing of interactions and tensions between economic development and conservation of the natural environment. Furthermore, it facilitates the formulation of policies and strategies that promote balanced and sustainable development, meeting present needs without compromising opportunities for future generations. The results highlight the urgent need to continue researching and debating the concept of territory and its interrelation with sustainability in specific national contexts such as Brazil and Mexico. This call to action is grounded in the understanding that the sustainable and equitable development of these regions largely depends on how their territories are managed and conceptualized.

Firstly, the term "territory" encompasses not only geographical dimensions but also political, economic, cultural, and social aspects. It is essential to understand how these multiple facets interact and affect the development process in each country. The relationship between territory and sustainability involves considering how natural resources are utilized, how economic activities are planned, and how the benefits and burdens of development are distributed in the geographical space. Brazil and Mexico face similar challenges in terms of territorial development. Both countries possess rich geographical and cultural diversity but also grapple with issues of social inequality, environmental degradation, and territorial conflicts. Therefore, studying how these issues intersect and can be comprehensively addressed to promote fairer and more sustainable development is crucial.

Achieving this objective requires continuous and rigorous research analyzing various aspects of territorial development, including socio-economic, environmental, political, and institutional factors. Moreover, it is essential to foster dialogue and knowledge exchange among academics, professionals, community leaders, and policymakers in both countries. This interdisciplinary and transnational collaboration can generate new perspectives and innovative solutions to address territorial development challenges more effectively.

This chapter explores the intersection between sustainable territorial development and the transformation of urban landscapes in the post-COVID-19 era. It delves into the implications of the pandemic on urban planning and development, highlighting the need for resilient and adaptable strategies to address the challenges brought forth by the crisis. The chapter examines how the pandemic has reshaped urban environments, emphasizing the importance of sustainable practices in mitigating future crises and promoting long-term resilience. Additionally, it provides insights into potential pathways for integrating sustainability into territorial development policies and urban planning initiatives to create more inclusive, livable, and environmentally sustainable cities in the aftermath of the pandemic.

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

Antonio-Vieira, Elias: Conducted primary research, collected data, and drafted sections related to sustainable territorial development.

Niño-Castillo, Jacob Elías: Focused on analyzing the transformation of urbna landscapes in the post-COVID-19 era, gathering relevant literaure, and synthesizing findings.

Belandia-Silva, César Augusto and *Condori-Chura, Delia:* Contributed by providing expertise in urban planning and offering insights into policy implications and recommendations for sustainable development strategies.

Availability of data and materials

Availability of Data: The collected data as well as supplementary materials accompanying the publication of this research are accessible to other users. Through request to the authors.

Availability of Materials: The authors specify that the materials are freely available for other users to use without any restrictions or conditions associated with access to them. This means that the materials, such as data sets, experimental protocols, software code, or other resources, can be accessed and utilized by anyone interested in the research without requiring permission or facing any limitations. This commitment to open access promotes transparency, reproducibility, and collaboration in research, allowing others to verify findings, replicate experiments, or build upon the work without barriers.

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Abbreviations

Conagua: National Water Commission
COVID-19: Coronavirus Disease 19
NMS: National Meteorological Service
NMS-Conagua: National Meteorological Service-Conagua
SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2
TSD: Territorial Sustainable Development
List abbreviations in alphabetical order.

References

Background

Baltazar, N. C. & Mendes Ferrerira, I. (2020). Paisaje y lugar como categorias de análisis em la Gestión de resíduos sólidos urbanos. *Mediacao, Pires do rio-GO*, 15(1):42-58.

Dey, A. K.; oufiquil, G. M., Das, K. P., & Panovska, I. (2022). Impacts of COVID-19 local spread and Google search tren on the US stock market. *Physica A 589*. 126423.

Holling, C. S. (1986). The resilience of terrestrial ecosystems: local surprise and global change. In W. C. Clark y R. E. Munn (eds). *Sustainable development of the biosphere. International Institute for Applied Systems Analysis*. Cambridge University Press. Pp. 292-317.

Holling, C. S. (1973). Resilience and Sustainability of ecological systems. *Annual Review of Ecology and Systematics*, 4, 1-23.

National Meteorological Service (NMS)-Conagua (2023). *Accumulated precipitation forecast*.

Sánchez, C. A. (2016). Evolution of the concept of climate change and its impact on public health in Peru. *Peruvian Journal of Experimental Medicine and Public Health*.

Basics

Höfling, E. de Mattos. (2001). *Políticas estatales y sociales (públicas). Cadernos Cedes*, XXI(855), 30-41.

Holling, C. S.; Berkes, F. & Folke, C. (1998). Science, Sustainability and resources management. In F. Berkes y C. Folkes (eds). *Linking social and ecological systems: management practices and social mechanisms for Building resilience*. Cambridge: Cambridge University Press. Pp. 342-362.

Support

ABNT (Associacao Brasileira de Normas Técnicas). (2004). *Resíduos sólidos-Classificacao*.

Barcellos, C.; Buzai, G. D.& Handschumacher, P. (2018). Geografia e saude: o que está em jogo? ¿qué está en Historia, temas e desafíos. *Paru dans Confins*, 37.

Costa, T.; Alperstedt, G. D. & Andion, C. (2021). Dimensiones del enfoque territorial del desarrollo: una propuesta conceptual. *Revista Brasileña de Gestión y Desarrollo Regional*, 21(2).

DICIO-Diccionario en línea de portugués. *Definición de metáfora*.

Morita, A. K. M.; Ibellli-Bianco, C.; Coutinho, J. V.; Anache, J. A. A.; Pelinson, N. S.; Nobrega, J.; Rosalem, L. M. P.; Leite, C. M. C., Niviadonski, L. M.; manastella, C. & Wendland, E. (2021). Pollution threat to wáter and soil quality by dumpsites and non-sanitary landfills in Brzail: A review.

Raeyze, S.; Duchek, S.; Maynard, M. T. & Wohlgemuth, M. (2022). Resilience in organization-Related Research: Na integrative conceptual review across disciplines and levels of analysis. *Journal of Applied Psychology*, *107*(6), 867-897.

Rodríguez, M. M., Mauro, J. M., Russo, C. A. de, Silva, I. L. dos S., Bovo, C. M., Arcuri, R., Marinho, M. E. P., & Freitas, V. L. (1995). Análise da paisagem como base para uma estratégia de organizaçao geoambiental. *Geografia*, 20(1), 81-129.

Ruggerio, C. A. (2021). Sustainability and sustainable development: A review of principles and definitios. *The Science of The Total Environment*, 786, 147481.

Trajanoska, M.; Trajanov, R. & Eftimov, T. (2022). Dietary, comorbility, and geo-economic data fusio for explanaible COVID-19 mortality prediction. *Expert Systems With Applications*, 209. 118377.

Discussions

Auerach, A. J.; Gorodnichenko, Y. & Murphy, D. (2021). Inequality, fiscal policy and COVID19 restrictions in a demand-determined economy. *European Economic Review*, 137. 103810.

Couto, A.; Costa, C.; de Castro, M. E.; Vidal, G. & Gomes, M. P. (2022). Anlysis of healtcare waste management in hospital of Belo Horizonte, Brazil. *Environmental Science and Pollution Research*, *29*(60), 90601-90614.

Hentges, T. I.; Machado, E. A.; de Lima, T. V.; Moraes, D.; Acir, M.; Fabiani, M & Spiering, J. (2021). Circular economy in Brazil constrution industri: Current scenario, challenges and opportunities. *Waste Management & Research The Journal for Sustainable Circular Economy, 40*(6), 642-653.

Li, W.; Zhang, P.; Zhao, K. & Zhao, S. (2022). The geographical distribution and influencing factors of COVID-19 in China. TROPICAL Medicine and Infectious Disease, 7, 45.

Matías, L. G. (1998). Some effects of the precipitation of Hurricane Paulina in Acapulco, Guerrero. *Geographical Research Bulletin. 37*(1), 17-19.

Morillo, M. & Van Roekel, E. (2022). Economías inflamables en tiempos de COVID-19: la reventa de gasolina en la frontera de Venezuela-Brasil. The Journal of latín American and Caribbean Anthropology. 27(1-2), 37-56.

Niño-Gutiérrez, N. S. (2023). Resilience in adversity: Acapulco and the aftermath of Otis hurricane category 5 of october 25, 2023. *South Asian Journal of Social Studies and Economics, 20*(4), 209-224.

Niño-Gutiérrez, N. S. (2022). Geographical synthesis of the landscape in Vista Hermosa, Acapulco. *ECORFAN Journal-Republic of Cameroon, 8*(15), 7-13.

Niño-Gutiérrez, N. S. (2021). Socioformación y distribución espacial del COVID-19 en Guerrero, México en el primer semestre del 2020. En Luna-Nemecio, J. & Tobón, S. (coords). COVID-19: retos y oportunidades para la socioformación y el desarrollo social (pp.201-228). Universidad pablo de Olavide-CICSAHL-Kresearch.

Rodríguez, J. M. (2017). Recurring disasters in Mexico: Hurricane Pauline and storm Manuel in Acapulco, Guerrero. *Electronic Yearbook of studies in social communication "Dissertations"*. 10:2.

Tae-Woo, P. & Song, Z. (2023). Exploring a new development direction of the Belt and Road Initiative in the transitional perios towards the post-COVID-19 era. *Transportation Research Part E 172*. 103082.

Uhlig, M.; Contin, B.; Beserra, P. R.; Ruschel-Soares, R.; Uhlig, P. & Baruque-Ramos, J. (2022). Brazilian agro-industrial waste as potential textile and other raw materials: a sustainable approach. *Materials Circular Economy, 4*(1), 9.

Diagnosis of learning styles as a tool for improvement in teaching processes

Diagnóstico de los estilos de aprendizaje como herramienta de mejora en los procesos de enseñanza

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Key Handbooks

This research demonstrates the need to include in the study plans activities that allow students to improve their learning styles. The diagnosis of learning styles is a tool for the teacher since it allows them to identify the way in which each of the students learns, so once determined, the teacher can help the student improve their academic performance, for example. Therefore, identifying students' learning styles should be accompanied by teachers' teaching strategies, to the extent that these preferences will impact their usual teaching methods, consequently affecting the ways of learning and student performance. Currently, new techniques can be integrated using ICTs given that the ways of learning change over time and there are electronic means that allow diagnosis through surveys that can be completed online using a cell phone, a similar situation in teaching techniques. teaching in which social networks through programs such as YouTube and TikTok allow teaching with the use of computing. Research on learning styles initially involves knowing students' preferences on how to acquire knowledge and thereby combining it with the teaching styles of teachers, so that they allow better academic performance, which is why various actions are proposed in This document is intended to take advantage of students' abilities and, according to their learning style, to access knowledge that they can apply for their professional development. Of the learning styles evaluated, it was found that the reflective was the one that presented a higher value in relation to the others, however, this did not make any difference between men and women, which indicates that teachers should take advantage of it in their academic activities to develop work where reflection is within the objectives of their classes and thus achieve greater participation as well as better results in it. However, students who learn with other learning styles other than reflective ones should not be left aside since one of the seven transversal axes of the new Mexican school addresses the inclusion of students, so attending and Teaching from particularity is one of the priorities of education at the present time.

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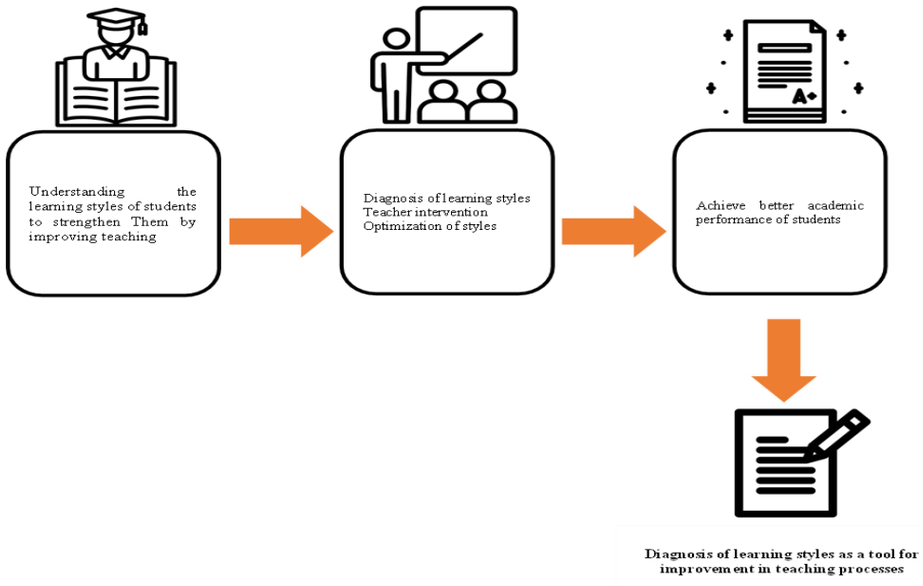
Abstract

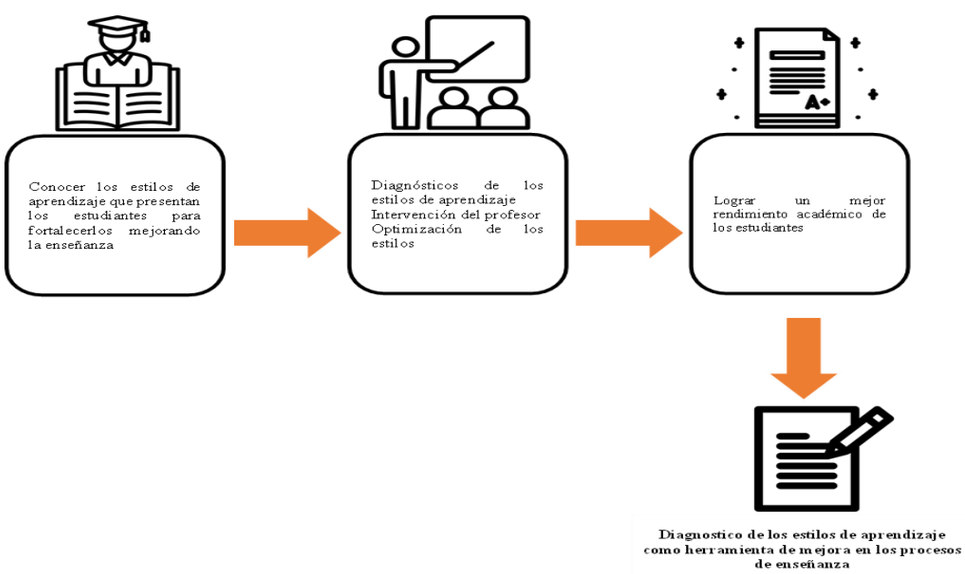
Educational processes include teaching and learning, which represent the interaction between students and teachers. Learning styles (LS) are a set of psychological characteristics, cognitive, affective, and physiological traits that are expressed together when a person faces a learning situation. There are several models that are applied in different areas of knowledge such as: the model of multiple intelligences of Howard Gardner, the Felder-Silverman, Kolb, Myers-Briggs, Kagan Cooperative Learning, Felder, and Soloman Learning Styles Inventory, the VARK Neurolinguistic programming, Margaret Martínez, Grasha and Hruska-Riechmann and Honey-Alonso Learning Styles. The study was carried out with agricultural high school students from the Autonomous University of Chapingo. The Honey-Alonso learning styles questionnaire was applied in print and in person. The analysis of the LS according to the scales was performed. Work must be done in the classrooms with a diversity of methodologies to promote the different LS of each student.



Teaching, teaching strategies, educational processes

Resumen

Los procesos educativos incluyen la enseñanza y el aprendizaje que representan la interacción entre estudiantes y profesores. Los estilos de aprendizaje (LS) son un conjunto de características psicológicas, cognitivas, afectivas y fisiológicas que se expresan en conjunto cuando una persona enfrenta una situación de aprendizaje. Existen varios modelos que se aplican en diferentes áreas del conocimiento como son: el modelo de inteligencias múltiples de Howard Gardner, el Inventario de Estilos de Aprendizaje de Felder-Silverman, Kolb, Myers-Briggs, Kagan Cooperative Learning, Felder y Soloman, el de programación neurolingüística VARK, Margaret Martínez, Grasha y Hruska-Riechmann y Honey-Alonso estilos de aprendizaje. El estudio se realizó con estudiantes de la preparatoria agrícola de la Universidad Autónoma Chapingo. Se aplicó el cuestionario de estilos de aprendizaje Honey-Alonso de forma impresa y presencial. Se realizó el análisis de la LS según las escalas. Se debe trabajar en las aulas con diversidad de metodologías para potenciar las diferentes LS de cada estudiante.



Enseñanza, estrategias didácticas, procesos educativos

Introduction

Educational processes include teaching and learning, which represent the interaction between students and teachers. Teaching is supported by curricula to program activities that allow students to learn. For their part, learning styles are very important since they are based on personal characteristics during the acquisition of knowledge. Learning styles are support for the teacher, they allow them to identify the way in which each of their students learns or allows them to acquire knowledge more easily (Roque Herrera et al., 2023). Diagnosing the way the student learns helps create the most appropriate method for each one. However, it has been indicated that on many occasions this interaction does not occur, since teachers teach according to their way of learning and according to strategies that were effective for them in teaching (Vargas-Murillo, 2020). Therefore, identifying students' learning styles should be accompanied by certain teaching strategies of teachers, to the extent that these preferences will impact their usual teaching methods, consequently affecting the ways of learning and student performance (Ventura et al., 2012).

In this study, the diagnosis of learning styles was carried out considering several factors, including the differences between men and women in the different learning styles. The effect of the study location on the learning styles of the students is also determined, since there are different sociocultural conditions in each of them (Montero et al., 2007). In addition, the grades that the students presented during their secondary education studies (secondary or preparatory) were considered in relation to their learning style and the correlations between the different learning styles were also identified with the purpose of knowing the relationship between them. However, an important aspect has been the students' response to the questionnaire during the COVID-19 pandemic, which shows that it is necessary to adapt the instrument to the new conditions to adapt to ICTs (Barbosa Granados & Amariles Jaramillo, 2019) .

The proposed hypothesis considers that learning styles can be improved in students who have received better conditions, as would occur in students who live at the Texcoco campus where the conditions of infrastructure and healthcare services allow for greater comfort and the problem is that school performance It is not similar in all the locations where the university has a campus, which is a reflection of the differences between the learning styles that students have. Furthermore, it is assumed that during the pandemic period, students' learning styles decline due to being in conditions that are not optimal for online study.

In recent times, the world has gone through various changes in the economy, medicine, and education after having overcome a global pandemic (Covid-2019) (Hoofman & Secord, 2021). In the education significant adaptations were developed to cope with confinement, such as the change from face-to-face education to distance education (Aristeidou & Cross, 2021), which implied substantial changes in learning styles (LS). In Mexico, in addition to the development of online classes, in recent years a change has also been implemented in education, with the new Mexican school (Frade Rubio, 2019), which considers four training fields and seven articulating axes, within which is inclusion, a term that implies that all students feel safe, respected, and accepted as they are. Therefore, it is necessary to make adaptations in teaching and in the evaluation of different learning styles and skill levels, so that it is possible to detect the effect of some belonging or inclusion factors on students.

Students must be able to identify their strengths and weaknesses, define their personal goals for the future, practice more complex skills that help them achieve their short, medium, and long-term goals, as well as assume their responsibility to be adults with values. Furthermore, students have an almost unlimited learning potential, which, together with the different learning styles they have, favors them to some extent and contributes to improving or enhancing meaningful learning, and it is the teacher's task to help the student discover how to learn (García Luna et al., 2015; Hurtado Bello et al., 2017).

Due to this situation, both students and teachers are closely related in the teaching-learning process, because students must learn and teachers must use various strategies that adapt to the needs of each of them, to that everyone acquires the expected knowledge, and the expected objectives are achieved. The teacher must be clear about the individual characterization of each student since everyone learns in different ways, but to facilitate their work they must form groups based on common interests and learning preferences.

Learning styles (LS)

Learning styles are defined in psychology as the way in which everyone carries out an activity, which is reflected in a communication style, lifestyle or speaking style (Aguilera Pupo & Ortiz Torres, 2009). Therefore, LS are a set of psychological characteristics, cognitive, affective, and physiological traits that are expressed together when a person faces a learning situation. A broad study on the conceptualization of learning style models was carried out in Venezuela (Silva Sprok, 2018) and studies have also been developed in Mexico that describe the measurement instruments of LS (García-Cué et al., 2009). Other authors have defined LS in different ways, one of them is the form that a student adopts as a special learning strategy, independent of the environment.

Kolb proposed a model of learning through experience in the same learning process (Romero Agudelo et al., 2010), while another definition identified students' LS with a model based on “the onion analogy”, with three layers or three levels: the first level, the outer part that focuses on instructional preference and learning environments; the second stratum is based on preferences about how information is processed; and the third, the center is related to learning preferences due to personality (Ortiz Ojeda & Canto Herrera, 2013). To determine these forms of learning, the learning style and its dimensions must be diagnosed, for which there are several models that are applied in different areas of knowledge such as:

Cognitive models of learning styles

The model of multiple intelligences (MI) of Howard Gardner has constituted an innovative, risky, and provocative proposal for the conception of intelligence (Carpintero Molina et al., 2009). This author originally established seven styles: a) verbal / linguistic intelligence, b) logical / mathematical intelligence, c) visual / spatial intelligence, d) bodily / kinesthetic intelligence, e) musical / rhythmic intelligence, f) interpersonal intelligence, and g) intrapersonal intelligence. The epistemological bases of Howard Gardner's MI model are found in the humanistic psychology of education, neuropsychology, and the holistic model of education (Chura Luna, 2019).

Felder-Silverman model: addresses ten different learning styles: sensory vs. intuitive; visual vs. verbal; inductive vs. deductive; active vs. reflective; sequential versus global (Silva Sprok, 2018). Offer a list of teaching-learning strategies that are not exclusive and that will help the teacher treat the different contents based on the learning styles proposed by Felder and Silverman and the key competencies they enhance.

In this way, will be able to create more complete and effective instructional designs, selecting learning strategies based on the diversity of classroom styles and ensuring key competencies are achieved (Marcos Salas et al., 2020).

Kolb Model is based on learning that takes the student's direct experience as its central axis. The four types are: divergent (concrete and reflective); assimilator (abstract and reflective); convergent (abstract and active); and accommodator (concrete and active), the evaluation uses two dimensions for learning to occur. The first is the perception of the environment and the second is processing (Romero Agudelo et al., 2010; Roque Herrera et al., 2023). Kolb's model has been one of the most worked on and the one that has contributed the most to the creation of other models (Silva Sprok, 2018).

Myers-Briggs Model: Both authors developed an instrument to evaluate personality characteristics. The Myers Briggs Type Indicator (MBTI) is based on the way in which the functions of consciousness interact, that is, the psychodynamic aspect of the typological model (Couto et al., 2016). A set of learning styles are proposed that are combined into 16 different types; The basic styles are: extroverted/introverted; sensory/intuitive; thoughtful/emotional; and judges/receivers.

Kagan Model: The structural approach to cooperative learning (Kagan Cooperative Learning) is based on the use of step-by-step instructional structures or strategies, free of content, that structure the interaction of students with each other, the plan of studies and the teacher. Empowering theoretical concepts are addressed, the keys to success, and the teacher. Kagan structures produce positive results that can be the basis of an educational revolution (Chophel & Norbu, 2021).

The Felder and Soloman Learning Styles Inventory (ILS) to determine learning styles. The ILS measures four cognitive scales: 1) perception, 2) processing, 3) representation, and 4) comprehension. The evaluation is through 44 dichotomous items and 11 reagents for each dimension. Choosing one of the two possible answers in each question indicates opposite learning styles: sensory or intuitive (perception), active or reflective (processing), visual or verbal (representation), sequential or global (comprehension). In each dimension, negative scores refer to the sensory, active, visual, and sequential style. For its part, positive scores refer to the intuitive, reflective, verbal, and global style (Diago Egaña et al., 2022; Ventura et al., 2012).

The VARK Neurolinguistic programming model. It summarizes the words: visual, aural, read/write, kinesthetic, is based on people's sensory preferences, it focuses on measuring the way in which the four dimensions included are related to each other used during learning processes: vision, hearing, reading/writing, and kinesthesia (Medina-Velandia & Plazas-Gómez, 2018).

Models of psychologically oriented learning styles

Margaret Martínez (1999): It has a full psychological orientation on emotions and intentions and points out the existence of several learning styles: student in transformation; student performer; conformist student; and student who resists (Martínez, 1999).

Grasha and Hruska-Riechmann Model: They developed the Learning Style Scale (GRLSS), and Teaching Style Inventory (TSI) defines learning styles as the preferences of each student, referring to two elements: their way of thinking and interaction with the rest of the students in different educational environments and experiences. They propose the existence of the independent student; the dependent student; the competitive student; the collaborative student; the reticent student and the participative student (Rojas-Jara et al., 2016).

Honey-Alonso Questionnaire: Honey-Alonso Learning Styles Questionnaire (HALSQ) has been used in much research. This instrument consists of 80 brief and dichotomous items, from which four learning styles are determined: active, reflective, theoretical, and pragmatic. It consists of 80 items that are structured in four groups of 20, which correspond to the four learning styles. The scoring of the 20 items is additive (Esguerra Pérez & Guerrero Ospina, 2010; Quintanal Pérez & Gallego Gil, 2011).

The styles that are generated from HALSQ are:

- **Active learning style:** They seek new experiences, they are open-minded, not at all skeptical and they enthusiastically undertake new tasks: entertainer, improviser, discoverer, risk-taker, spontaneous.

- **Reflective learning style:** They gives preference to reflection over action, carefully observes different experiences: thoughtful, conscientious, receptive, analytical, exhaustive.

- **Theoretical learning style:** They seek rationality and objectivity, fleeing from the subjective and ambiguous: methodical, logical, objective, critical, structured.

- **Pragmatic learning style:** They like to act quickly and confidently with those ideas and projects that attract them: experimental, practical, direct, effective, realistic (Alonso et al., 2007).

The HASLQ has been a widely used instrument in different grades of study such as secondary school (Quintanal Pérez & Gallego Gil, 2011), it has also been applied at the secondary level in a longitudinal study with high school students from the State of Mexico (Ramírez Gallegos et al., 2017) and a bachelor's degree in different areas of knowledge such as: Psychology (Esguerra Pérez & Guerrero Ospina, 2010; Juárez Lugo et al., 2011). In different engineering careers such as Computer Systems, Industrial Engineering, Electromechanical Engineering (Ortiz Ojeda & Canto Herrera, 2013) to determine the relationship that exists with academic performance. Also, in the Forest Engineering (Piorno Ruíz, 2014) and in pedagogy students (Moreno Morales & León Ávila, 2015), as well as in university social work students from Mexico and Chile (Caballero Pino et al., 2015). Also, in the specialty in Rural Sociology at the Autonomous University of Chapingo (UACh), teaching styles and their influence on students' learning styles have been identified (Aguilar-Antonio et al., 2017).

Box 1

Table 1

Studies that address learning styles and their relationship with academic performance in different educational institutions

Author	Country	Level of study	Category	Conclusions
(Esguerra Pérez & Guerrero Ospina, 2010)	Colombia	Universidad Santo Tomás (Psicology)	80 items in 4 groups of 20. Styles: active, reflective, theoretical and pragmatic. Honey - Alonso	The reflective style is more prevalent.
(Romero Agudelo et al., 2010) *et al*.	Colombia	Corporación Universitaria Minuto de Dios (Virtual education)	a) Concrete-experience; b) Abstract-conceptualization c) Active-experimentation d) Observation-reflection.	The divergent learning style is the predominant one
(Quintanal Pérez & Gallego Gil, 2011)	Spain	High school	Honey -Alonso	Teachers are reflective and theoretical. Reflective and pragmatic students
(Juárez Lugo et al., 2011) *et al*.	Mexico	UAEM (Psicology).	Honey -Alonso	The predominant style is reflective.
(Ventura et al., 2012)	Argentina	Universidad Pública Argentina (Engineering and Psychology)	1) perception, 2) processing, 3) representation 4) understanding	Engineering students: sensory and visual-practical style Psychology students, style: intuitive and verbal-innovative
(Ortiz Ojeda & Canto Herrera, 2013)	Mexico	Instituto Tecnol. de Motul, (Engineering)	Honey -Alonso	The reflective learning style predominated.
(Piorno Ruíz, 2014)	Cuba	Universidad de Guantánamo, Cuba (Forest engineering).	1: (Active and Reflective) 2: (Active and Theoretical) 3:(Active and Pragmatic) 4: (Reflective and Theoretical) 5: (Reflective and Pragmatic) 6: (Theoretical and Pragmatic).	Reflective, theoretical and pragmatic learning styles have greater predominance in students.
(Moreno Morales & León Ávila, 2015)	Cuba	Universidad de Ciencias Pedagógicas (Pedagogy)	Characterization of learning styles. Role of planning and strategic organization of the potential development of student training.	Students are dependent on the family and guardianship of the teacher (little motivation to study)
(Caballero Pino et al., 2015)	Mexico y Chile	UNAM y la Universidad de la Frontera de Chile.	Honey -Alonso	The pragmatic and theoretical style predominates in Mexicans and the reflective style in Chilean students.
(Ramírez Gallegos et al., 2017)	Mexico	Preparatory of Estado de México.	Honey-Alonso	Multiple learning styles (multimodal styles).
(Aguilar-Antonio et al., 2017)	Mexico	Universidad Autónoma Chapingo (Rural Sociology)	Honey-Alonso	Formal teaching styles and reflective learning styles are related.

Source own

A current topic is Artificial Intelligence (AI), which has recently revolutionized education, specifically learning. AI is increasingly being used to personalize instruction and streamline administrative tasks. In education, AI is used to develop intelligent tutoring systems, adaptive learning platforms, and automated grading systems, among other applications. As AI continues to evolve, its impact on education will also increase. AI has the potential to personalize learning experiences, improve student academic outcomes, and make education more inclusive. By leveraging AI, teachers can create adaptive learning environments that meet the individual needs of students, improving attention and retention (Onesi-Ozigagun et al., 2024). The integration of AI globally has enabled people to acquire essential skills in their roles, especially in the field of education, where students and educators make use of AI technologies (Ayanwale et al., 2024). A recent study offers practical advice and practical ideas for incorporating artificial intelligence (AI) in medical education, covering practical, ethical, pedagogical, and professional implications for both medical educators and students with the knowledge and tools necessary to learn about medical education in the age of AI (Garcia et al., 2024).

Methodology

The study was carried out with agricultural high school students from the Autonomous University of Chapingo. The Honey-Alonso learning styles questionnaire (HALSQ) (Alonso et al., 2007) was applied in print and in person.

The sample was taken for convenience from students in the fifth semester of agricultural high school and those in the second semester of propaedeutic studies. In both cases, the students were detached from the family nucleus since many of them were of different origin (state of the Republic) than the center or regional unit in which they developed their studies.

In the analysis of the information, a total of 339 records were used, coming from the headquarters located in Tabasco, Yucatán, Veracruz and Texcoco. Two propaedeutic groups from the Unidad Regional Universitaria Sursureste (URUSSE) (n = 19 and n = 41), in Tabasco, and a propaedeutic group at the Centro Regional Universitario Península de Yucatán (CRUPY) (n = 44), located in Mérida, and two groups from the Centro Regional Universitario de Oriente (CRUO) (n = 41 and n = 43), in Huatusco, Veracruz and four groups in Texcoco (n = 39, n = 39, n = 37, n = 36). With a sample of 140 men and 199 women, with an average age of 19.2 ± 2.8 years.

The origin of the students was very varied, predominating the states of Yucatán, Campeche, Oaxaca, Quintana Roo, Veracruz, and Chiapas. It is worth mentioning that all the sampled students have all the services and supports of the UACh.

The database was prepared in an Excel sheet and consisted of recording the general data of the students (sex, age, name, surname, group, grade, average grade in the immediately previous grade, state of origin, regional affiliation, etc.) and the score for each item, as well as the total points accumulated for each of the learning styles.

The maximum score that can be obtained for each style was 20. For the interpretation of the LS, the scheme used called scales allows us to know who is above or below the average, for which the complete list of each rating is ordered. a certain style and the population are divided into five categories (Alonso et al., 2007).

a) Very high preference: 10% of people who have had the highest score
b) High preference: 20% of the people who follow the highest score are grouped and counted.
c) Moderate preference: Here 40% of the people who are still in the score are counted.
d) Low preference: 20% of people with low scores are counted.
e) Very low preference: 10% of people with the lowest score are counted.

With the constructed scales and with the information on the origin and sex of the students, the distributions were obtained with the JASP program (JASP Team, 2023) in addition to the figures of boxes, as well as the analysis of variance to separate the averages from the qualifications for each of the LS according to the scales.

Results

The interpretation scales of UACh students obtained with a total sample of 343 students indicated that the average of each of the LS was in the moderate preference. Because all scales had a normal distribution, the highest percentage of students are around the mean, which corresponds to a moderate preference. With these scales, a comparative interpretation can be made of any result obtained in HALSQ applications. The maximum score that can be obtained is 20 points in each style.

The interpretation of the scores is based on the results of all participating subjects with whom the individual data are compared. With the scales it is easy to know who is average, who is above and who is below.

The results indicate that the active learning style (11.8 ± 3.1) was the one with the lowest score compared to reflective (14.7 ± 2.9), theoretical (13.6 ± 2.9) and pragmatic (13.6 ± 3.0).

Box 2

Table 2

Scales of the learning styles of high school students at the Autonomous University of Chapingo.

N = 343	10% Preference Very low	20% Preference Low	40% Preference moderate	20% Preference high	10% Preference Very high
Active	0-7	8-10	11-13 Mean (11.8)	14-15	16-20
Reflective	0-10	11-13	14-16 Mean (14.7)	17-18	19-20
Theoretical	0-9	10-12	13-15 Mean (13.6)	16-17	18-20
Pragmatic	0-9	10-12	13-15 Mean (13.6)	16-17	18-20

Source own

In general, the agricultural high school students showed the reflective learning style as their main learning style, which obtained the highest score (14.73), while the pragmatic and theoretical styles had similar values (13.56 and 13.53, respectively), while active learning was the one that had the lowest score (11.79). These values had similar behavior in both women and men (Figure 1).

Box 3

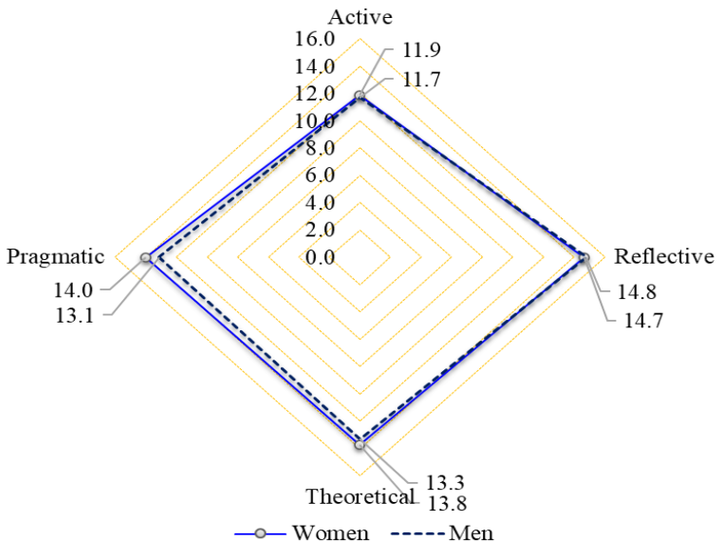


Figure 1

Learning styles of high school students at the Autonomous University of Chapingo, categorized by gender on the 1-20 scale.

Source own

The learning styles in all the groups studied were similar in women and men (P>0.05) and between the different locations of the agricultural high school (P>0.05). The observed values of the LS were not significant (P>0.05), but some trends observed were that the average in the active LS was slightly higher in men and women at the Veracruz and Texcoco sites. In the case of pragmatic LS, the lowest value was observed only in men from the state of Tabasco. In the reflective style, only women from the state of Veracruz had slightly higher values. In the theoretical LS, men and women at the Veracruz headquarters had the lowest value and all other comparisons were similar between them (Figure 2). The shapes of the distributions of all LS (active, reflective, theoretical, pragmatic) show a trend towards normality in both men and women, although high variability is observed in the distributions.

Box 4

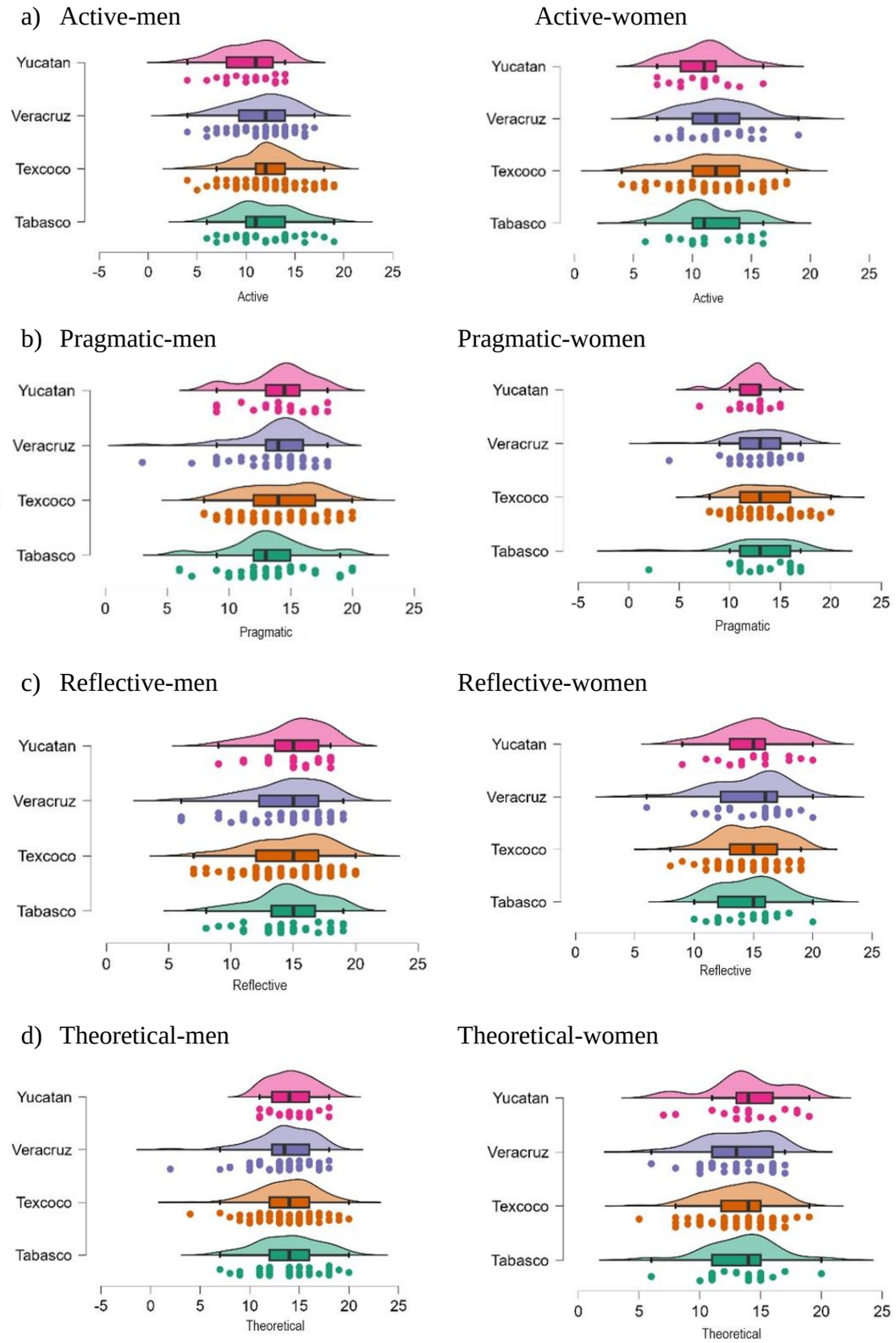


Figure 2

Learning styles of agricultural and preparatory high school students according to location of origin and gender.

Source own

The level of learning style in the average score did not show trends in the cases of reflective, theoretical, and pragmatic LS. It was observed that the very low and very high levels had similar scores, while in the case of active LS it was observed that a very high level in the LS obtained the lowest score in both men and women (Table 3).

Box 5

Table 3

Average grades from the previous degree and their relationship with the level of learning style in high school students at the Autonomous University of Chapingo.

	Active			Reflective			Theoretical			Pragmatic		
Level	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
					Men							
Very low	18	8.6	0.5	17	8.5	0.5	12	8.7	0.5	17	8.8	0.6
Low	41	8.8	0.8	41	8.6	0.7	46	8.6	0.7	35	8.5	0.6
Moderate	70	8.7	0.6	70	8.7	0.7	73	8.5	0.7	74	8.7	0.7
High	38	8.4	0.7	48	8.6	0.6	41	8.7	0.7	40	8.5	0.7
Very high	21	8.5	0.6	12	8.8	0.7	16	8.9	0.5	22	8.5	0.7
					Women							
Very low	12	9.0	0.6	6	8.5	0.6	8	8.5	1.2	8	8.8	0.8
Low	30	8.7	0.6	37	8.7	0.7	34	8.6	0.6	42	8.8	0.7
Moderate	42	8.7	0.7	45	8.7	0.7	49	8.8	0.6	42	8.6	0.7
High	19	8.7	0.6	21	8.8	0.7	23	8.6	0.6	23	8.7	0.5
Very high	17	8.6	0.7	11	8.7	0.5	6	9.3	0.5	5	8.9	0.4

SD. Standard deviation

Source own

In each of the subjects, the highest averages were found in one of the scales without any trend (Table 4).

Box 6

Table 4

Active learning styles and their relationship with the grades of different subjects taught in preparatory studies at the Autonomous University of Chapingo.

						First semester					
Scale	**N**	**Bot**	**SS1**	**ADiv**	**Phy**	**Chem**	**Math1**	**APSy**	**Stt1**	**Ave 1**	**SD**
Very low	11	74.2	84.1	82.2	75.9	80.0	79.4	86.1	88.5	81.4	6.3
Low	40	75.7	83.1	77.6	82.0	82.6	79.6	88.8	91.3	82.6	10.5
Moderate	44	76.9	86.0	81.0	79.8	78.8	78.7	87.5	88.3	82.2	9.0
High	32	71.8	81.4	75.6	75.8	74.2	74.0	86.4	86.4	78.2	9.5
Very high	15	75.1	79.1	75.7	77.5	76.3	72.7	87.0	85.6	78.5	11.8
						Second semester					
Scale		**Fore**	**SS2**				**Math2**	**AnPS**	**Stt2**	**Ave 2**	**SD**
Very low		86.7	88.1				84.8	87.1	90.0	87.3	9.4
Low		85.0	85.3				82.8	83.0	84.5	84.0	11.5
Moderate		86.6	90.1				83.4	83.2	86.8	85.4	10.3
High		85.3	84.8				78.7	79.3	83.0	80.0	12.3
Very high		82.6	83.1				77.6	78.1	79.7	80.2	13.3

Bot: Botany of seed plants, SS1: Social Sciences 1, Adiv: Animal diversity, Phy: Basic experimental physics, Chem: introduction to chemistry, Math1: mathematics, APSy: Agricultural production systems, Stt1: Integrative study tour 1, Ave1: Average 1, Fore: Forestry production systems, SS2: Social sciences 2, Math2: Mathematics 2, AnPS: Animal production systems, Stt2: Integrative study tour 2, Ave2: Average 2, SD: Standard deviation.

Source own

In Active style, learning styles did not show any trend with the grades of the preparatory students at the Autonomous University of Chapingo. The high and very high scales did not correspond to the best grades (Table 4) in any of the subjects (Botany of seed plants, social sciences 1, animal diversity, basic experimental physics, introduction to chemistry, mathematics, agricultural production systems, integrative study tour 1, forest production systems, social sciences 2, mathematics 2, animal production systems, integrative study tour 2).

In the case of students with the reflective style, the grade averages obtained by preparatory students did not show any trend in any of the subjects taken either in the first semester or in the second, and on the contrary, in some cases the low and very low reflective style showed high scores as in the case of integrative trip 1 and 2 and forestry production systems, which indicates that it is necessary to know very well how learning style influences academic performance (Table 5).

Box 7

Table 5

Reflective learning styles and their relationship with the grades of different subjects taught in preparatory studies at the Autonomous University of Chapingo.

					First semester						
Scale	**N**	**Bot**	**SS1**	**ADiv**	**Phy**	**Chem**	**Math1**	**APSy**	**Stt1**	**Ave 1**	**SD**
Very low	13	74.3	85.6	82.1	76.2	73.5	78.2	85.6	90.0	80.6	13.5
Low	31	72.5	81.7	76.1	77.6	76.8	73.9	85.9	87.2	79.1	11.4
Moderate	57	75.9	82.8	77.6	81.1	81.5	78.4	89.2	89.7	82.0	9.0
High	32	76.6	85.8	79.8	78.3	77.6	78.8	86.9	86.5	81.2	7.9
Very high	9	73.8	79.4	80.8	76.7	78.4	75.1	86.6	89.6	80.1	8.5
					Second semester						
Scale		**Fore**	**SS2**				**Math2**	**AnPS**	**Stt2**	**Ave 2**	**SD**
Very low	12	88.3	84.2				79.3	85.8	86.8	84.9	11.5
Low	25	87.6	86.0				77.7	81.3	84.1	82.8	14.0
Moderate	50	84.0	86.7				84.7	82.7	84.2	84.0	11.0
High	30	85.9	88.7				81.2	79.3	85.9	82.5	10.5
Very high	7	81.6	85.9				82.4	87.0	84.1	84.2	10.5

Bot: Botany of seed plants, SS1: Social Sciences 1, Adiv: Animal diversity, Phy: Basic experimental physics, Chem: introduction to chemistry, Math1: mathematics, APSy: Agricultural production systems, Stt1: Integrative study tour 1, Ave1: Average 1, Fore: Forestry production systems, SS2: Social sciences 2, Math2: Mathematics 2, AnPS: Animal production systems, Stt2: Integrative study tour 2, Ave2: Average 2, SD: Standard deviation.

Source own

The relationship between school performance measured through the grade before entering university and learning styles showed that the correlation between active EA and grade was negative (r=-0.133), so students with very high active style will have the lowest rating. Positive correlations were also observed between the pragmatic style with the active, reflective, and theoretical style and between the theoretical style with the active and reflective style, but there was no relationship between the active and reflective style (Table 6).

Reflective, theoretical, and pragmatic learning styles have a greater predominance than active ones in forestry engineering students at the University of Guantánamo, Cuba (Piorno Ruíz, 2014). In other studies, a high frequency of the reflective style is observed, and it has been indicated as the most consistent with the area of social sciences in the case of the UACh (Aguilar-Antonio et al., 2017). In secondary school students there is a slight inclination towards reflective and pragmatic styles (Quintanal Pérez & Gallego Gil, 2011). In the same way, in the case of Psychology students, the reflective style predominates (Esguerra Pérez & Guerrero Ospina, 2010; Juárez Lugo et al., 2011).

The same was found in engineering careers, in which the predominant learning style was reflective (Ortiz Ojeda & Canto Herrera, 2013). However, there are differences in learning styles when comparing the country of origin, thus pragmatic and theoretical styles predominated in Mexican students, while the reflective style was the most frequent for Chilean students (Caballero Pino et al., 2015).

Box 8

Table 6

Spearman correlations between the learning styles of high school students at the Chapingo Autonomous University.

Variable		Active	Reflective	Theoretical	Pragmatic
Reflective	Spearman's rho	0.047	—		
	p-value	0.388	—		
Theoretical	Spearman's rho	0.115	0.427	—	
	p-value	0.035	< .001	—	
Pragmatic	Spearman's rho	0.264	0.320	0.406	—
	p-value	< .001	< .001	< .001	—
Average	Spearman's rho	-0.133	0.057	0.098	-0.056
	p-value	0.018	0.313	0.082	0.320

Source own

The reflective and theoretical styles have been associated with students with higher averages and who pursue scientific careers (Quintanal Pérez & Gallego Gil, 2011). It has been shown that "high achieving" students reflect a greater tendency to behave in creative, adventurous, innovative, and novel ways. And a significant relationship has been observed between learning styles and academic performance in students who show active style (Esguerra Pérez & Guerrero Ospina, 2010). Although other authors indicate that the results of academic performance and learning styles are not necessarily associated with outstanding academic performance, because there are other factors of greater weight that influence student performance, such as: the teaching methodology by teachers, the context of the students and the curricular content taught in the courses (Caballero Pino et al., 2015; Ramírez Gallegos et al., 2017).

Regarding gender, it has been observed that the averages obtained by female students in all learning styles were higher than that of men (Quintanal Pérez & Gallego Gil, 2011). Furthermore, the learning style of men is more pragmatic, and is above the reflective, theoretical, and active style, in contrast to that of women in which there is a preference for the reflective, then pragmatic, theoretical and active styles (Juárez Lugo et al., 2011). It has also been indicated that between men and women there are significant differences in the average academic performance, demonstrating that women have better academic performance (Ortiz Ojeda & Canto Herrera, 2013). In a study with university students in the physiology course, no differences were observed between men and women in the learning style preference when using the VARK Neurolinguistic programming model (Ankad et al., 2015). A similar situation occurred in a study in the Philippines in which both men and women did not have significant differences. The reasons for this behavior were the pandemic and the modular learning approach (Cabual, 2021). However, there are other studies in which differences are indicated, for example a study with Dun's learning styles inventory, found that 9 of 22 styles showed differences between men and women, in this case the children were more kinesthetic and oriented. than girls, while girls revealed higher levels of self-motivation, persistence, responsibility, need for warmer temperatures and sociological variety, parental motivation, and teacher motivation than boys (Honigsfeld & Dunn, 2003). With other instruments such as the Kolb learning styles inventory, it has been observed that men and women have different learning preferences. Women have a greater preference for abstract materials than men. On the other hand, female respondents chose testing implications as the preferred method of learning new material (45.5%) and conducting research (41.3%) as the second preferred method (Kulturel-Konak et al., 2011). Also with the perceptual learning style preferences questionnaire, it has been observed that male and female students have different types of learning styles. Female students outnumbered males and in the types of tactile, auditory, and kinesthetic learning, female students had higher average scores than males (Şener & Çokçalışkan, 2018).

There are other factors that affect the learning style, such as coexistence, in which it has been shown that those who live with their family have a reflective learning style (Esguerra Pérez & Guerrero Ospina, 2010) and in students of Pedagogical Sciences in Cuba a high dependence on the family and the tutorship of the teacher was indicated (Moreno Morales & León Ávila, 2015). Other factors such as socioeconomic status and age have had a low influence on learning styles, which were not associated in a particular way with a style directly (Esguerra Pérez & Guerrero Ospina, 2010).

Regarding the relationship of learning styles with academic performance, there are contradictory results, while some authors do not find a direct relationship with academic performance (Juárez Lugo et al., 2011), others indicate a positive relationship between learning style pragmatic and academic performance, both in students of Computer Systems Engineering and Industrial Engineering (Ortiz Ojeda & Canto Herrera, 2013).

In a study carried out on secondary school teachers, high values were presented in the reflective and theoretical styles (Quintanal Pérez & Gallego Gil, 2011). However, another study shows that the ideal is to identify the relationship between the teaching style and the learning style, with which a direct relationship has been found between the teaching style (formal) in teachers and the learning style (reflective) in students (Aguilar-Antonio et al., 2017).

Improving Learning Styles through learning opportunity

According to Alonso et al. (2007), the five conditions that help learning are: Lifelong learning. In a colloquial way, one never stops learning through family, colleagues, at work, through the media and currently through social networks and all the technology that has been generated in recent years. However, formal ways of learning have evolved and with the pandemic there have been important changes in the way we learn. Furthermore, scientific, and technological development in all areas of knowledge requires that students learn at an accelerated pace since knowledge quickly becomes obsolete. This situation requires Universities to train professionals with updated knowledge and who can also do so on their own. have habits and styles to learn throughout life, in which the direction of the teacher is important since it is their responsibility to promote self-learning that allows them to provide solutions to professional problems that require self-management of knowledge (Tinoco-Izquierdo & Tinoco-Cuenca, 2018).

Learning is a personal and natural process. This concept is taken up even in transversal competencies that include independent learning. Furthermore, the important role played by values such as discipline, perseverance, and concentration during a period of professional training is recognized, along with values that support individual training such as: adaptability and creativity, knowledge processing, critical thinking and learning strategies, and managing harmonious learning relationships (Caena & Stringher, 2020).

Learning implies changing. Learning theories, institutional changes or teaching and learning modes are not enough for change to occur. The aim is to reorient students' disposition to foster a positive self-concept that allows them to feel capable of learning, overcoming the conditioning that may have been generated during the course of their studies. The changes empower the student for the learning process. However, work on conceptual change shows that they occur in the very long term, therefore it is important that teachers change their conceptions and adapt better to current conditions and especially university professors must be trained to be teachers, or they must be immersed in continuous training processes (Pérez-Echeverría, 2014).

Learning is linked to human development and gives meaning to evolutionary development with its alternating periods of stability and transition. Human development is the different levels of well-being in all aspects of life. Learning is always an interactive process, mediated by the existence of a culture that becomes its own, the existence of others and oneself. There exists here a dialectical unity between learning and development. Each new level of development is the result and starting point for the continuous learning that the subject carries out in his or her life (Molerio Pérez et al., 2007).

Learning combined with experience. It is a process of reaffirming, reorganizing and reintegrating previous experiences. In education and even more so in higher education, a lot of weight has been given to reason and logical thinking and the first form of learning has been left aside: sensitive, intuitive, experiential. This process of giving weight to the rational allowed an advance in science and technology, however, you cannot take only one aspect of the human being, it is important to integrate both forms in learning. Integration is desired, as part of a holistic view of the human being. The main challenge for the teacher, the group's facilitator, is to generate the necessary climate so that the students allow themselves to enter the realm of art, play and imagination. Delimiting agreements such as respect for others and care for confidentiality, in itself is already a learning experience (Osés Ruiz, 2014).

To improve learning styles according to Granados López and García Zuluaga (2016), four phases of carrying out the project are proposed. In the first phase, the Honey-Alonso Learning Strategies Questionnaire is applied to identify and characterize the preferred learning styles of the students who are the reason for the project. Subsequently, in the second phase, the design of workshops is carried out, according to the dominant and non-dominant preferences after analyzing the results derived from the administration of the HALSQ questionnaire. Afterwards, the third phase will be carried out in which the workshops will be developed and once the improvement workshops are finished, it will be verified whether or not there was mobility in learning preferences, so in the fourth phase the statistical analyzes are carried out with based on the data obtained (descriptive statistics), according to the application before the improvement program and after (Granados López y García Zuluaga, 2016).

Strategies to improve learning styles

Strategies are a set of actions that are carried out to reach a proposed goal. This term has been used in the educational field within the framework of the proposals of "teaching to think" and "learning to learn." Also, strategies are considered to be the system of activities, actions and operations that allow the completion of a task with the required quality (Gutiérrez Tapias & García Cué, 2016).

Teaching strategies have been approached from different points of view, one of them considers that they are procedures that a teacher uses in a conscious, controlled, and intentional way as flexible instruments to teach meaningfully and solve problems (Vargas-Murillo, 2020).

Furthermore, teaching strategies can be classified into (Vargas-Murillo, 2020):

1) pre-instructional (at the beginning),
2) co-instructional (during)
3) post-instructional (at the end).

Although the teaching strategies have been classified into four different groups (Gutiérrez Tapias & García Cué, 2016):

1) Cognitive
2) Teaching
3) Didactics
4) Learning

The purpose of pre-instructional strategies is for the student to be able to set objectives and goals, which allow the teacher to know if the student has an idea of what the subject includes and the purpose of its instruction. Some proposed activities are the objectives themselves, introductions, signage, prior knowledge, brainstorming and others (Vargas-Murillo, 2020).

Co-instructional teaching strategies support the curricular contents during the teaching process, they perform functions such as detection of the main information, conceptualization of the contents, delimitation of the organization, structuring, and interrelationships between said contents, some activities proposed are illustrations, graphic organizers, interspersed questions, maps, and conceptual networks (Vargas-Murillo, 2020).

Post-instructional teaching strategies are presented after the content to be learned. Its usefulness lies in generating in the student the formation of an integrative and even critical vision of the material, allowing a critical stance on the contents developed, the types. Post-instructional strategies are link promotion, summaries, analogies, among others (Vargas-Murillo, 2020).

Cognitive. They are internally organized capacities that the student uses to guide his or her own attention, learning, memory, and thinking. The student uses a cognitive strategy when she pays attention to various features of what she is reading, to select and employ a cue about what she learns, and another strategy.

To get it back. Most importantly, she employs cognitive strategies to think about what she has learned and to solve problems.

Teaching. They take the form of a series of learning activities aimed at students and adapted to their characteristics, the available resources, and the contents under study. They determine the use of certain media and methodologies in specific organizational frameworks and provide students with the appropriate information, motivation, and guidance systems. The activities must promote the understanding of concepts, their classification and relationship, reflection, the exercise of forms of reasoning, and the transfer of knowledge.

Didactics. They are the system of actions and operations, both physical and mental, that facilitate the confrontation (interactivity) of the learning subject with the object of knowledge and the relationship of help and cooperation with other colleagues during the learning process (interaction) to carry out a task with the required quality.

Learning. They are a set of steps or skills that a student intentionally acquires and uses as a flexible instrument to learn meaningfully and solve academic problems and demands. The responsibility falls on the student (comprehension of academic texts, composition of texts, problem solving, etc.). Students go through processes such as recognizing new knowledge, reviewing their previous concepts about it, organizing, and restoring that previous knowledge, assembling it with the new and assimilating it and interpreting everything that has happened with their knowledge on the topic (Gutiérrez Tapias & García Cué, 2016).

To improve study habits, it is necessary to know the questions asked in the Honey-Alonso questionnaire. Therefore, the analysis will be carried out on each of the learning styles.

The designed activities consider the characteristics of each learning style and must be adapted to the way of learning of each student. The activities have been designed to be inserted into the teaching work plan and can be adapted to the different specialties of knowledge.

Active Style (Alonso et al., 2007)

3. Many times I act without looking at the consequences
5. I believe that formalisms restrict and limit the free action of people
7. I think that acting intuitively can always be as valid as acting reflectively
9. I try to be aware of what is happening here and now
13. I prefer original and novel ideas, even if they are not practical
20. I feel like I grow with the challenge of doing something new and different
26. I feel comfortable with spontaneous and fun people
27. Most of the time I openly express how I feel.
35. I like to face life spontaneously and not have to plan everything in advance.
37. I feel uncomfortable with quiet and overly analytical people.
41. It is better to enjoy the present moment than to delight in thinking about the past or the future
43. I contribute new and spontaneous ideas in discussion groups
46. I think it is necessary to break the rules many more times than to comply with them
48. Overall, I talk more than I listen
51. I like to seek new experiences
61. When something goes wrong, I downplay it and try to do it better
67. I find it uncomfortable having to plan and foresee things.
74. I am often one of the people who cheers up the parties the most.
75. I get bored quickly with methodical and meticulous work.
77. I usually let myself be carried away by my intuitions

Students with an active style integrate fully, without prejudice and with enthusiasm in the tasks; They have an open mind; its activity is very high; They intend to make new attempts, even if it is only once, and as soon as the pace of the activity they have started slows down, they begin the next one; They face new experiences as a challenge and grow from them; They don't like long deadlines; They become the center of group work activities (De Moya Martínez et al., 2009).

Activities proposed for the active learning style (De Moya Martínez et al., 2009)

- Coordination of work in small groups, avoiding activities in large groups.
- Preparation of summaries, based on articles and conferences.

- Participation in classes in which practical activities prevail.
- Sharing of ideas.
- Bibliography consultation.
- Attendance at classes with a playful approach.
- Use of ICT (video, audio, photography, internet, computer applications, etc.) to carry out tasks.
- Exchange of notes.
- For multiple choice exams, group study; for development testing, individual study.
- Preparation of concept maps with keywords.
- Putting into practice what was learned in class.
- Using Powerpoint to summarize the most important things.
- Teacher-student interaction in dynamic classes.

Pragmatic style (Alonso et al., 2007)

1. I have a reputation for saying what I think clearly and bluntly.
8. I think the most important thing is that things work.
12. When I hear a good idea, I immediately start thinking about how to put it into practice.
14. I admit and adjust to the rules only if they help me achieve my goals.
22. When there is an argument I don't like to beat around the bush.
24. I like realistic and concrete people more than theoretical ones.
30. I am attracted to experimenting and practicing the latest techniques and innovations.
38. I frequently judge other people's ideas by their practical value.
40. In meetings I support practical and realistic ideas.
47. I often realize other better and more practical ways of doing things.
52. I like to experiment and apply things.
53. I think we should get to the point quickly, to the heart of the issues
56. I get impatient when they give me irrelevant and incoherent explanations.
57. I check first if things really work.
59. I am aware that in discussions I help keep others focused on the topic, avoiding digressions.
62. I reject original and spontaneous ideas if I do not see them as practical.
68. I believe that, in many cases, the end justifies the means.
72. In order to achieve the goal I aim for, I am capable of hurting other people's feelings.
73. I don't mind doing whatever is necessary for my work to be effective.
76. People often think that I am insensitive to their feelings.

Students with a pragmatic style seek the rapid application of their ideas, attributing the positive side and taking advantage of the first opportunity to experiment with them. Students are restless, they like to act and quickly manipulate those projects or activities that attract them. They are concerned about theoretical speeches and masterful presentations that are not accompanied by demonstrations or applications. They become impatient in long-term theoretical debates and discussions where they do not appreciate anything tangible.

Activities proposed for the pragmatic learning style (De Moya Martínez et al., 2009)

Preparation of schematic tables.
Using repetitions to memorize.
Attendance at classes that present a useful approach to help you learn.
Participation in midterm exams before finals.
Study with summaries and diagrams prepared by themselves.
Motivating and varied activities that encourage them to study.
Taking notes in class.
Reading and highlighting notes.
Voluntary reading of books.
Individual and voluntary work.
Participation in classes that have surprising content and creative and dynamic activities.
Carrying out activities that relate theory to practice.
Daily study to avoid accumulating material.

Reflective style (Alonso et al., 2007)

10. I enjoy when I have time to prepare my work and do it conscientiously.
16. I listen more often than I speak.
18. When I have any information, I try to interpret it well before expressing any conclusions.
19. Before doing something, I carefully study its advantages and disadvantages.
28. I like to analyze and turn things around.
31. I am cautious when drawing conclusions.
32. I prefer to have as many sources of information as possible. The more data you gather to reflect, the better.
34. I prefer to hear other people's opinions before expressing my own.
36. In discussions I like to observe how the other participants act.
39. I get overwhelmed if I am forced to speed up work too much to meet a deadline.
42. I get annoyed by people who always want to rush things.
44. I think that decisions based on thorough analysis are more consistent than those based on intuition.
49. I prefer to distance myself from the facts and observe them from other perspectives.
55. I prefer to discuss specific issues and not waste time with empty talk.
58. I make several drafts before final writing a work.
63. I like to weigh various alternatives before making a decision.
65. In debates and discussions I prefer to play a secondary role rather than being the leader, or the one who participates the most.
69. I usually reflect on issues and problems.
70. Working conscientiously fills me with satisfaction and pride.
79. I am often interested in finding out what people think.

Students with a reflective style consider aspects from different perspectives; They collect data and analyze it carefully; they are prudent; They listen to others before intervening, creating a sense of tolerance around them. In the reflective style, students collect all possible data, and, after careful analysis, make a decision, and even do not hesitate to go back to rethink it. They like to study all facets of an issue and consider all possible implications before managing it. They are not in favor of actively participating in meetings, they prefer to remain on the lookout by observing and analyzing the behaviors and expressions of others.

Activities proposed for the reflective learning style (De Moya Martínez et al., 2009)

- Attendance at a master class with slides that serve as a script.
- Preparation of summaries and outlines of the topics.
- Attendance in class where the teacher gives various examples that allow reflection.
- Preparation of very brief outlines that allow later development.
- Work with ICT and bibliographic search.
- Keep work up to date.
- Transfer class notes to clean.
- Carry out individual work based on proposed topics.
- Internet search for useful and relevant information.
- Collect opinions from the teacher or other classmates and compare them with your own.
- Study individually to review with other classmates.
- Preparation of summary tables with important ideas.
- Critical reflection on articles or short texts.
- Use of ICT as a complement to books.
- -Group work, where each member contributes their ideas to finish the task sooner.
- Memorization through mnemonic techniques: rewrite what has been read and analyze it several times; read aloud repeatedly what needs to be studied; make sentences with difficult words and acrostics.
- Carrying out work on paper, taking care of structuring, order, and cleanliness.
- Reflection on everything learned.

Theoretical style (Alonso et al., 2007)

2. I am sure of what is good and what is bad, what is right and what is wrong.

4. I usually try to solve problems methodically and step by step.
6. I am interested in knowing what the value systems of others are and with what criteria they act.
11. I am comfortable following an order, at meals, in study, exercising regularly.
15. I normally fit in well with thoughtful people and it is difficult for me to tune in with people who are too spontaneous, unpredictable.
17. I prefer structured things to organized ones.
21. I almost always try to be consistent with my criteria and value system. I have principles and I follow them.
23. I dislike being effectively involved in my work environment. I prefer to maintain distant relationships.
25. It is difficult for me to be creative, break structures.
29. It bothers me that people don't take things seriously.
33. I tend to be a perfectionist.
45. I frequently detect inconsistencies and weaknesses in the arguments of others.
50. I am convinced that logic and reasoning must prevail.
54. I always try to get clear conclusions and ideas.
60. I notice that I am often one of the most objective and dispassionate in discussions.
64. I often look ahead to foresee the future.
66. People who do not act logically bother me.
71. Faced with events, I try to discover the principles and theories on which they are based.
78. If I work in a group I try to follow a method and order.
80. I avoid subjective, ambiguous and unclear topics.

Students with a theoretical style adapt the observations they make within logical and complex theories; they use logic to solve problems; They are perfectionists; they frequently use analysis and synthesis; They possess objectivity and deep thinking. In the theoretical style, students approach problems vertically and in logical phases and are not satisfied until they consider that they have reached perfection or are the best.

They resist working in a group, unless they consider that the members are of the same intellectual level. They tend to be perfectionists and are not satisfied when there is no organization, or the elements are not articulated according to rational logic. They are interested in everything related to systems of thought, theoretical models, general principles, and conceptual maps.

Activities proposed for the reflective learning style (De Moya Martínez et al., 2009)

- Attendance at classes and asking questions.
- Individual study to concentrate better.
- Resolution of problems and conflictive exercises.
- Formulation of questions among colleagues to strengthen their self-esteem.
- Carrying out concrete and clear activities, avoiding excess redundant information.
- Promotion of a participatory environment in class.
- Participation in activities that allow the search for information on the Internet, rather than in the library.
- Essential attendance to class.
- Use of online educational platforms, such as Moodle.
- Use of study techniques, such as underlining and summaries of books and notes.
- Raising doubts to the teacher-tutor so that they can be resolved by him.

Conclusions

Although the learning styles in the average grades did not show trends in the reflective, theoretical and pragmatic learning styles, work must be done in the classrooms with a diversity of methodologies to promote the different learning styles of each student, taking into account that observed positive correlations between the pragmatic style with the active, reflective and theoretical style and between the theoretical style with the active and reflective style, even when there was no relationship between the active and reflective style.

Of the learning styles evaluated, it was found that the reflective was the one that presented a higher value in relation to the others, however, this did not make any difference between men and women, which indicates that teachers should take advantage of it in their activities. academics to develop work where reflection is within the objectives of their classes and thus achieve greater participation as well as better results in it. However, students who learn with other learning styles other than reflective ones should not be left aside since one of the seven transversal axes of the new Mexican school addresses the inclusion of students, so attending and Teaching from particularity is one of the priorities of education at the present time.

Annexes

Honey-Alonso Learning Styles Questionnaire

1 I am known for speaking my mind clearly and bluntly.
2 I am sure of what is right and wrong, what is good and what is bad.
3 I often act without looking at the consequences.
4 I usually try to solve problems methodically and step by step.
5 I believe that formalisms restrict and limit people's freedom of action.
6 I am interested in knowing what the value systems of others are and what criteria they act with
7 I think that acting intuitively can always be just as valid as acting reflexively.
8 I believe that the most important thing is that things work out.
9 I try to be aware of what is happening here and now.
10 I enjoy it when I have the time to prepare my work and do it thoroughly.
11 I am at ease following an order, at meals, in my studies, exercising regularly.
12 When I hear a good idea, I immediately start thinking about how to put it into practice.
13 I prefer original and novel ideas, even if they are not practical.
14 I accept and conform to rules only if they help me to achieve my goals.
15 I usually fit well with thoughtful people and find it difficult to get along with people who are too spontaneous and unpredictable.
16 I listen more often than I speak.
17 I prefer structured things to orderly things.
18 When in possession of any information, I try to interpret it well before expressing any conclusion.
19 Before I do something, I carefully study its advantages and disadvantages.
20 I feel that I grow with the challenge of doing something new and different.
21 I almost always try to be consistent with my criteria and value system. I have principles and I follow them.
22 When there is a discussion I don't like to beat around the bush.
23 I dislike getting effectively involved in my work environment. I prefer to maintain distant relationships.
24 I like people who are realistic and concrete rather than theoretical.
25 I find it difficult to be creative, to break structures.
26 I feel at ease with people who are spontaneous and fun.
27 Most of the time, I openly express how I feel.
28 I like to analyze and turn things around
29 It bothers me when people don't take things seriously.
30 I enjoy experimenting and practicing the latest techniques and novelties.
31 I am cautious about drawing conclusions.
32 I prefer to have as many sources of information as possible. The more data I can gather for reflection, the better.
33 I tend to be a perfectionist
34 I prefer to listen to the opinions of others before expressing my own.
35 I like to face life spontaneously and not have to plan everything in advance.
36 In discussions, I like to observe how the other participants act.
37 I feel uncomfortable with people who are quiet and overly analytical.
38 I often judge other people's ideas by their practical value.
39 I get overwhelmed if I am forced to speed up work to meet a deadline
40 In meetings I support practical and realistic ideas.

41 It is better to enjoy the present moment than to delight in thinking about the past or the future.
42 I am annoyed by people who always want to rush things.
43 I contribute new and spontaneous ideas in group discussions.
44 I think that decisions based on careful analysis are more consistent than those based on intuition.
45 I frequently detect inconsistency and weaknesses in the arguments of others.
46 I believe that it is necessary to break the rules many more times than to follow them.
47 I often notice better and more practical ways of doing things.
48 On the whole, I talk more than I listen.
49 I prefer to distance myself from the facts and look at them from other perspectives.
50 I am convinced that logic and reasoning must prevail.
51 I like to seek new experiences
52 I like to experiment and apply things
53 I think that we should get to the point, to the heart of the matter, early on
54 I always try to reach clear conclusions and ideas
55 I prefer to discuss concrete issues and not to waste time with empty talk
56 I get impatient when I am given irrelevant and incoherent explanations.
57 I check beforehand if things really work out
58 I make several drafts before the final writing of a paper
59 I am aware that in discussions I help to keep others focused on the topic, avoiding digressions
60 I find that I am often one of the most objective and dispassionate in discussions.
61 When something goes wrong, I play it down and try to make it better.
62 I reject original and spontaneous ideas if I don't see them as practical.
63 I like to weigh various alternatives before making a decision
64 I often look ahead to foresee the future.
65 In debates and discussions, I prefer to play a secondary role rather than being the leader or the one who participates the most.
66 I am annoyed by people who do not act logically.
67 I find it uncomfortable to have to plan and foresee things.
68 I believe that, in many cases, the end justifies the means.
69 I tend to reflect on issues and problems.
70 Working conscientiously fills me with satisfaction and pride.
71 Faced with events, I try to discover the principles and theories on which they are based.
72 I am capable of hurting other people's feelings in order to achieve the objective I am aiming at.
73 I do not mind doing whatever is necessary for my work to be effective.
74 I am often one of the most lively people at parties.
75 I get bored very quickly with methodical and meticulous work.
76 People often think that I am insensitive to their feelings.
77 I tend to let myself be carried away by my intuitions.
78 If I work in a group, I try to follow a method and an order.
79 I am often interested in finding out what people are thinking.
80 I avoid subjective, ambiguous and unclear topics.

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

Peña-Escalona, Fleider Leiser: Writing the original draft, review, data curation.
González-Garduño, Roberto: Statistical analysis, review, and correction.
Cruz-Tamayo, Alvar Alonzo: Review and correction.

Availability of data and materials

The information contained in this document is available upon express request from the main author.

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Abbreviations

AI	Artificial Intelligence
CRUO	Centro Regional Universitario de Oriente
CRUPY	Centro Regional Universitario Península de Yucatán
HALSQ	Honey-Alonso Learning Styles Questionnaire
ICTs	Informatic
ILS	Felder and Soloman Learning Styles Inventory
LS	Learning Styles
MBTI	Myers Briggs Type Indicator
MI	Multiple intelligence
TSI	Teaching Style Inventory
UACh	Autonomous University of Chapingo
URUSSE	Unidad Regional Universitaria Sursureste

References

Antecedents

Ayanwale, M. A., Adelana, O. P., Molefi, R. R., Adeeko, O., & Ishola, A. M. (2024). Examining artificial intelligence literacy among pre-service teachers for future classrooms. *Computers and Education Open*, *6*, 100179.

Barbosa Granados, S. H., & Amariles Jaramillo, M. L. (2019). Learning styles and the use of ICT in university students within a competency-based training model. *Journal of New Approaches in Educational Research*, *8*(1), 1–6.

Cabual, R. A. (2021). Learning styles and preferred learning modalities in the new normal. *Open Access Library Journal*, *08*(04), 1–14.

Caena, F., & Stringher, C. (2020). Hacia una nueva conceptualización del Aprender a Aprender. *Aula abierta*.

Carpintero Molina, E., Cabezas Gómez, D., & Pérez Sánchez, L. (2009). Inteligencias múltiples y altas capacidades. Una propuesta de enriquecimiento basada en el modelo de Howard Gardner. *FAISCA*, *14*(16), 4–13.

Chophel, Y., & Norbu, L. (2021). Effect of Kagan cooperative learning structures on learning achievement: An experimental study. *International Journal of Multidisciplinary Research and Explorer*.

Chura Luna, E. (2019). Bases epistemológicas que sustentan la teoría de las inteligencias múltiples de Howard Gardner en la pedagogía. *Revista de Investigaciones de La Escuela de Posgrado*, *8*(4), 1331–1340.

Couto, G., Bartholomeu, D., & Montiel, J. M. (2016). Estructura interna do Myers Briggs Type Indicator (MBTI): Evidência de validade. *Avaliacao Psicologica*, *15*(1), 41–48.

Frade Rubio, L. (2019). El tránsito de la nueva escuela mexicana: del pasado posible al futuro posible. *Revista Electrónica Inteligencia Educativa*, *01-08–2019*, 1–20.

Garcia, M. B., Arif, Y. M., Khlaif, Z. N., Zhu, M., de Almeida, R. P. P., de Almeida, R. S., & Masters, K. (2024). Effective integration of artificial intelligence in medical education: Practical tips and actionable insights. In *Transformative Approaches to Patient Literacy and Healthcare Innovation* (pp. 1-19). IGI Global.

Hoofman, J., & Secord, E. (2021). The effect of COVID-19 on education. *Pediatric Clinics of North America*, *68*(5), 1071–1079.

Kulturel-Konak, S., D'Alegro, M. Lou, & Dickinson, S. (2011). Review of gender differences in Learning Styles: Suggestions for STEM education. *Contemporary Issues In Education Research-March*, *4*(3), 9–18.

Marcos Salas, B., Alarcón Martínez, V., Serrano Amarilla, N., Cuetos Revuelta, M. J., & Manzanal Martínez, A. I. (2020). Aplicación de los estilos de aprendizaje según el modelo de Felder y Silverman para el desarrollo de competencias clave en la práctica docente. *Tendencias Pedagógicas*, *37*, 104–120.

Medina-Velandia, L., & Plazas-Gómez, L. (2018). Agentes inteligentes y modelo VARK, proponen estrategias de aprendizaje según la manera en que asimila un individuo. *Revista Educación en Ingeniería*, *13*(26), 11–19.

Molerio Pérez, O., Otero Ramos, I., & Nieves Achón, Z. (2007). Aprendizaje y desarrollo humano. *Revista Iberoamericana de educación*, *44*(3), 1-9.

Onesi-Ozigagun, O., Ololade, Y. J., Eyo-Udo, N. L., & Ogundipe, D. O. (2024). Revolutionizing education through AI: a comprehensive review of enhancing learning experiences. *International Journal of Applied Research in Social Sciences*, *6*(4), 589-607.

Osés Ruiz, E. (2014). Aprender de la experiencia sensible: El arte en el aprendizaje. *En Blanco y Negro*, *5*(1).

Pérez-Echeverría, M. (2014). ¿Por qué nos cuesta tanto cambiar nuestra forma de enseñar y aprender?. *Desde la patagonia. Difundiendo saberes*, *11*(18), 30-37.

Romero Agudelo, L. N., Salinas Urbina, V., & Mortera Gutiérrez, F. J. (2010). Estilos de aprendizaje basados en el modelo de Kolb en la educación virtual. *Apertura*, *2*(1), 72–85.

Şener, S., & Çokçalışkan, A. (2018). An Investigation between Multiple Intelligences and Learning Styles. *Journal of Education and Training Studies*, *6*(2), 125.

Silva Sprok, A. (2018). Conceptualización de los modelos de estilos de aprendizaje. *Revista de Estilos de Aprendizaje*, *11*(21), 35–67.

Basic

Alonso, C., Gallego, D., & Honey, P. (2007). *Los estilos de aprendizaje: Procedimientos de diagnóstico y mejora* (7a ed.). Ediciones Mensajero.

De Moya Martínez, M. D. V., Bravo, J. A. H., Bravo, J. R. H., & Gutiérrez, R. C. (2009). Un estilo de aprendizaje, una actividad. Diseño de un plan de trabajo para cada estilo. *Revista de Estilos de Aprendizaje*, *2*(4).

García-Cué, J., Santizo-Rincón, J., & Alonso-García, C. (2009). Instrumentos de medición de estilos de aprendizaje. *Revista Estilos de Aprendizaje*, *2*(4), 3–21.

Granados López, H. & García Zuluaga, C. L. (2016). El modelo de aprendizaje experiencial como alternativa para mejorar el proceso de aprendizaje en el aula. *Ánfora: Revista Científica de la Universidad Autónoma de Manizales*, *23*(41), 37-54.

Gutiérrez Tapias, M. & García Cué, J.L. (2016). Estilos de aprendizaje y diseño de estrategias didácticas desde la perspectiva emocional del alumnado y del profesorado. *Revista de estilos de aprendizaje*, *9*(18).

Martínez, M. (1999). Using learning orientation to investigate how individuals learn successfully on the web. *Technical Communication*, *46*(4), 470–487.

Montero, R. E., Villalobos, P. J., & Valverde, B. A. (2007). Factores institucionales, pedagógicos, psicosociales y sociodemográficos asociados al rendimiento académico en la Universidad de Costa Rica: Un análisis multinivel. *Revista Electrónica de Investigación y Evaluación Educativa*, *13*(2), 215–234.

Roque Herrera, Y., Tenelanda Lopez, D., Basantes Moscoso, D., & Erazo Parra, J. (2023). Teorías y modelos sobre los estilos de aprendizaje. *Edumecentro*, *15*(2362), 1–19.

Vargas-Murillo, G. (2020). Estrategias educativas y tecnología digital en el proceso enseñanza aprendizaje. *Cuadernos Hospital de Clínicas*, *61*(1), 114-129.

Support

Aguilar-Antonio, B. M., García-Cué, J. L., & Antonio-Pérez, P. (2017). Estilos de enseñanza y de aprendizaje en ingeniería agronómica con especialidad en sociología rural: caso UACH. *XXXI Congreso Alas Uruguay 2017*, 25.

Diago Egaña, M. L., Martínez Abad, F., & Perochena González, P. (2022). Learning styles preferences of Spanish students between 11 and 15 years of age. *Revista de Investigación Educativa*, *40*(2), 589–606.

Esguerra Pérez, G., & Guerrero Ospina, P. (2010). Estilos de aprendizaje y rendimiento académico en estudiantes de Psicología. *Diversitas: Perspectivas En Psicología*, *6*(1), 97–109.

García Luna, A., Tamez Herrera, C., & Lozano Rodríguez, A. (2015). Estilos de aprendizaje y rendimiento académico en alumnos de segundo grado de secundaria. *Journal of Learning Styles*, *8*(15), 146–174.

Juárez Lugo, C. S., Hernández Castro, S. G., & Escoto Ponce de León, M. del C. (2011). Rendimiento académico y estilos de aprendizaje en estudiantes de Psicología. *Revista Estilos de Aprendizaje*, *4*, 13.

Ortiz Ojeda, A., & Canto Herrera, P. (2013). Estilos de aprendizaje y rendimiento académico en estudiantes de ingeniería en México. *Revista Estilos de Aprendizaje*, *11*(6), 160–177.

Piorno Ruíz, Y. (2014). Estilo de aprendizaje predominante en los estudiantes del segundo año de Ingeniería Forestal de la Universidad de Guantánamo. *EduSol*, *14*(49), 1–8.

Ramírez Gallegos, E. N., Lozano Rodríguez, A., & Zárate Ortiz, J. F. (2017). Los estilos de aprendizaje y el rendimiento académico en estudiantes de cuarto semestre de bachillerato. *Revista de Estilos de Aprendizaje*, *10*(20), 182–219.

Differences

Caballero Pino, M., Norambuena Paredes, I., Gálvez Nieto, J. L., & Salamé Coulón, A. M. (2015). Estilos de aprendizaje y rendimiento académico en estudiantes de Trabajo Social: un análisis entre México y Chile. *Ts Cuadernos De Trabajo Social*, *14*, 79–100.

Honigsfeld, A., & Dunn, R. (2003). High school male and female learning-style similarities and differences in diverse nations. *Journal of Educational Research*, *96*(4), 195–206.

Moreno Morales, L., & León Ávila, M. (2015). Caracterización de los estilos de aprendizaje y de vida en estudiantes de primer año de la Universidad de Ciencias Pedagógicas “Enrique José Varona.” *VARONA*, *60*, 36–41.

Quintanal Pérez, F., & Gallego Gil, D. J. (2011). Incidencia de los estilos de aprendizaje en el rendimiento académico de la física y química de Secundaria. *Revista Estilos de Aprendizaje*, *4*(8), 198–223.

Rojas-Jara, C., Díaz-Larenas, C., Vergara-Morales, J., Alarcón-Hernández, P., & Ortiz-Navarrete, M. (2016). Estilos de enseñanza y estilos de aprendizaje en educación superior: Análisis de las preferencias de estudiantes de Pedagogía en Inglés en tres universidades chilenas. *Revista Electrónica Educare*, *20*(3), 1.

Ventura, A. C., Moscoloni, N., & Gagliardi, R. P. (2012). Estudio comparativo sobre los estilos de aprendizaje de estudiantes universitarios argentinos de diferentes disciplinas. *Psicología Desde El Caribe*, *29*(2), 276–304.

Discussion

Aguilera Pupo, E., & Ortiz Torres, E. (2009). Las investigaciones sobre los estilos de aprendizaje y sus modelos explicativos. *Revista de Estilos de Aprendizaje*, *2*(4), 22–35.

Ankad, R. B., Herur, A., Chinagudi, S., & Patil, S. (2015). PowerPoint presentation in learning physiology by undergraduates with different learning styles. *Adv Physiol Educ*, *39*, 367–371.

Aristeidou, M., & Cross, S. (2021). Disrupted distance learning: the impact of Covid-19 on study habits of distance learning university students. *Open Learning*, *36*(3), 263–282.

Hurtado Bello, P., Tamez Almaguer, R., & Lozano Rodríguez, A. (2017). Características que presentan los estudiantes con estilos de aprendizaje diferentes en ambientes de aprendizaje colaborativo. *Tendencias Pedagógicas*, *30*, 191–206.

Tinoco-Izquierdo, W. E., & Tinoco-Cuenca, N. P. (2018). El proceso de enseñanza aprendizaje en la educación superior: aprender para aprender durante toda la vida. *Maestro y Sociedad*, *15*(3), 409-419.

Impact of pesticides on environmental, health, and agriculture sustainability

Impacto de los pesticidas en la sustentabilidad ambiental, sanitaria y agrícola

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Key Handbooks

Mexican agriculture has largely incorporated a technological model dependent on pesticides. This management and its toxic effects are evident in the areas of greatest agricultural activity. The objective of this paper is to characterize the management of pesticides, including their toxic effects on the environment, food safety, health, and agricultural sustainability for the world. In this vein, a bibliographic synthesis was made regarding the historical development of pesticides, and the basic aspects related to the application of pesticides in Mexico. This paper also provides evidence of the harmful effects of pesticides on human health, and the impact of their residuality in biotic and abiotic environments. It also discusses the role of legislation in the challenge between the immediate benefits of pesticides and the health and ecological damage caused to diverse ecosystems. The information contained within will support anyone involved in, or related to, sustainable agricultural production.

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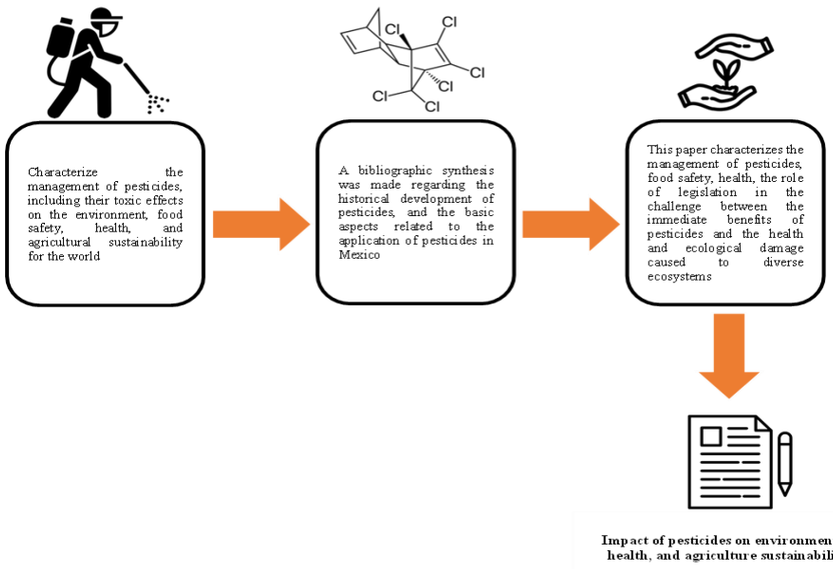
Abstract

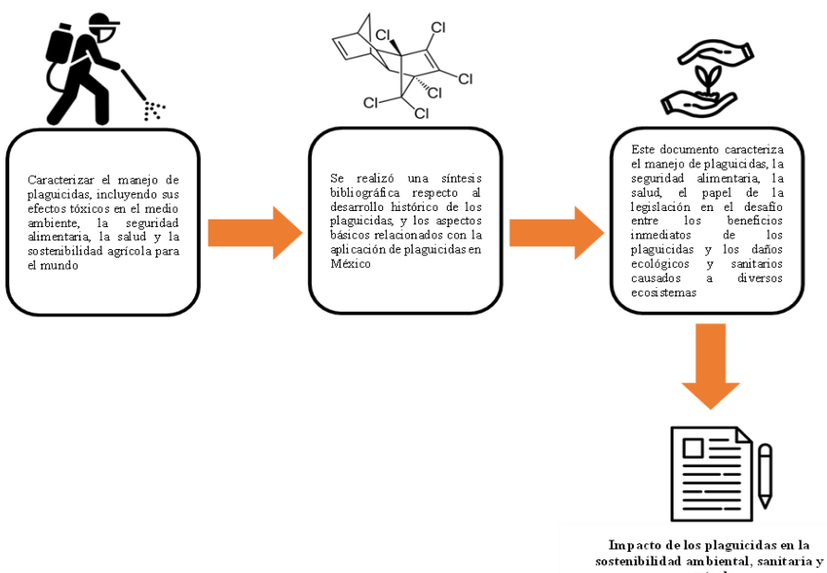
Mexican agriculture has largely incorporated a technological model dependent on pesticides. This management and its toxic effects are evident in the areas of greatest agricultural activity. The objective of this paper is to characterize the management of pesticides, including their toxic effects on the environment, food safety, health, and agricultural sustainability for the world. In this vein, a bibliographic synthesis was made regarding the historical development of pesticides, and the basic aspects related to the application of pesticides in Mexico. This paper also provides evidence of the harmful effects of pesticides on human health, and the impact of their residuality in biotic and abiotic environments. It also discusses the role of legislation in the challenge between the immediate benefits of pesticides and the health and ecological damage caused to diverse ecosystems. The information contained within will support anyone involved in, or related to, sustainable agricultural production.



Food security, Agricultural, Sustainability, Legislation, Ecological

Resumen

La agricultura mexicana ha incorporado en gran medida un modelo tecnológico dependiente de plaguicidas. Este manejo y sus efectos tóxicos se evidencian en las zonas de mayor actividad agrícola. El objetivo de este trabajo es caracterizar el manejo de plaguicidas, incluyendo sus efectos tóxicos sobre el medio ambiente, la seguridad alimentaria, la salud y la sostenibilidad agrícola para el mundo. En este sentido, se realizó una síntesis bibliográfica respecto al desarrollo histórico de los plaguicidas, y los aspectos básicos relacionados con su aplicación en México. Este artículo también proporciona evidencia de los efectos nocivos de los plaguicidas en la salud humana y el impacto de su residualidad en ambientes bióticos y abióticos. También analiza el papel de la legislación en el desafío entre los beneficios inmediatos de los plaguicidas, los daños ecológicos causados a diversos ecosistemas y los daños a la salud. La información contenida en él capítulo apoyará a cualquier persona involucrada o relacionada con la producción agrícola sostenible.



Seguridad alimentaria, Agrícola, Sostenibilidad, Legislación, Ecológico

Introduction

The term pesticide is generally used to identify agrochemicals to prevent, control, or destroy unwanted species that interfere with the production, storage, transportation, and drying of food, wood, and wood products (Pereira *et al.*, 2021; Tudi *et al.*, 2021). Pesticides can be grouped into different chemical families, such as: Organochlorines (**OCPs**); organophosphates(**OPPs**); organofluorines; carbamates; pyrethroids; bipyridyl herbicides; triazine herbicides; triazoles; and chloroacetanilide herbicides (Tudi *et al.*, 2021). Globally, about 2 million t of pesticides are utilized each year (Bhattu *et al.*, 2021). Their functions are expressed with varying degrees of toxicity that are related to the Median Lethal Dose (**LD_{50}**) parameter (Weis *et al.*, 2019), and for field handling, the container is identified with a color (Kaur *et al.*, 2019). The chemical nature and physical properties of these compounds make them especially toxic by altering structures and functions of fundamental biomolecules (Nagy *et al.*, 2020), consequently blocking cellular homeostasis and damaging vital processes (Machado and Martins, 2018). They are abundantly used in agriculture to control pests (Afshari *et al.*, 2021), in industry as solvents (Musarurwa and Tavengwa, 2021), in petroleum additives (Purkait and Hazra, 2020), and in treatment of green areas, water reservoirs. and cleaning of physical spaces (Wang *et al.*, 2021). It is estimated that, by 2023, there will be 1,600 Active Ingredient (**a.i.**) (Zhang and Yang, 2021), which will generate more than 50,000 products registered as pesticides in the world (Kalyabina *et al.*, 2021). The World Health Organization (2022) has estimated that about 3 million workers in developing countries experience severe poisoning from pesticides each year, of which approximately 18,000 of those affected eventually die. This paper will review, in greater depth: i) the historical development of pesticides; ii) the application of pesticides in Mexico; iii) the harmful effects of pesticides on human health; iv) the harmful effects of pesticides on biotic and abiotic media; and v) legislation on the use of pesticides.

1. Historical development of pesticides

Pesticides are any substance or mixture of substances which purpose is to prevent, destroy, repel, or control a pest (Pesticide Action Network, 2017). There are different types of pesticides, and each serves to combat specific pests. For example: i) insecticides to control insects; ii) herbicides to kill or inhibit the growth of unwanted plants (also known as weeds); and iii) fungicides to control fungal problems, such as mold, mildew, and rust (Silveira *et al.*, 2018; Pesticide Action Network in Mexico, 2022) (Table 1):

Box 1

Table 1

General classification of the most frequently used pesticides worldwide

Pesticide	Class: Substance
Insecticide	Carbamate: Aldicarb, Pirimicarb, Carbofuran, Carbary1, Propoxur, Oxamyl, Terbucarb Neonicotinoid: Acetamiprid, Thiamethoxam OCPs: Endosulfan, Lindane, DDT, Dieldrin OPPs: Diazinon, Fenthion, Malathion, Ethion, Parathion, Phosphamidon, Dimethoate, Dichlorvos, Chloropyrifos, Mevinphos, Oxydemeton-methyl, Methamidophos, Monocrotophos, Disulfoton, Isofenphos, Carbophenothion Phenylpyrazole degradate: Aldicarb sulfoxide Pyrethroid: Deltamethrin, Fenpropathrin, Permethrin
Herbicide	Aminophosphonates: Glyphosate Benzamide: Fluopicolide, Zoxamide Cloroacetamide: Alaclor, Butachlor, Dimethenamid, Metolachlor Quaternary nitrogens: Paraquat dichloride Substituted urea: Diuron Triazine: Atrazine, Cyanazine
Fungicide	Carboxamide: Boscalid, Captofol Chlorinated hydrocarbon: Hexachlorbenzene Chlorophenyl: Dichloran, Quintozene OPPs: Edifenphos, Iprobenfos

OCPs: organochlorines; OPPs: organophosphates.

(Pesticide Action Network in Mexico, 2022)

There are also other types of pesticides with less global use, such as algaecides to kill algae and/or slow their proliferation, and rodenticides to kill rodents, such as mice and rats (Pesticide Action Network, 2016). The chemical synthesis of pesticides, as well as their applications, got a significant boost from the study done by the Food and Agriculture Organization (**FAO**) in 1995 to analyze losses due to pathologies, pests, and weeds in 60 crops (Kang *et al.*, 1995). In 1998, the world consumption of pesticides was worth $34.15 billion USD, of which North America accounted for $9 billion USD, and Latin America (**LA**) represented 10% of the total, equivalent to about $3 billion USD (Sidhu *et al.*, 2019).

In the late 19th and early 20th century, data appeared on the benefits of using Bt cotton, the result of biotechnology, in the field of biopesticides (Meghana *et al.*, 2018). Cotton was genetically modified with the inclusion of a strain of Bacillus thuringiensis, and researchers showed the benefit of using the bacterium via four factors: i) increased yield; ii) lower cost for production; iii) lower expenditure of additional pesticide; and iv) lower number of intoxications (Fleming *et al.*, 2018; Tokel *et al.*, 2021).

This research directly favored the production, transport, and application of the transgenic/pesticide binomial in Mexico (Nava *et al.*, 2019). OPPs were introduced shortly after OCPs, a group of semi-volatile pesticides, characterized by having carbon and chlorine atoms bonded in their structure, which entered the Mexican market in the 1950s (Valdez *et al.*, 2000). Their consumption was on the rise, so much so that, in 1995, 54,678 t were used; 47% were insecticides, 29% herbicides, 17% fungicides, and 7% others, with 200 brands of products, including 24 banned and 13 restricted (Sanchez *et al.*, 2011). During 2017, pesticide production in Mexico was over 106 thousand t (Leyva *et al.*, 2017a). According to the consultation of Sanitary Registrations of Pesticides, Plant Nutrients and Maximum Residue Level (**MRL**), for their use by the Federal Commission for the Protection against Sanitary Risks (2022), 2,070 a.i. were manufactured in Mexico, during 2019, across more than 230 companies. The World Health Organization (2022) classifies pesticides (Table 2), based on their toxicity, into: Extremely hazardous (I_a); Highly hazardous (I_b); Moderately hazardous (II); Slightly hazardous (III); and Unlikely to present acute hazard (IV). For example, the insecticide OPPs Dichlorvos cholinesterase inhibitor is Highly hazardous (I_b) and has LD_{50} of 5-50 mg/kg body wt. (Zhang *et al.*, 2021).

Box 2

Table 2

World Health Organization recommended classification of pesticides

Class	Toxicological bands	LD_{50} for rats mg/kg body wt.		Examples
		Oral	Dermal	
I_a	Extremely hazardous	< 5	< 50	Parathion, Dieldrin
I_b	Highly hazardous	5 – 50	50 - 200	Aldrin, Dichlorvos
II	Moderately hazardous	50 – 2000	200 - 2000	DDT, Chlordane
III	Slightly hazardous	> 2000	> 2000	Malathion
IV	Unlikely to present acute hazard	5000 or higher	-	Carbetamide, Cycloprothrin

LD_{50}: Median Lethal Dose.

(World Health Organization, 2022)

The use of pesticides over the last 4 decades requires deep inspection. Originally, pesticide development used metal precursors of arsenic, mercury, lead, and copper in the 1970s (Pesticide Action Network, 2016). This resulted in the discovery of Dichlorodiphenyltrichloroethane (**DDT**). However, the adverse impact of DDT on the environment and human health was realized, and its domestic and agricultural use was banned, leading to the development of other synthetic pesticides, such as Pyrethroid and OPPs (International Agency for Research on Cancer, 2022b).

OPPs are esters derived from phosphoric acid and have their antecedents in the toxic gases sarin, tabun, and soman - originally used for military purposes (Dash and Osborne, 2022). After their application in war, their insecticidal effect was discovered (Rashid *et al.*, 2022). One of the first OPPs produced was parathion, marketed by Bayer^{MR} in 1944 (Garcia *et al.*, 2022). As an insecticide, its synthetic production expanded, and by 1998, the Environmental Protection Agency (**EPA**) of the United States of America (**USA**) had registered 20,000 products (García *et al.*, 2003; Edwards and Tchounwou, 2005; Calaf *et al.*, 2021).

Calaf *et al*. (2021) reported that 23,000 t of a.i. were consumed in Central America, of which Guatemala used 9,000 t, El Salvador 7,000 t, Nicaragua 5,800 t, and Honduras 176 t. Imports during 1974 totaled $641 million USD, and by 1980, they amounted to $2,817 million USD (Kang *et al*., 1995). In 1978, Colombia ranked 3rd in LA, with the use of insecticides OPPs and carbamates, and herbicide Paraquat dichloride (also known as Gramoxone) (Chaparro and Castañeda, 2015). The agricultural population of the country corresponded to 40% of its inhabitants, whose health was at risk due to intoxications. Consequently, Paraquat dichloride was withdrawn (due to damage to multiple organs of the body) thanks to the decision of the Constitutional Court of Colombia T-080-17 (2017).

However, at the same time that Paraquat dichloride was banned in 1984, the Colombian government authorized the use of Glyphosate, and by 1994, the "Program for the Eradication of Illicit Crops using Aerial Spraying with the Herbicide Glyphosate" was officially regulated (Olasolo, 2015). Since then, Glyphosate, composed of 480 g/L of isopropylamine salt of N-phosphonomethylglycine, and which commercial brand worldwide is Roundup^{MR}, is frequently used in Valle del Cauca for sugarcane ripening, and as an herbicide for: i) coffee; ii) banana; iii) rice; iv) cocoa; v) African palm; and vi) citrus (Varela *et al*., 2019). Arellano *et al.* (2016) of Greenpeace compiled the data in Table 3, referencing the global use of pesticides.

Box 3

Table 3

Pesticides used worldwide

Compound	Type	Prohibited	Restricted	Effect	Applications
Aminophosphonates: Glyphosate	H	France, Netherlands, Sri Lanka, El Salvador, Denmark, Belgium	Colombia, United Kingdom, Germany, Switzerland, Canada, some states in the USA	Resistance to 14 weeds	Transgenics: corn, soybean, cotton, canola, rapeseed, wheat, barley, avocado, lemon, orange, tangerine, grapefruit
Substituted urea: Diuron		Belize, Sweden, New Zealand, EU	Canada, Yugoslavia	Carcinogenic	Corn, cotton, banana, sugar cane
OPPs: Metamidofos		Brazil, EU, China, Kuwait, Uruguay, Ecuador, Dominican Rep., Indonesia	Bangladesh, India, USA, Guatemala, Belize, China, Sri Lanka	IA (World Health Organization, 2022) Extremely dangerous (Rotterdam Convention, 2022)	Chia, tomato, potato, cucumber, chili, watermelon, soybean, cotton, cabbage, broccoli, cantaloupe, tobacco
OPPs: Mevinfos	I	EU, Belize, USA, India	China, Costa Rica Malaysia, Sudan	Endocrine disruptor	Garlic, onion
OPPs: Monocrotophos		EU, Australia, China, Philippines, Thailand, Nigeria, Jamaica		IB (World Health Organization, 2022) Regularly toxic (Rotterdam Convention, 2022)	Soybean, tobacco
OPPs: Parathion		Peru, Denmark		Extremely toxic (Rotterdam Convention, 2022)	Cotton, onion, beans, peanut, tomato, corn, wheat

OPPs: organophosphates; H: Herbicide, I: Insecticide.

The Food and Agriculture Organization (2013) reported the application of 4.85 t of pesticides per 1,000 ha in 2012, with 37,455 t of insecticides, 31,195 t of herbicides, and 42,223 t of fungicides worldwide. Centner and Eberhart (2014) indicated the consumption of 2.36 billion kg of pesticides/yr worldwide. Agricultural uses of such compounds in the USA alone amounted to 0.5 billion kg. Globally, about 2 million t of pesticides are being used each year (International Agency for Research on Cancer, 2022b). China is the largest pesticide-producing nation, followed by the USA and Argentina (Basílico *et al*., 2022).

The herbicide, Glyphosate, was introduced by the USA agrochemical company, Monsanto[MR] (European Food Safety Authority, 2022). It is applied in agriculture (Maggi *et al.*, 2020), forestry (Rolando *et al.*, 2017), horticulture, and in parks and streets (Connolly *et al.*, 2018). In Germany, the use of Glyphosate increased by 100% during the years between 1999 and 2010 (Villnow *et al.*, 2019). Steinmann *et al.* (2012) analyzed application patterns by surveying 896 farmers. They found that the compound was applied at pre-sowing in 20.7% of the study area, at pre-harvest in 11.2%, and to stubble in 68.1%, mainly in oilseed rape (27.5%), barley (20.1%), and wheat (15.8%). Farmers expected an increase in yield between 38.1% and 71.4% in cultivated areas.

Glyphosate management in oilseed rape and wheat crops in the UK was estimated by Cook *et al.* (2010) with benefits of 3% for wheat and 9% for oilseed rape. They analyzed the potential results of eliminating the use of this herbicide in wheat and gave a figure of 2.9 million t/yr. If they returned to natural processes in seeds, the change for the industry would mean around $55,000 USD/yr. In recent years, the herbicide, Glyphosate, has become the most widely used non-selective, broad-spectrum, systemic herbicide (Heap and Duke, 2018). However, public concern arose regarding Glyphosate in the EU because Monsanto[MR] started to sell a broad-spectrum herbicide, which contains Glyphosate as an a.i., together with genetically modified (**GM**) crops (Tosun *et al.*, 2019). Most GM crops are resistant to other herbicides produced by different agrochemical companies, so farmers who wanted to use Glyphosate became dependent on Monsanto[MR] GM crops. In 2015, the International Agency for Research on Cancer (2022a) concluded that the herbicide, Glyphosate, among other herbicides, "is probably carcinogenic to humans".

This put the herbicide in the media spotlight and sparked a scientific controversy about the potential risks to health and industrialized agriculture.

By 2020, the total use of pesticides in agriculture remained stable globally, registering at 2.7 million t of a.i. (European Food Safety Authority, 2022). This volume of pesticides is about 47.5% herbicides, 29.5% insecticides, 17.5% fungicides, and 5.5% other pesticides (European Food Safety Authority, 2022). Global pesticide application per crop area was 1.8 kg/ha (Food and Agriculture Organization/World Health Organization, 2021). Total pesticide trade reached approximately 7.2 million t of products, with a value of $41.1 billion USD (European Food Safety Authority, 2022).

Despite the stability achieved during the last few years, pesticide use during the last 4 decades increased 50%, compared to the 1990s, and pesticide use per crop area increased from 1.2 to 1.8 kg/ha (Food and Agriculture Organization/World Health Organization, 2021), with increases in the proportion of herbicides (from 41% to 52% of total pesticides), and reductions in the proportion of fungicides (from 25% to 23%) and insecticides (from 24% to 18%) (United Nations Statistics Division of the Food and Agriculture Organization, 2021). The maximum consumption per hectare of pesticides is about 25 kg, with Asia being the highest in the world (Pesticide Action Network, 2016, 2017).

During 2020, Asia was the largest exporter of pesticides globally, with 3.7 million t, equivalent to $16.1 billion USD (Food and Agriculture Organization/World Health Organization, 2021). For its part, pesticide use in European agriculture increased by only 3% between 1990 and 2020, most likely due to the strict European Common Agricultural Policy put in place, which monitors and controls the use of pesticides (European Food Safety Authority, 2022).

During 2020, LA was the largest importer of pesticides worldwide, with 1.1 million t, equivalent to $6.9 billion USD, an increase of 160% compared to 2019 (United Nations Statistics Division of the Food and Agriculture Organization, 2021). Argentina's agricultural activity has increased in the last 30 yrs, to the point that it has become the largest producer of oil, soybean meal, and the world's 3rd largest supplier of seeds (United Nations Statistics Division of the Food and Agriculture Organization, 2021).

These economic benefits have been achieved through applications of 200 million L of different pesticide formulations, mainly of the herbicide, Glyphosate, on 19.7 million ha/yr, primarily on transgenic soybeans, followed by corn and wheat (Basílico *et al.*, 2022).

Mac Loughlin *et al*. (2017) have reported on pesticide applications in vegetable production and their effects on water bodies. They studied a peri-urban area of the city of La Plata in Argentina with application of 36 pesticides and investigated the amount of residues in stream sediments at five sampling sites. They found that the sum of fungicides, insecticides, and herbicides measured gave values of 1,080/2,329, 3,715/88, and 367/5 ng.g^{-1} respectively. Brazil is a country that is economically dependent on agriculture, with 88 million ha across a variety of products, ranging from forage grains and oilseeds to fruits and vegetables (Castro *et al*., 2020). The harvested area has expanded by 23.48% between 1930 and 2017, with an increase in productivity of 8% per decade. To meet this demand, Brazilian producers use a large amount of pesticides, estimated at 549,280 t in 2018 (Lopes *et al*., 2022). Almost half of all approved products contain a.i., listed by the Pesticide Action Network (2016, 2017).

2. Application of pesticides in Mexico

It is important to note that despite Mexico's participation in the Rotterdam Convention (2022), in the United Nations Environment Programme (2022), in the Stockholm Convention on Persistent Organic Pollutants (2022), and in the Codex Alimentarius (2022), different companies in Mexico have sanitary registrations for pesticides with undetermined production periods, which include highly toxic substances. Fifty-one active products were identified, and the presence of OPP insecticides Phosphamidon, Mevinphos, Monocrotophos, Disulfoton, and Isofenphos qualified as extremely toxic, with OPP insecticides Chloropyrifos and Oxydemeton-methyl designated as highly toxic (Valdez *et al.*, 2000; Sanchez *et al*., 2011; Nava *et al.*, 2019).

Leyva *et al*. (2017a) monitored pesticide residues in rivers in northwestern Mexico and detected DDT, and the insecticides OPPs Parathion, Diazinon, Ethion, Malathion, Chlorpyrifos, Carbophenothion, as well as insecticide carbamate Pirimicarb, and insecticides OCPs Endosulfan, Lindane. During the period of 2005-2017 (Table 4), sanitary actions with pesticides were carried out in the states of Nayarit, Sonora, Campeche, Chiapas, Chihuahua, Michoacan, Nayarit, Puebla, Sinaloa, Tamaulipas, Veracruz, Guanajuato, and Yucatan.

Box 4

Table 4

Estimation of pesticides used in different states of the Mexican Republic, period 2005-2017

Pesticides	Estimate (t)	State	Period (yrs)	References
Carbamate OCPs OPPs Pyrethroid	N.R.	Nayarit	2014-2015	(Benitez *et al.*, 2018)
Endosulfan, 2,4-Dichlorophenoxyacetic acid, Paraquat dichloride, Glyphosate, Chlorothalonil, Mancozeb	16 to 211	Sonora	2010-2014	(Silveira *et al.*, 2018)
Pesticides in general	Insecticides 37455 Herbicides 31195 Fungicides 42223	Campeche Chiapas Chihuahua Michoacan Nayarit Puebla Sinaloa Tamaulipas Veracruz	2013-2017	(Gamboa *et al.*, 2018)
Chloropyrifos, 2,4-Dichlorophenoxyacetic acid, Glyphosate, Mancozeb	9878	Guanajuato	2014-2016	(Perez *et al.*, 2017)
Methamidophos, Malathion, Diazinon, Carbofuran, Mancozeb, 2,4-Dichlorophenoxyacetic acid, Glyphosate	N.R.	Yucatan	2005-2007	(Gómez, 2017)

OCPs: organochlorines; OPPs: organophosphates; N.R.: No Register.

The group of Highly Hazardous Pesticides (**HHPs**) has recently been categorized. This classification responds to a modality authorized by the Strategic Approach to International Chemicals Management (**SAICM**) (Deguine *et al.*, 2021). The criteria by which a pesticide is considered an HHPs are: i) high acute toxicity; ii) chronic toxicity; iii) long-term effects; iv) environmental toxicity; and v) inclusion in international conventions for which compliance is mandatory (Pesticide Action Network, 2016, 2017; Food and Agriculture Organization/World Health Organization, 2021).

The record of accredited HHPs in Mexico corresponds to the comparison that researchers of the Pesticide Action Network in Mexico (**RAPAM**) made between the Pesticide Action Network (2016) and the Federal Commission for the Protection against Sanitary Risks (2022). This agency authorizes the pesticides that are allowed to be imported, marketed, and used in the country. Among the accredited HHPs are 183 a.i., for agricultural, domestic, gardening, and industrial use. For human health, 63 of them have acute toxicity, according to IA and IB classification (World Health Organization, 2022), 19 can be lethal by inhalation, 43 are likely to cause cancer, according to the EPA, 35 are endocrine disruptors, according to the Globally Harmonized System (**GHS**), 21 are toxic in reproductive processes, and 2 are mutagenic (Pesticide Action Network in Mexico, 2022).

In relation to environmental toxicity, 44.81% present high toxicity to bees, as they can cause death at doses greater than 2 g/bee (Pesticide Action Network, 2016), 15 are included in Annex III of the Rotterdam Convention (2022), 3 in the Stockholm Convention on Persistent Organic Pollutants (2022) as persistent, organic pollutants, with methyl bromide included in the United Nations Environment Program (2022) as a substance that destroys the ozone layer. In Mexico, there are 282 companies with HHP registrations for: i) agricultural; ii) forestry; iii) livestock; iv) domestic; v) urban; and vi) industrial use. The top five manufacturers are Bayer^{MR} (with 202 registrations), Syngenta Agro^{MR} (with 133 registrations), FMC Agroquímica de Mexico^{MR} (with 93 registrations), Dow Agrosciences de Mexico^{MR} (with 92 registrations), and BASF Mexicana^{MR} (with 85 registrations) (Pesticide Action Network in Mexico, 2022). At the end of 2022 (Table 5), 2,322 people were reported to have been poisoned by pesticides in Mexico, of which 1,489 were men and 833 were women (National Epidemiological Surveillance System, 2022). The states of Jalisco, Chiapas, Guerrero, and Veracruz stand out for pesticide poisoning (Pesticide Action Network in Mexico, 2022).

Box 5

Table 5

Pesticide poisoning by state, year 2022

Federal State	Men	Women	Total
Aguascalientes	7	4	11
Baja California Norte	20	17	37
Baja California Sur	13	6	19
Campeche	11	4	15
Coahuila	31	9	40
Colima	19	7	26
Chiapas	137	90	227
Chihuahua	12	10	22
Mexico City	23	9	32
Durango	5	6	11
Guanajuato	43	33	76
Guerrero	112	86	198
Hidalgo	52	38	90
Jalisco	263	165	428
Mexico (State)	82	47	129
Michoacan	88	49	137
Morelos	59	25	84
Nayarit	88	21	109
Nuevo Leon	16	11	27
Oaxaca	79	30	109
Puebla	46	23	69
Queretaro	3	3	6
Quintana Roo	13	15	28
San Luis Potosi	12	5	17
Sinaloa	51	22	73
Sonora	24	18	42
Tabasco	26	11	37
Tamaulipas	21	13	34
Tlaxcala	3	1	4
Veracruz	109	43	152
Yucatan	2	3	5
Zacatecas	19	9	28
Total	1489	833	2322

(National Epidemiological Surveillance System, 2022)

About 50,000 ha of cruciferous vegetables are planted in Mexico, of which 74.42% is broccoli (*Brassica oleracea*) (Rocha and Cisneros, 2019). Guanajuato is the main producer of broccoli in Mexico, with 62% of the total harvested area, and an average yield of 12.98 t/ha (National Institute of Statistics and Geography, 2022a). However, in recent years there has been increasing concern about the consequences of pesticide use on this crop (Pesticide Action Network in Mexico, 2022). As a result, the standards established for the safety of this food, and its MRLs, have become stricter (Federal Commission for the Protection against Sanitary Risks, 2022).

Castro *et al*. (2021) analyzed 78 samples from a packing house in Irapuato, Guanajuato, Mexico, and from the Central Food Depot of Huixcolotla, Puebla, Mexico, reporting that, of the 78 samples, 42 were free of pesticides, 14 had unquantifiable concentrations (traces), and 22 had at least one residue. The pesticides found were: Boscalid (0.0061 mg/kg), Dimethoate (0.0068 mg/kg), Imidacloprid (0.0087 mg/kg), Methamidophos (0.0266 mg/kg), Omethoate (0.0111 mg/kg), Penconazole (0.0039 mg/kg), Propamocarb (0.0061 mg/kg), and Thiamethoxam (0.0045 mg/kg).

The state of Sinaloa has an arable area of 1,245,638 ha and produces corn, sorghum, tomato, chili, potato, sugarcane, watermelon, and mango (Agri-Food and Fisheries Information Service, 2022). Among the technologies used in its agriculture, 61.5% are chemical fertilizers, 67% are chemical herbicides, and 65% are chemical insecticides (National Institute of Statistics and Geography, 2022b). According to the National Epidemiological Surveillance System (2022), in the state of Sinaloa, at the end of 2022, 73 people were reported to have been poisoned by pesticides, of which 51 were men and 22 were women (Table 4). On average, there are 2.5 intoxications per week in the state (Pesticide Action Network in Mexico, 2022). Leyva *et al*. (2017a) calculated 263 commercial products applied from 97 a.i. The most abundant compounds were OPPs insecticides: Diazinon, Malathion, Parathion, Dimethoate, Chloropyrifos, and herbicide amino-phosphonate Glyphosate.

Leyva *et al*. (2017b) have reported that about 800,000 t are produced in the agricultural zone of the Culiacan valley between exported vegetables and grains. The valley is composed of eight municipalities totaling 1,243,770 inhabitants. Different researchers have identified the use of 118 pesticides, with 63 of them in the category of HHPs (Pesticide Action Network in Mexico, 2022). Total consumption was 69.92 t of 97 a.i. yr^{-1}. Malathion (3 591.80 kg a.i. yr^{-1}), and Dichlorvos (1 275.77 kg a.i. yr^{-1}) were among the most widely used OPP insecticides, but ten others of the same chemical classification were also applied during this period (Food and Agriculture Organization/World Health Organization, 2021).

Malathion was applied to bean, sorghum, safflower, and mango crops to suppress pests, such as leafhoppers, bugs, thrips, scales, weevils, and ants; it is highly toxic to bees and is banned in two countries. Dichlorvos was applied on tomato and cucumber crops to control spider mite, whitefly, leafminer, and pinworm. It is considered acutely toxic and very toxic to bees; it is banned in 32 countries (Leyva *et al*., 2017a).

Arellano *et al*. (2016) reported that Greenpeace, during 2015, monitored ten water bodies in Sinaloa and reported elevated contents of insecticides OPPs Diazinon and Parathion in the Culiacan River, as well as insecticides OPPs Parathion, Chloropyrifos, and Mevinphos in the El Fuerte River. They also found Glyphosate residues at concentrations between 3.62 and 4.3 ng/L in 100% of the water samples in Yucatan.

In two valleys in northwestern Mexico (the Culiacan Valley in Sinaloa and the Yaqui Valley in Sonora), approximately 250,000 kg a.i. yr^{-1} of 54 products are used each year, 43 of which are classified as HHPs because they are persistent, bio-accumulative, or very toxic (Pesticide Action Network, 2016). García *et al*. (2021) reported that the most frequently detected pesticides (mean, µg g^{-1}) in the Culiacan Valley were OCPs (0.1967), OPPs (0.0928), Pyrethroid (0.2565), organonitrogen (0.0552), and miscellaneous pesticides (0.1851). In the Yaqui Valley, the most frequently detected pesticides were OCPs (0.8607), OPPs (0.0001), Pyrethroid (0.0124), and miscellaneous pesticides (0.0009). The OPP insecticides used are Dimethoate, Parathion, and Methamidophos for control of the bud aphid and wheat ear aphid. For safflower, chickpea, corn, citrus, and cotton crops, along with the above OPPs, they also apply OCPs and Pyrethroid (Garcia *et al*., 2017).

Similar realities are present in other regions of the country. The reproductive health problems of flower growers in the State of Mexico are highly relevant; in the case of Coatepec Harinas and Villa Guerrero, 80% and 70% of the respective populations are dedicated to flower growing. The applications of pesticide mixtures in flower production are qualitatively and quantitatively severe, since 75% of their a.i., are classified as HHPs (Pesticide Action Network in Mexico, 2022). In that list, OPPs are abundant, and their prohibition is established in 10 (and up to 90) countries (Castillo *et al.*, 2017).

In Campeche and Yucatan, similar conditions are present in corn, horticultural, floristic, and beekeeping agri-food systems, due to the high consumption of HHPs, which cause environmental imbalances, contamination of abiotic and biotic resources, and massive death of bees, which consequently results in economic damage due to rejection of contaminated exported honey and, to a larger extent, abundant and severe damage to the health of workers (Gómez, 2017; Rendon von Osten and Hinojosa, 2017).

In Chiapas, 55 a.i. yr^{-1} are used. OPPs insecticides dominate - Parathion leads, followed by Monocrotophos; 18 of them are applied to maize, in addition to the herbicide, Glyphosate, (available in five presentations). In floriculture, 46 a.i. yr^{-1} are applied; 32 of them are on the list of HHPs, and 27 ingredients are banned worldwide (Hernandez *et al.*, 2017).

Recent studies in southern Yucatan reported that 55% of farmers use the herbicide, Glyphosate, for GM soybean production (Ponce *et al.*, 2022), and in the cattle zone of eastern Yucatan, 72% of farmers use Glyphosate for their crops (Polanco *et al.*, 2018). In the Yucatan Peninsula, Campeche is the main producer of GM soybeans (National Institute of Statistics and Geography, 2022c).

In 2012, producers requested permission to cultivate 60,000 ha, with extensive use of the herbicide, Glyphosate (Ponce *et al.*, 2022). Soy (Glycine max L. cv.A5403) Faena Solution (or **RR**) (MON-04032-6) has been introduced in its experimental phase in Campeche beginning in 2001, being incorporated in Yucatan since 2003, and in Quintana Roo since 2005 (Polanco *et al.*, 2018).

Soybean cultivation in Yucatan exceeded 25,000 t in 2017, 25% more than in 2016, covering the peninsular area since then (National Institute of Statistics and Geography, 2022c); the products used in greater proportion are six commercial herbicides which a.i., is Glyphosate; they also employ the OPPs insecticides Methamidophos and Chloropyrifos, in addition to Pyrethroid, Carbamate, and OCPs (Rendón von Osten and Hinojosa, 2017).

Other observations that Gómez (2017) refers to are related to industrial agriculture in the Yucatan peninsula and are the following: (i) the handling of pesticides with spray pumps and backpacks near the population; (ii) aerial spraying disperses most of the pesticide via wind to distant sites; (iii) the handling of agrochemicals by workers is virtually experimental, sometimes mixing up to eight compounds without respecting the indicated doses; iv) they do not follow safety standards, and there is no adequate protection; v) there is no care in the handling of containers, and they contaminate water bodies; vi) this type of corporate agriculture does not protect human resources, soil, or water it is only oriented towards economic benefit; and vii) it does not protect the environment overall.

3. Harmful effects of pesticides on human health

In the national territory, there is extensive evidence of the consequences of pesticide use (Sierra *et al.*, 2019). Their presence was identified in the blood serum of agricultural workers (Valencia *et al.*, 2021) and in pasteurized milk consumed in Mexico City (Schopf *et al.*, 2022).

In the field of human health, epidemiological studies have suggested that high levels of pesticide exposure are associated with increased risk of cancer (Leonel *et al.*, 2021), cardiotoxicity (El-Nahhal and El-Nahhal, 2021), Parkinson's disease (Islam *et al.*, 2021), diabetes mellitus (Sarath *et al.*, 2021), and birth defects (Ventura *et al.*, 2022), in addition to producing various adverse health effects, such as affecting the immune system (Bartling *et al.*, 2021), nervous system (Arab and Mostafalou, 2022), endocrine system (Gea *et al.*, 2022), and reproductive system (Kaboli *et al.*, 2022).

The OPPs Diazinon, Fenthion, Malathion, Ethion, Parathion, and Phosphamidon are widely recognized to be particularly neurotoxic because they inhibit acetylcholinesterase, an enzyme that hydrolyzes the neurotransmitter, acetylcholine, at brain cholinergic synapses and neuromuscular junctions (Lopes *et al.*, 2022). During the last few years, different biomarkers have been used to detect the consequences of pesticide exposure before adverse clinical effects occur, such as modifications in blood cell composition (Neghab *et al.*, 2018) and alterations in enzymatic activities (Medithi *et al.*, 2021). In Mexico, as biomarkers of exposure, residues of OCPs and DDT have been found in human adipose tissue, breast tissue, human semen, and blood serum (Fucic *et al.*, 2021; López *et al.*, 2022).

Calderón *et al*. (2018) demonstrated that due to the lipophylic characteristic of some pesticides, residues of Lindane, α-Hexachlorocyclohexane (**α-HCH**), β-Hexachlorocyclohexane (**β-HCH**), p, p′-dichlorodiphenyl dichloroethylene (**p,p′-DDE**), and p,p'-dichlorodiphenyldichloroethane (**p,p'-DDDD**) were detected in 1,485 samples of adipose tissues of deceased people who lived in Veracruz City, Mexico.

Polanco *et al*. (2017) monitored OCPs residues in 18 Yucatan municipalities with high cervical cancer mortality rates. OCPs detected were Endosulfan I (7.35 μg/mL), Aldrin (3.69 μg/mL), and p,p'-DDDD (2.33 μg/mL), including 1.39 and 1.46 μg/mL of δ-Hexachlorocyclohexane (δ-HCH). Women from the agricultural area had high concentrations of OCPs in their blood, particularly Dieldrin (1.19 μg/mL) and of p,p′-DDE (1.26 μg/mL). In the metropolitan area, 0.080 μg/mL of γ-Hexachlorocyclohexane (**γ-HCH**) and 0.064 μg/mL of Heptachlore were detected.

Two cross-sectional studies were carried out in villages of the states of Sonora and Sinaloa in Mexico, where high levels of OPPs have been detected through environmental and human monitoring. OPPs were measured in the serum of 60 fertile-aged women. The most commonly detected OPPs in serum were: Pentachloroanisole (**PCA**) (71%), Polychlorinated biphenyl (PCB) #205 (43%), Tetrachlorobenzenes (17-33%), p,p′-DDE (21%), and residues of Lindane by-products α-HCH or β-HCH (15%). Congeners of Furans and Dioxins with the highest concentrations in milk were 2, 3, 4, 7, 8 - PeCDF (3.42 pg/g) and Octachlorodibenzo-p-dioxin (33.0 pg/g), respectively, which may reach developing embryos and infants via the placenta and lactation (Farías *et al.*, 2019).

The International Agency for Research on Cancer (2022b) classified a wide range of pesticides as carcinogenic, including 56 as carcinogenic in laboratory animals, with some associated with cancer in humans, including cervical and breast cancer. Current studies directly link the presence of xenobiotics to adverse health effects. There is evidence of these detriments in the genome with mutagenic or carcinogenic manifestations (Ramirez, 2015). Glyphosate is considered by the International Agency for Research on Cancer (2022a) as a possible carcinogen; methyl parathion, methamidophos, and methomyl are banned in numerous countries and are included in the Rotterdam Convention (2022), which Mexico has signed.

Martinez *et al*. (2017) compared the levels of OCPs in blood serum and adipose tissue, calculating their differences in concentrations for both biological matrices. 126 pairs of blood serum and adipose tissue samples were collected during autopsies and analyzed as case studies in Los Mochis, Sinaloa, Mexico. Among OCPs, higher concentrations corresponded to β-HCH and p,p′-DDE in blood serum lipids, while pp'-DDDT showed higher concentrations in adipose tissue.

Flores *et al*. (2017) evaluated 247 serum samples from children between the ages of 6 and 12 yrs old from two zones in Mexico (indigenous zones and industrial zones) to determine α-Endosulfan (178.6-306.9 ng/g lipid), β-Endosulfan (901.5 ng/g lipid), endosulfan sulfate (1,096.4 ng/g lipid), p,p′-DDE in malaria-endemic areas (1,782.2-1,358.3 ng/g lipid), and PCB #101 (1,032.7 ng/g lipid). The evidence provided by this exploratory study indicates that the evaluation of the health risks posed to children living in contaminated areas is a high-priority health issue. There are 26 HHPs used in the Campeche region; the effects on human health range from mild to severe intoxications. Estimates of pesticide residues indicate that 66% of the farmers who prepare the pesticide mixtures are the most affected by intoxication. Workers in Holpechen have registered Glyphosate in urine from 0.06 to 0.87 g. L-1, while purified water coming from groundwater has been estimated at 0.03-0.78 g. L-1 (Rendón von Osten and Dzul Caamal, 2017).

Poisonings by OPPs are numerous; the World Health Organization (2022) quantified 500,000 to 1,000,000 OPPs poisonings; deaths from pesticide accidents have been estimated at 220,000/yr; 40,000 of them have occurred in Asia and Africa, and in smaller proportion in Mediterranean countries and in the USA (Pesticide Action Network, 2016, 2017; United Nations Statistics Division of the Food and Agriculture Organization, 2021).

4. Harmful effects of pesticides on biotic and abiotic media

Pesticide formulations generally have a high concentration of solvents with low dispersion, remaining in soil for a long time, thus moving through the environment and putting biological systems at risk (Pesticide Action Network in Mexico, 2022). The main water polluting pesticides are: herbicides, insecticides, fungicides, and bactericides, including OPPs, Carbamates, Pyrethroids, OCPs, and others (many, such as DDT, are banned in most countries but are still being used illegally and persistently) (Rad *et al.*, 2022). Agricultural activities can reintroduce these pollutants into aquatic environments through wastewater (Dahshan *et al*., 2016).

According to the Food and Agriculture Organization/World Health Organization (2021), agricultural land, which requires irrigation, has more than doubled in recent decades, which has increased the use of pesticides, eventually affecting ground/underground water quality. OPPs are soluble in water; consequently, they occur widely in water bodies (Wang *et al.*, 2021). In addition, they are toxic to aquatic microorganisms, disrupt photosynthesis and cell growth, and, therefore, cause loss of biodiversity (Rad *et al.*, 2022). The two most significant source points of pollution via OPPs into aquatic systems are sewage overflows and wastewater treatment plant effluents (Daud *et al.*, 2017; Rad *et al.*, 2022).

Rodriguez *et al*. (2019) have referenced contamination within the Ayuquila-Armeria river basin (Mexico). The most frequent pesticides were Ametryn, Dimethoate, and Diazinon. The sites with the highest number of pesticides in the four samplings were Palo Blanco, Antes Manantlan, Tuxcacuesco, and Ayuquila. Sites near the intensive agriculture zone presented higher numbers of pesticides than those located in areas with rain-fed agriculture.

Clemente *et al*. (2019) quantified the concentrations of OCPs in the water of the Laguna Negra of Puerto Marques, Acapulco. The OCPs compounds were determined by gas chromatography analysis with electron capture detector. The results obtained from the sampling sites were divided into lagoon and discharge sites and did not show a significant difference, since the total average concentrations were 5.55 and 6.02 μg/L, respectively. It was also noted that, during the dry season, a total average of 6.80 μg/L was recorded, while in the rainy season, it was 3.56 μg/L. According to the Official Mexican Standard NOM-SSA1-1994 (2022), there should be no OCPs. Although concentrations are low (μg/L), they can cause some alteration to organisms through bioaccumulation and biomagnifications, with risks to the health of both the natural ecosystem and the human being.

Pesticide residues have also been identified in water and sediments from Chacahua-Pastoria Lagoon System in the Oaxaca Coast, Mexico. The spatial distribution of insecticide OPPs Malathion and OCPs in water showed the highest values near to adjacent land with some pattern differences. DDT was the most frequent in water and sediment samples showed the highest concentrations in the Pastoria Lagoon. These results indicate the need to establish permanent monitoring programs to implement mitigation measures (Leal *et al.*, 2022).

Regarding contamination by residual pesticides in abiotic and biotic environments, accidents have unique consequences. The city of Salamanca, located in the state of Guanajuato, is characterized by its agricultural development. There is a particular case related to OCP contamination in this place: the facilities and surroundings of the former Tekchem Industrial Unit, where OCPs and OPPs were manufactured. The company ceased operations in 2007; however, to date, there is a problem of soil and groundwater contamination, due to inadequate management of processes and waste during most of the production stages (Hernandez *et al*., 2019). An on-site study showed that the soil is mostly contaminated by OCPs, which represent approximately 70% of the identified compounds, with DDT and its metabolites found in the highest concentrations (Secretariat of Environment and Natural Resources of Mexico, 2018).

Ecological costs are another set of consequences from massive application of OPPs. Several studies have analyzed air pollution (Hamsan *et al.*, 2017; Lopez *et al.*, 2017; Pozo *et al.*, 2017), water pollution (Stamatis *et al.*, 2013; Dahshan *et al.*, 2016; Daud *et al.*, 2017; Zhang *et al.*, 2017a; Di Guardo and Finizio, 2018), and soil pollution (Simon *et al.*, 2017; Zhang *et al.*, 2017b), including the interaction of the constituent elements of the biosphere, which can be synthesized into the following environmental problems: i) contamination of abiotic resources (DiGiacopo and Hua, 2020); ii) imbalance of populations (Kaur *et al.*, 2019); iii) loss of biodiversity (Kumar *et al.*, 2019); iv) contamination of food chains (Lima *et al.*, 2019); v) bioaccumulation (Rossi *et al.*, 2020); and vi) residues in food (Abbas *et al.*, 2017).

5. Legislation on the use of pesticides

Production processes and socioeconomic phenomena related to the use of pesticides, as well as their effects on biota and animal health, are regulated by conventions, institutions, treaties, and standards. Among the most relevant ones at the international level are the following:

Annex III of the Rotterdam Convention (2022), which aims to promote shared responsibility and joint efforts in the international trade of certain hazardous chemicals, in order to protect human health and the environment from potential harm, while contributing to their environmentally sound use by facilitating the exchange of information about their characteristics and establishing a national decision-making process on their import and export.

The Stockholm Convention on Persistent Organic Pollutants (2022) aims to protect human health and the environment from persistent organic pollutants by strengthening national legislation and enacting national implementation plans. Mexico signed the agreement on May 23, 2001, in Sweden, and ratified it on February 10, 2003. It was the first Latin American country to ratify the convention, which entered into force on May 17, 2004.

The World Health Organization (2022), in collaboration with the Food and Agriculture Organization/World Health Organization (2021), is responsible for assessing the risks of pesticides to humans, either through direct exposure or residues in food, and recommending appropriate protective measures. These assessments are based on all data submitted for national pesticide registrations worldwide, as well as on all scientific studies published in peer-reviewed journals. After assessing the level of risk, safe intake limits are established to ensure that the amount of pesticide residues to which people are exposed to by eating food over a lifetime does not result in adverse health effects.

These acceptable daily intake limits are used by governments and international risk managers, such as Codex Alimentarius (2022), to establish MRLs for pesticides in food. Codex standards are the benchmark for international food trade, which means that consumers around the world can be confident that the food they buy meets agreed safety and quality standards, regardless of where it was produced.

The World Health Organization (2022) and the Food and Agriculture Organization/World Health Organization (2021) have also jointly developed the International Code of Conduct on Pesticide Management. The most recent edition of this voluntary framework was published in 2014. It provides guidance to regulators, the private sector, the general public, and other stakeholders on best practices in the management of pesticides throughout their lifecycle, from production to disposal.

The European Food Safety Authority (2022) provides scientific advice to the European Commission on potential risks related to the presence of pesticide residues in food treated with plant protection products, including the approval of a.i. for use in the EU. It is also involved in the establishment of MRLs in food. In addition, it is responsible for preparing the Annual Report on Pesticide Residues in the EU.

The International Agency for Research on Cancer (2022b) is the specialized cancer agency of the World Health Organization. It is an interdisciplinary group that brings together expertise in epidemiology, laboratory science, and biostatistics to identify the causes of cancer (e.g., by the presence of pesticide residue), so that preventive measures can be taken.

The Pesticide Action Network (2017) is a network of over 600 participating non-governmental organizations, institutions, and individuals in over 90 countries who are working to replace the use of hazardous pesticides with ecologically-sound and socially-just alternatives.

The Federal Commission for the Protection against Sanitary Risks (2022) establishes an electronic database for individual consultation of sanitary registrations of pesticides, plant nutrients, and their MRLs in food.

"http://siipris03.cofepris.gob.mx/Resoluciones/Consultas/ConWebRegPlaguicida.asp"

The Pesticide Action Network in Mexico (2022) is a Mexican, non-profit, civil association that works to progressively eliminate chemical pesticides that affect human health and the environment, promoting the necessary changes in public policies that promote agroecological pest control. It trains and supports workers, communities, producers, and consumers to strengthen the rights to healthy food and food sovereignty. They also establish collaboration agreements with professionals and specialists from the academic sector, institutions, environmental organizations, and social organizations to protect the rights to healthy food, free of pesticides and transgenics, as well as food sovereignty and an environment free of contaminants. The Official Mexican Standard NOM-SSA1-1994 (2022) provides information on the permissible limits and chemical characteristics of water for human use and consumption. According to the standard, the content of chemical constituents must conform to Aldrin and Dieldrin (separate or combined) 0.03 µg/L, Chlordane (total isomers) 0.30 µg/L, DDT (total isomers) 1.00 µg/L, γ-HCH 2.00 µg/L, Hexachlorobenzene 0.01 µg/L, and 2,4-D 50.00 µg/L. It is important to recognize that pesticide management regulations and provisions become more restrictive as both theoretical and methodological research provides greater insight into health effects and environmental alterations, as well as increases in sensitivity and resolution of analytical determinations.

Conclusions

Pesticide exposure is very common throughout the world. Farmers and people who come into contact with pesticides are often unaware of their history, classification, and hazardous effects. With knowledge of pesticide classification, proper use, exposure, toxicity, and regulation, along with effective public health programs, the burden of human disease caused by pesticide exposure should be greatly reduced, while public health and the ecosystem should be improved. In addition, the rationale for pesticide regulation should be clarified. The benefits and costs related to pesticide use on farmers or consumers are essentially private in nature, so the duality between health and sustained profit growth is unclear. Our final observation is that our review, which involves highly specialized research in different disciplines, also illustrates that interactions between disciplines are very limited. Indeed, health studies generally deal with pesticide toxicity in farmers, while economic studies generally deal with the effects of pesticides on the agricultural market, without pursuing interdisciplinary cohesion.

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

García-Casillas, Arturo César: Writing original draft.
Prado-Rebolledo, Omar Francisco: Review and correction.
Martínez-González, Sergio: Data curation.
Téllez, Isaías Guillermo: Supervision.

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Abbreviations

2,4-D	2,4-Dichlorophenoxyacetic acid
a.i.	Active Ingredient
DDT	Dichlorodiphenyltrichloroethane
EPA	Environmental Protection Agency
EU	European Union
FAO	Food and Agriculture Organization
GHS	Globally Harmonized System
GM	Genetically Modified
HHPs	Highly Hazardous Pesticides
LA	Latin America
LD_{50}	Median Lethal Dose
MRL	Maximum Residue Level
OCPs	Organochlorine Pesticides
OPPs	Organophosphates Pesticides
p,p'-DDD	p,p'-dichlorodiphenyldichloroethane
p,p′-DDE	p,p′-dichlorodiphenyl dichloroethylene
PCA	Pentachloroanisole
PCB	Polychlorinated biphenyl
RAPAM	Pesticide Action Network in Mexico
SAICM	Strategic Approach to International Chemicals Management
USA	United States of America
α-HCH	α-Hexachlorocyclohexane
β-HCH	β-Hexachlorocyclohexane
γ-HCH	γ-Hexachlorocyclohexane
δ-HCH	δ-Hexachlorocyclohexane

References

Antecedents

Abbas, Q., Yousaf, B., Liu, G., Zia Ur Rehman, M., Ali, M. U., Munir, M. A. M., and Hussain, S. A. [2017]. Evaluating the health risks of potentially toxic elements through wheat consumption in multi-industrial metropolis of Faisalabad, Pakistan. Environmental Science and Pollution Research. 26646-26657.

Arab, A., and Mostafalou, S. [2022]. Neurotoxicity of pesticides in the context of CNS chronic diseases. International Journal of Environmental Health Research. 2718-2755.

Arellano, A. O., Ponce de León, H. C., and Rendón, J. V. O. [2016]. La huella de los plaguicidas en México.

Bartling, M. T., Thumecke, S., Russert, J. H., Vilcinskas, A., and Lee, K. Z. [2021]. Exposure to low doses of pesticides induces an immune response and the production of nitric oxide in honeybees. Scientific Reports. 681-670.

Basílico, G., Cogollo, R., M., Ionno, V., Faggi, A., and de Cabo, L. [2022]. The use of glyphosate in regions of Argentina and Colombia and its socio-environmental impacts. En Naeem, M., Bremont, J. F. J., Ansari, A. A., and Gill, S. S. (Eds.), Agrochemicals in Soil and Environment (Vol. 1, pp. 195-212). Singapore: Springer.

Benitez, T. A. B., Herrera, M. J. F., del Carmen, X. G. M., Bernal, H. Y. Y., Medina, D. I. M., Barrón, V. B. S., González, A. C. A., and Rojas, G. A. E. [2018]. Patrón de uso de plaguicidas y biomarcadores bioquímicos en una población de fumigadores urbanos. Revista Internacional de Contaminación Ambiental. 61-71.

Calderón, G. A. L., Waliszewski, S. M., Ruiz, R. R., and Martinez, V. M. C. [2018]. Time trend tendency (1988–2014 years) of organochlorine pesticide levels in the adipose tissue of Veracruz inhabitants. Environmental Monitoring and Assessment. 1-10.

Castro, N. R., Spolador, H. F. S., and Marin, F. R. [2020]. Assessing the economy–climate relationships for Brazilian agriculture. Empirical Economics. 1161-1188.

Castro, V. D. F., Pérez, G. M., Pérez, O. M., Contreras, C. L. F., and Pineda, P. J. [2021]. Pesticides residues in broccoli (*Brassica oleracea* var. Italica) for the national and international market. Revista Internacional de Contaminación Ambiental. 133-143.

Centner, T., and Eberhart, N. [2014]. Requiring pollutant discharge permits for pesticide applications that deposit residues in surface waters. International Journal of Environmental Research. 4978-4990.

Chaparro, N. P., and Castañeda, O. C. [2015]. Mortality due to pesticide poisoning in Colombia, 1998-2011. Journal of Biomedical. 90-102.

Clemente, S. C. J., Vega, L. S., Gutiérrez, T. R., Ortiz, S. R., Pérez, G. J. J., and Camilo, E. M. A. [2019]. Organochlorine pesticides in water of the Laguna Negra of Puerto Marqués, Acapulco, Guerrero, Mexico. Revista Internacional de Contaminación Ambiental. 397-406.

Connolly, A., Basinas, I., Jones, K., Galea, K. S., Kenny, L., McGowan, P., and Coggins, M. A. [2018]. Characterising glyphosate exposures among amenity horticulturists using multiple spot urine samples. International Journal of Hygiene and Environmental Health. 1012-1022.

Cook, S. K., Wynn, S. C., and Clarke, J. H. [2010]. How valuable is glyphosate to UK agriculture and the environment? OutLook Pest Management. 280-284.

Dahshan, H., Megahed, A. M., Abd Elall, A. M., Abd El Kader, M. A., Nabawy, E., and Elbana, M. H. [2016]. Monitoring of pesticides water pollution. The Egyptian River Nile. Journal of Environmental Health Science and Engineering. 15-18.

Daud, M. K., Nafees, M., Ali, S., Rizwan, M., Bajwa, R. A., Shakoor, M. B., Arshad, M. U., Chatha, S. A. S., Deeba, F., Murad, W., Malook, I., and Zhu, S. J. [2017]. Drinking water quality status and contamination in Pakistan. BioMed Research International. 790-818.

Di Guardo, A., and Finizio, A. [2018]. A new methodology to identify surface water bodies at risk by using pesticide monitoring data. The glyphosate case study in Lombardy region (Italy). Science of the Total Environment. 421-429.

DiGiacopo, D. G., and Hua, J. [2020]. Evaluating the fitness consequences of plasticity in tolerance to pesticides. Ecology and Evolution. 4448-4456.

El-Nahhal, Y., and El-Nahhal, I. [2021]. Cardiotoxicity of some pesticides and their amelioration. Environmental Science and Pollution Research. 44726-44754.

Farías, P., Rodríguez, D. S., Baltazar, R. M. C., Gold, B. G., Zapata, P. O., Loreto, G. C., and Riojas, R. H. [2019]. Persistent organic pollutants in serum and breast milk of fertile-aged women. Revista Internacional de Contaminación Ambiental. 281-293.

Fleming, D., Musser, F., Reisig, D., Greene, J., Taylor, S., Parajulee, M., Lorenz, G., Catchot, A., Gore, J., Kerns, D., Stewart, S., Boykin, D., Caprio, M., and Little, N. [2018]. Effects of transgenic *Bacillus thuringiensis* cotton on insecticide use, heliothine counts, plant damage, and cotton yield: a meta-analysis, 1996-2015. PLoS One.e0200131.

Flores, R. R., Pérez, V. F. J., Rodríguez, A. M., Medellín, G. S. E., van Brussel, E., Cubillas, T. A. C., Carrizales, Y. L., and Diaz, B. F. [2017]. Biomonitoring of persistent organic pollutants (POPs) in child populations living near contaminated sites in Mexico. Science of the Total Environment. 1120-1126.

Fucic, A., Duca, R. C., Galea, K. S., Maric, T., Garcia, K., Bloom, M. S., Andersen, H. R., and Vena, J. E. [2021]. Reproductive health risks associated with occupational and environmental exposure to pesticides. International Journal of Environmental Research and Public Health. 1-9.

Gamboa, G. T. G., Servín, M. R. S., Cota, F. P., Pereyra, J. G., Martínez, G. N. A., and Villalobos, S. S. [2018]. Plaguicidas en la agricultura mexicana y potenciales alternativas sustentables para su sustitución. Revista Biológico Agropecuaria Tuxpan. 61-75.

García, H. J., Leyva, M. J. B., Bastidas, B. P. J., Leyva, G. G. N., Valdez, T. J. B., Aguilar, Z. G., and Betancourt, L. M. [2021]. A comparison of pesticide residues in soils from two highly technified agricultural valleys in northwestern Mexico. Journal of Environmental Science and Health, Part B. 548-565.

Gea, M., Zhang, C., Tota, R., Gilardi, G., Di Nardo, G., and Schiliro, T. [2022]. Assessment of five pesticides as endocrine-disrupting chemicals: effects on estrogen receptors and aromatase. International Journal of Environmental Research and Public Health. 50-59.

Gómez, G. I. [2017]. El uso de plaguicidas altamente peligrosos en la Península de Yucatán. En Bejarano, G. F. (Ed.), Los plaguicidas altamente peligrosos en México. RAPAM, CIAD, UCCS, INIFAP, IPEN, PNUD (pp. 10-117). Ciudad de México, México: Red de Acción sobre Plaguicidas y Alternativas en México A. C.

Hamsan, H., Ho, Y. B., Zaidon, S. Z., Hashim, Z., Saari, N., and Karami, A. [2017]. Occurrence of commonly used pesticides in personal air samples and their associated health risk among paddy farmers. Science of the Total Environment. 381-389.

Heap, I., and Duke, S. O. [2018). Overview of glyphosate-resistant weeds worldwide. Pest Management Science. 1040-1049.

Hernández, H. U. B., Mariaca, M. R., Nazar, B. A., Álvarez, S., Torres, D. A., and Herrera, P. C. [2017]. Los plaguicidas altamente peligrosos en los Altos de Chiapas. En Bejarano, G. F. (Ed.), Los plaguicidas altamente peligrosos en México. RAPAM, CIAD, UCCS, INIFAP, IPEN, PNUD (pp. 10-117). Ciudad de México, México: Red de Acción sobre Plaguicidas y Alternativas en México A. C.

Hernández, R. I. B., Cruz, M. A. S., Ortega, R. E., and Lucho, C. C. A. [2019]. Un ejemplo de mala praxis ambiental: Tekchem en Salamanca, Gto. Pädi Boletín Científico de Ciencias Básicas e Ingenierías del ICBI. 17-19.

International Agency for Research on Cancer. [2022a]. IARC Monographs Volume 112: evaluation of five organophosphate insecticides and herbicides. Lyon, France. Retrieved 25 Dec

International Agency for Research on Cancer. [2022b]. IARC Monographs on the Identification of Carcinogenic Hazards to Humans. Lyon. Retrieved 25 Dec

Islam, M. S., Azim, F., Saju, H., Zargaran, A., Shirzad, M., Kamal, M., Fatema, K., Rehman, S., Azad, M. A. M., and Ebrahimi, B. S. [2021]. Pesticides and Parkinson's disease: current and future perspective. Journal of Chemical Neuroanatomy. 101-112.

Kang, J., Zettel, V. H., and Ward, N. I. [1995]. The organophosphate pesticides. Journal of Nutritional & Environmental Medicine. 325-339.

Kaur, R., Mavi, G. K., Raghav, S., and Khan, I. [2019]. Pesticides classification and its impact on environment. International Journal of Current Microbiology and Applied Sciences. 1889-1897.

Kumar, A., Thakur, A., Sharma, V., and Koundal, S. [2019]. Pesticide residues in animal feed: status, safety, and scope. Animal Feed Science and Technology. 73-80.

Leal, A. M. L., Bastidas, B. P. J., Cruz, A. E., Aguilar, J. E. E., Perea, D. X. P., Martínez, A. I. G., and Leyva, M. J. B. [2022]. Pesticides in water and sediments of Chacahua-Pastoria Lagoon System, Oaxaca, Mexico. Marine Pollution Bulletin. 113-121.

Leyva, M. J. B., Martínez, R. I. E., Bastidas, B. P. J., and Betancourt, L. M. [2017b]. Plaguicidas altamente peligrosos utilizados en el valle de Culiacán, Sinaloa. En Bejarano, G. F. (Ed.), Los plaguicidas altamente peligrosos en México. RAPAM, CIAD, UCCS, INIFAP, IPEN, PNUD (pp. 197-207). Ciudad de México, México: Red de Acción sobre Plaguicidas y Alternativas en México A. C.

Leyva, M. J. B., Valdez, T. J. B., Bastidas, B. P. d. J., Angulo, E. M. Á., Sarmiento, S. J. I., Barraza, L. A. L., Olmeda, R. C., and Chaidez, Q. C. [2017a]. Monitoring of pesticides residues in northwestern Mexico rivers. Acta universitaria. 45-54.

Lima, F. E., Bundschuh, M., Bakanov, N., Englert, D., Schulz, R., and Schafer, R. B. [2019]. Effects of a systemic pesticide along an aquatic tri-trophic food chain. Bulletin of Environmental Contamination and Toxicology. 507-514.

Lopes, F. M., Maleski, A. L. A., Balan, L. L., Bernardo, J. T. G., Hipolito, L. M., Seni, S. A. C., Batista, F. J., Falcao, M. A. P., and Lima, C. [2022]. Impact of pesticides on human health in the last six years in Brazil. International Journal of Environmental Research and Public Health. 23-31.

López, A., Coscollà, C., Yusà, V., Armenta, S., de la Guardia, M., and Esteve, T. F. A. [2017]. Comprehensive analysis of airborne pesticides using hard cap espresso extraction-liquid chromatography-high-resolution mass spectrometry. Journal of Chromatography A. 27-36.

López, E. A., Charruau, P., Dzul, C. R., and Rendón-von, O. J. [2022]. Bioaccumulation and trophic transfer of polycyclic aromatic hydrocarbons (Pahs) and organochlorine pesticides (OCPs) in a lagoon system of the municipality of Emiliano Zapata, Tabasco, Mexico. Social Science Research Network. 1-27.

Mac Loughlin, T. M., Peluso, L., and Marino, D. J. G. [2017]. Pesticide impact study in the peri-urban horticultural area of Gran La Plata, Argentina. Science of the Total Environment. 572-580.

Machado, S. C., and Martins, I. [2018]. Risk assessment of occupational pesticide exposure: use of endpoints and surrogates. Regulatory Toxicology and Pharmacology. 276-283.

Maggi, F., la Cecilia, D., Tang, F. H. M., and McBratney, A. [2020]. The global environmental hazard of glyphosate use. Science of the Total Environment. 137-143.

Martínez, V. M. C., Waliszewski, S. M., Gómez, A. S., Villalobos, P. R., Calderón, V. C., Ortega, M. D., Meza, E., and Caba, M. [2017]. Comparison of organochlorine pesticide levels between human blood serum and adipose tissue. Revista Internacional de Contaminación Ambiental. 393-401.

Medithi, S., Jonnalagadda, P. R., and Jee, B. [2021]. Predominant role of antioxidants in ameliorating the oxidative stress induced by pesticides. Archives of Environmental & Occupational Health. 61-74.

Meghana, H., Jagginavar, S. B., and Sunitha, N. D. [2018]. Efficacy of insecticides and biopesticides against sucking insect pests on Bt cotton. International Journal of Current Microbiology and Applied Sciences. 2872-2883.

Musarurwa, H., and Tavengwa, N. T. [2021]. Deep eutectic solvent-based dispersive liquid-liquid micro-extraction of pesticides in food samples. Food Chemistry. 127-132.

National Epidemiological Surveillance System. [2022]. SINAVE. Pesticide poisoning. CIE-10ª REV. T60. Retrieved 27 Dec

National Institute of Statistics and Geography. [2022a]. INEGI. National, state, municipal and locality information/Guanajuato. Retrieved 27 Dec

National Institute of Statistics and Geography. [2022b]. INEGI. National, state, municipal and locality information/Sinaloa. Retrieved 27 Dec

National Institute of Statistics and Geography. [2022c]. INEGI. National, state, municipal and locality information/Yucatan. Retrieved 27 Dec

Nava, C. U., Terán, V. A. P., Aguilar, M. S., Martínez, C., J. L., Ávila, R., V., Rocha, M. M. G., Castañeda, C. S., Niaves, N. E., Mota, S. D., and Blanco, C. A. [2019]. Agronomic and environmental impacts of Bt cotton in Mexico. Journal of Integrated Pest Management. 1-7.

Neghab, M., Jalilian, H., Taheri, S., Tatar, M., and Haji, Z. Z. [2018]. Evaluation of hematological and biochemical parameters of pesticide retailers following occupational exposure to a mixture of pesticides. Life Sciences. 182-187.

Official Mexican Standard NOM-SSA1-1994. [2022]. Environmental health, water for human use and consumption-permissible limits of quality and treatments to which the water must be subjected for its purification. Retrieved 30 Dec

Olasolo, H. [2015]. The response to the phenomenon of drug trafficking in Colombia through aerial fumigation of illicit crops: analysis of legality in light of International Humanitarian Law. Retrieved 30 Dec

Pérez, O. M. A., Navarro, G. H., Flores, S. D., Ortega, G. N., and Tristán, M. E. [2017]. Plaguicidas altamente peligrosos utilizados en el Bajío de Guanajuato. En Bejarano, G. F. (Ed.), Los plaguicidas altamente peligrosos en México. RAPAM, CIAD, UCCS, INIFAP, IPEN, PNUD (pp. 221-245). Ciudad de México, México: Red de Acción sobre Plaguicidas y Alternativas en México A. C.

Pesticide Action Network in Mexico. [2022]. RAPAM Highly Hazardous Pesticides (HHPs). Retrieved 23 Dec

Pesticide Action Network. [2016]. Replacing chemicals with biology: phasing out Highly Hazardous pesticides with agroecology. Retrieved 23 Dec

Pesticide Action Network. [2017]. International consolidated list of banned pesticides. Retrieved 23 Dec

Polanco, R. A. G., Araujo, L. J. A., Tamayo, M. J. M., and Munguía, G. A. [2018]. The glyphosate herbicide in Yucatan, Mexico. MOJ Bioequivalence & Bioavailability. 284-286.

Polanco, R. A. G., Riba, L. M. I., DelValls, C. T. A., Araujo, L. J. A., Mahjoub, O., and Prusty, A. K. [2017]. Monitoring of organochlorine pesticides in blood of women with uterine cervix cancer. Environmental Pollution. 853-862.

Ponce, C. C., Cardeña, E., F., Giácoman, V. G., Vega de Lille, M., and Góngora, E. V. R. [2022]. Pesticide management and farmers perception of environmental and health issues due to pesticide use in the state of Yucatán, Mexico: a study case. Revista Internacional de Contaminación Ambiental. 289-300.

Pozo, K., Martellini, T., Corsolini, S., Harner, T., Estellano, V., Kukučka, P., Mulder, M. D., Lammel, G., and Cincinelli, A. [2017]. Persistent organic pollutants (OPPs) in the atmosphere of coastal areas of the Ross Sea, Antarctica: Indications for long-term downward trends. Chemosphere. 458-465.

Purkait, A., and Hazra, D. K. [2020]. Biodiesel as a carrier for pesticide formulations: a green chemistry approach. International Journal of Pest Management. 341-350.

Rad, S. M., Ray, A. K., and Barghi, S. [2022]. Water pollution and agriculture pesticide. Clean Technologies. 1088-1102.

Ramírez, J. R. [2015]. Asociación entre la exposición a organofosforados y la paraoxonasa 1 (PON1) y las alteraciones neurocognitivas en niños y adolescentes de una comunidad agrícola en San Luis Potosí. (Tesis Doctorado en Ciencias Ambientales), Universidad Autónoma de San Luis Potosí (UASLP), San Luis Potosí, México.

Rendón von Osten, J., and Dzul Caamal, R. [2017]. Glyphosate residues in groundwater, drinking water and urine of subsistence farmers from intensive agriculture localities: a survey in Hopelchen, Campeche, Mexico. International Journal of Environmental Research and Public Health. 595-599.

Rendón von Osten, J., and Hinojosa, G. D. [2017]. Los plaguicidas altamente peligrosos. En Bejarano, G. F. (Ed.), Los plaguicidas altamente peligrosos en México. RAPAM, CIAD, UCCS, INIFAP, IPEN, PNUD (pp. 309-317). Ciudad de México, México: Red de Acción sobre Plaguicidas y Alternativas en México A. C. Retrieved 20 Dic

Rocha, J., and Cisneros, D. [2019]. La producción de brócoli en la actividad agroindustrial en México y su competitividad en el mercado internacional. Acta universitaria. 1-13.

Rodríguez, A. B. A., Martínez, R. L. M., Peregrina, L. A. A., Ortiz, A. C. I., and Cárdenas, H. O. G. [2019]. Analysis of pesticide residues in the surface water of the Ayuquila-Armeria River watershed, Mexico. TERRA Latinoamericana. 151-161.

Rolando, C. A., Baillie, B. R., Thompson, D. G., and Little, K. M. [2017]. The risks associated with glyphosate-based herbicide use in planted forests. Forests. 208-214.

Rossi, A. S., Fantón, N., Michlig, M. P., Repetti, M. R., and Cazenave, J. [2020]. Fish inhabiting rice fields: bioaccumulation, oxidative stress and neurotoxic effects after pesticides application. Ecological Indicators. 106-112.

Rotterdam Convention. [2022]. The chemicals listed in Annex III. Retrieved 20 Dic

Sánchez, G. M., Pérez, H. N., and Quintanilla, V. B. [2011]. Organophosphorous pesticides research in Mexico: epidemiological and experimental approaches. Toxicology Mechanisms and Methods. 681-691.

Sarath, A., David, J., Krishnaveni, K., Kumar, R. S., and Multidisciplinary, J. I. J. o. [2021]. Pesticide from farm to clinic: possible association between pesticides and diabetes mellitus. International Journal of Multidisciplinary and Current Research. 1-7.

Secretariat of Environment and Natural Resources of Mexico. [2018]. SEMARNAT. Actions and works carried out and in progress, for the environmentally sound management of waste and remediation from the contaminated site in the Tekchem Industrial Unit, Salamanca, Guanajuato. Retrieved 27 Dec

Sierra, D., E., Celis, R. A. J., Lozano, K. F., Trasande, L., Peregrina, L. A. A., Sandoval, P. E., and González, C. H. [2019]. Urinary pesticide levels in children and adolescents residing in two agricultural communities in Mexico. International Journal of Environmental Research and Public Health. 562-569.

Silveira, G. M. I., Aldana, M. M. L., Piri, S. J., Valenzuela, Q. A. I., Jasa, S. G., and Rodríguez, O. G. [2018]. Plaguicidas agrícolas: un marco de referencia para evaluar riesgos a la salud en comunidades rurales en el estado de Sonora, México. Revista Internacional de Contaminación Ambiental. 7-21.

Simon, S. Z., Pérez, V. D., Benimeli, C. S., Polti, M. A., and Álvarez, A. [2017]. Cr(VI) and lindane removal by *Streptomyces* M7 is improved by maize root exudates. Journal of Basic Microbiology. 1037-1044.

Stamatis, N., Hela, D., Triantafyllidis, V., and Konstantinou, I. [2013]. Spatiotemporal variation and risk assessment of pesticides in water of the lower catchment basin of Acheloos River, Western Greece. Scientific World Journal. 231-242.

Steinmann, H. H., Dickeduisberg, M., and Theuvsen, L. [2012]. Uses and benefits of glyphosate in German arable farming. Crop Protection. 164-169.

Stockholm Convention on Persistent Organic Pollutants. [2022]. National Plan for the Implementation of the Stockholm Convention on Persistent Organic Pollutants Mexico. Retrieved 20 Dec

Tokel, D., Genc, B. N., and Ozyigit, I. I. [2021]. Economic impacts of Bt (*Bacillus thuringiensis*) cotton. Journal of Natural Fibers. 1-18.

Tosun, J., Lelieveldt, H., and Wing, T. S. [2019]. A case of 'muddling through'? The politics of renewing glyphosate authorization in the European Union. Sustainability. 440-451.

Tudi, M., Daniel, R. H., Wang, L., Lyu, J., Sadler, R., Connell, D., Chu, C., and Phung, D. T. [2021]. Agriculture development, pesticide application and its impact on the environment. International Journal of Environmental Research and Public Health. 2-23.

United Nations Environment Programme. [2022]. UNEP. Manual of the Montreal Protocol on Substances that Deplete the Ozone Layer. Ozone Secretariat. Tenth edition, Kenya. Retrieved 20 Dec

United Nations Statistics Division of the Food and Agriculture Organization. [2021]. FAOSTAT. Pesticides use, pesticides trade and pesticides indicators global, regional and country trends, 1990-2020. Retrieved 26 Dec

Valencia, Q. R., López, D. R. M., Milic, M., Bonassi, S., Ochoa, O. M. A., Uriostegui, A. M. O., Pérez, F. G. A., Gómez, O. J. L., and Sánchez, A. J. [2021]. Assessment of cytogenetic damage and cholinesterases' activity in workers occupationally exposed to pesticides in Zamora-Jacona, Michoacan, Mexico. International Journal of Environmental Research and Public Health. 626-631.

Varela, M. D. A., González, C. M. A., González, S. J., and Hernández, B. J. [2019]. High-throughput analysis of pesticides in minor tropical fruits from Colombia. Food Chemistry. 221-230.

Villnow, V., Rombach, M., and Bitsch, V. [2019]. Examining German media coverage of the re-evaluation of glyphosate. Sustainability. 1910-1915.

Wang, R., Wang, Q., Dong, L., and Zhang, J. [2021]. Cleaner agricultural production in drinking-water source areas for the control of non-point source pollution in China. Journal of Environmental Management. 112-121.

Weis, G. C. C., de Oliveira, A. A., Assmann, C. E., Bonadiman, B. d. S. R., and Costabeber, I. H. [2019]. Pesticides: classifications, exposure and risks to human health. Arch in Bioscience & Health. 29-44.

World Health Organization. [2022]. WHO. Pesticide residues in food. Retrieved 20 Dec

Zhang, C., Zhao, X., Lei, J., Ma, Y., and Du, F. [2017a]. The wetting behavior of aqueous surfactant solutions on wheat (*Triticum aestivum*) leaf surfaces. Soft Matter. 503-513.

Zhang, J. J., and Yang, H. [2021]. Metabolism and detoxification of pesticides in plants. Science of the Total Environment. 148-161.

Zhang, S., Yao, H., Lu, Y., Yu, X., Wang, J., Sun, S., Liu, M., Li, D., Li, Y. F., and Zhang, D. [2017b]. Uptake and translocation of polycyclic aromatic hydrocarbons (PAHs) and heavy metals by maize from soil irrigated with wastewater. Scientific Reports. 121-131.

Basic

Agri-Food and Fisheries Information Service. [2022]. SIAP. World Food and Agriculture – Statistical Yearbook. Retrieved 27 Dec

Castillo, C. J., Montenegro, M. L. P., and López, A. J. A. [2017]. El uso de plaguicidas altamente peligrosos en la floricultura en el Estado de México y el efecto sinérgico de las mezclas. En Bejarano, G. F. (Ed.), Los plaguicidas altamente peligrosos en México. RAPAM, CIAD, UCCS, INIFAP, IPEN, PNUD (pp. 247-262). Ciudad de México, México: Red de Acción sobre Plaguicidas y Alternativas en México A. C. Retrieved 20 Dic

Codex Alimentarius. [2022]. Food and Agriculture Organization of the United Nations & World Health Organization (FAO/WHO). Retrieved 20 Dic

Corte Constitucional de Colombia T-080-17. [2017]. Derecho fundamental a la consulta previa-caso en que comunidades étnicas solicitan que se detenga definitivamente la fumigación de cultivos ilícitos mediante la aspersión aérea de glifosato. Recuperado 20 Dic

European Food Safety Authority. [2022]. How pesticides are regulated in the EU - EFSA. Retrieved 24 Dec

Federal Commission for the Protection against Sanitary Risks. [2022]. COFEPRIS. Consultation of sanitary registries of pesticides, plant nutrients and MRLs. Retrieved 20 Dec

Food and Agriculture Organization. [2013]. Guidelines on data requirements for the registration of pesticides. Code of conduct on the distribution and use of pesticides. Retrieved 20 Dec

Food and Agriculture Organization/World Health Organization. [2021]. 14th FAO/WHO joint meeting on pesticide management. Retrieved 25 Dec

García, H. J., Leyva, G. G., and Aguilera, M. D. [2017]. Los plaguicidas altamente peligrosos en el Valle del Yaqui, Sonora. En Bejarano, G. F. (Ed.), Los plaguicidas altamente peligrosos en México. RAPAM, CIAD, UCCS, INIFAP, IPEN, PNUD (pp. 209-245). Ciudad de México, México: Red de Acción sobre Plaguicidas y Alternativas en México A. C.

Supports

Afshari, M., Karimi, S. A., Khoshravesh, S., and Besharati, F. [2021]. Effectiveness of interventions to promote pesticide safety and reduce pesticide exposure in agricultural health studies: A systematic review. PLoS One. e0245766.

Bhattu, M., Verma, M., and Kathuria, D. [2021]. Recent advancements in the detection of organophosphate pesticides: a review. Analytical Methods. 4390-4428.

Calaf, G. M., Bleak, T. C., and Roy, D. [2021]. Signs of carcinogenicity induced by parathion, malathion, and estrogen in human breast epithelial cells (Review). Oncology Reports. 1-14.

Dash, D. M., and Osborne, W. J. [2022]. A systematic review on the implementation of advanced and evolutionary biotechnological tools for efficient bioremediation of organophosphorus pesticides. Chemosphere. 137-146.

Deguine, J. P., Aubertot, J. N., Flor, R. J., Lescourret, F., Wyckhuys, K. A. G., and Ratnadass, A. [2021]. Integrated pest management: good intentions, hard realities. A review. Agronomy for Sustainable Development. 1-35.

Edwards, F. L., and Tchounwou, P. B. [2005]. Environmental toxicology and health effects associated with methyl parathion exposure-a scientific review. International Journal of Environmental Research and Public Health. 430-441.

García, M. G., Sánchez, J. I. L., Bravo, K. A. S., Cabal, M. D. C., and Pérez, S. E. [2022]. Review: presence, distribution and current pesticides used in Spanish agricultural practices. Science of the Total Environment. 157-161.

García, S. J., Abu, Q. A. W., Meeker, O. C. W. A., Borton, A. J., and Abou, D. M. B. [2003]. Methyl parathion: a review of health effects. Journal of Toxicology and Environmental Health, Part B. 185-210.

Kaboli, K. S., Farkhondeh, T., and Miri, M. E. [2022]. Glyphosate effects on the female reproductive systems: a systematic review. Reviews on Environmental Health. 487-500.

Kalyabina, V. P., Esimbekova, E. N., Kopylova, K. V., and Kratasyuk, V. A. [2021]. Pesticides: formulants, distribution pathways and effects on human health - a review. Toxicology Reports. 1179-1192.

Leonel, A. C., Bonan, R. F., Pinto, M. B., Kowalski, L. P., and Perez, D. E. [2021]. The pesticides use and the risk for head and neck cancer: A review of case-control studies. Medicina Oral Patologia Oral y Cirugia Bucal. e56-e63.

Nagy, K., Duca, R. C., Lovas, S., Creta, M., Scheepers, P. T. J., Godderis, L., and Adam, B. [2020]. Systematic review of comparative studies assessing the toxicity of pesticide active ingredients and their product formulations. Environmental Research. 108-116.

Pereira, P. C. G., Parente, C. E. T., Carvalho, G. O., Torres, J. P. M., Meire, R. O., Dorneles, P. R., and Malm, O. [2021]. A review on pesticides in flower production: a push to reduce human exposure and environmental contamination. Environmental Pollution. 117-123.

Rashid, S., Rashid, W., Tulcan, R. X. S., and Huang, H. [2022]. Use, exposure, and environmental impacts of pesticides in Pakistan: a critical review. Environmental Science and Pollution Research. 43675-43689.

Schopf, M. F., Pierezan, M. D., Rocha, R., Pimentel, T. C., Esmerino, E. A., Marsico, E. T., De Dea Lindner, J., Cruz, A. G. D., and Verruck, S. [2022]. Pesticide residues in milk and dairy products: An overview of processing degradation and trends in mitigating approaches. Critical Reviews in Food Science and Nutrition. 1-15.

Sidhu, G. K., Singh, S., Kumar, V., Dhanjal, D. S., Datta, S., and Singh, J. [2019]. Toxicity, monitoring and biodegradation of organophosphate pesticides: a review. Critical Reviews in Environmental Science and Technology. 1135-1187.

Valdez, S. B., García, D. E. I., and Wiener, M. S. [2000]. Impact of pesticides use on human health in Mexico: a review. Reviews on Environmental Health. 399-412.

Ventura, M. M. I., Fernández, M. I. M., Guillen, R. E., Ortiz, A. R., and Ruiz, F. M. D. [2022]. Effect of gestational pesticide exposure on the child's respiratory system: a narrative review. International Journal of Environmental Research and Public Health. 1-11.

Zhang, Y., Zhang, W., Li, J., Pang, S., Mishra, S., Bhatt, P., Zeng, D., and Chen, S. [2021]. Emerging technologies for degradation of Dichlorvos: a review. International Journal of Environmental Research and Public Health. 1-13.

A look from the care ethics perspective at inclusion at the Bachelor's Level

Una mirada desde la ética del Cuidado a la inclusión a nivel licenciatura

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Key Handbooks

Identification of areas for improvement: The study provides valuable insights into specific areas where improvements can be made to promote inclusion and support diversity within the university campus. Practical recommendations: Based on the study's findings, practical recommendations are offered for implementing effective changes in infrastructure and support services, thus benefiting students with particular conditions and fostering a more inclusive educational environment. Diversity: Recognize and embrace the diverse perspectives, experiences, and backgrounds of individuals contributing to knowledge generation. This includes acknowledging different cultural, social, and intellectual contexts. Accessibility: Ensure that knowledge creation processes, resources, and outcomes are accessible to a wide range of individuals, regardless of geographical location, socio-economic status, or physical abilities. Equity: Promote fairness and justice in knowledge generation by providing equal opportunities for participation and recognition, and addressing systemic barriers that may hinder certain groups from contributing to or benefiting from knowledge creation. Collaboration: Foster collaborative efforts across disciplines, sectors, and communities to harness collective expertise and address complex challenges from multiple angles. Openness: Embrace openness and transparency in knowledge creation processes, including sharing data, methods, and findings, to facilitate replication, scrutiny, and innovation. Ethical considerations: Uphold ethical principles and values in knowledge generation, including integrity, respect for human dignity, and responsibility towards society and the environment. In conclusion, both at the University of Guadalajara in general and in the geography degree program in particular, there is still a long way to go to develop a comprehensive and truly broad inclusion program. Therefore, recommendations are made by teaching staff and students for there to be a policy that also encompasses this diversity among members of the university community.

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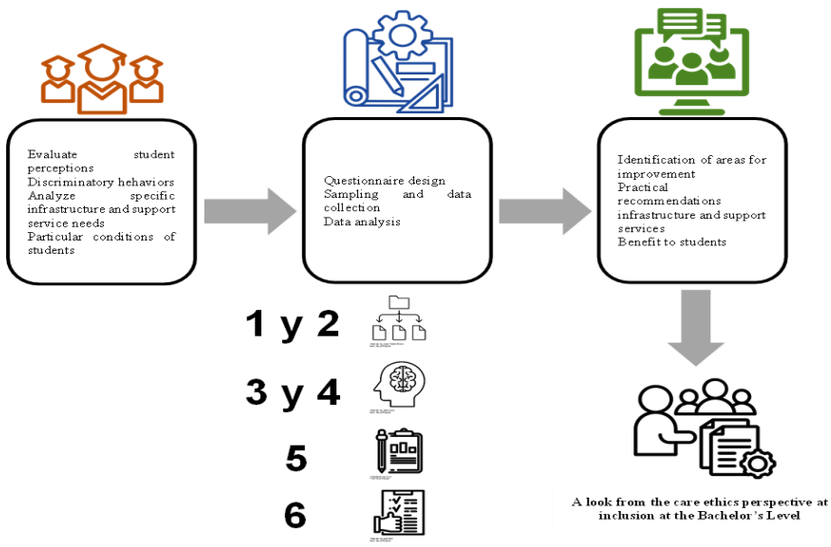
Abstract

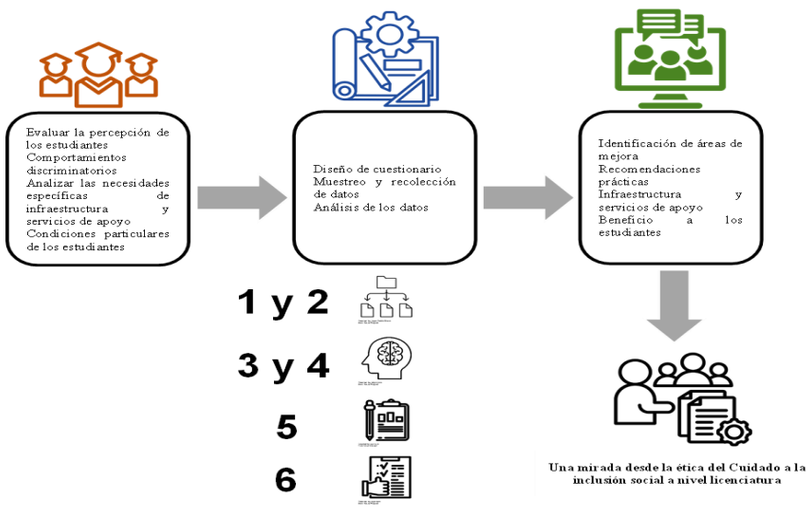
The context, narrative, and specificity of moral judgments should reflect a maturity in which the individual recognizes their immersion in a network of relationships with others. Objectives: To assess the perception of Geography undergraduate students at the University of Guadalajara regarding discriminatory behaviors, as well as to analyze specific infrastructure needs and support services for students with particular conditions. The methodology involved designing a structured questionnaire to gather data on inclusion perception, discriminatory experiences, and infrastructure needs among students, as well as sampling and data collection through university students living with particular conditions. Results: The staff at the University of Guadalajara has implemented policies and actions aimed at promoting a culture of inclusion, equity, and social justice in its network schools since 2005. Conclusions: The administrative and teaching staff at the University of Guadalajara in general, as well as in the geography undergraduate program in particular, are working on truly comprehensive and broad inclusion programs.



Access to education, Student diversity, Higher education, Geography, Inclusion, Equality of opportunity

Resumen

El contexto, la narrativa y la especificidad de los juicios morales deben reflejar una madurez en la que el individuo reconozca su inmersión en una red de relaciones con los demás. Objetivos: Evaluar la percepción de los estudiantes de la licenciatura en Geografía de la Universidad de Guadalajara respecto a los comportamientos discriminatorios así como, analizar las necesidades específicas de infraestructura física y servicios de apoyo para estudiantes con condiciones particulares. La metodología empleada implicó el diseño de un cuestionario estructurado para recopilar datos sobre la percepción de inclusion, experiencias discriminatorias y necesidades de infraestructura entre los estudiantes además de muestreo y recolección de datos a través de estudiantes universitarios que viven condiciones particulares. Resultados. El personal de la Universidad de Guadalajara ha implementado políticas y acciones dirigidas a promover una cultura de inclusión, equidad y justicia social en sus escuelas de la red desde 2005. Conclusiones: El personal administraivo y docente de la Universidad de Guadalajara en general como en el programa de la licenciatura en geografía en particular, se trabaja en programas de inclusion integral verdaderamente Amplio.



Acceso a la educación, Diversidad estudiantil, Educación superior, Geografía, Inclusión, Igualdad de oportunidades

Introduction

In the context of contemporary education, the promotion of inclusion has emerged as a fundamental guiding principle. This approach seeks to ensure that all students, regardless of their individual abilities, have equitable access to quality education. However, the effective implementation of inclusive practices in educational settings presents significant challenges, ranging from understanding the individual needs of students to creating learning environments that foster diversity and equity.

Central objective, the present study aims to explore students' perceptions and experiences regarding inclusion in the educational sphere, with a particular focus on identifying barriers, needs, and opportunities for improvement. Through a comprehensive analysis, it seeks to understand how policies, practices, and attitudes within educational institutions influence the perceived degree of inclusion by students.

Research question, how do students perceive inclusion in educational environments, and what are the main barriers and needs identified in relation to this concept? With the aim of proposing concrete actions that contribute to ensuring that all students have the possibility of becoming leaders in the near future once they graduate from the Bachelor's Degree in Geography and perform as entrepreneurs, academics, entrepreneurs, and/or community leaders who are individuals driving sustainable social development in Mexico, and in general, actions of equity and environmental care (Fardella Rozas & Niño Gutiérrez, 2017).

Literature Review, academic literature provides a solid foundation for the analysis of inclusion in education. Authors have addressed the importance of inclusive education and strategies for its effective implementation. On the other hand, experts have developed theoretical frameworks and guidelines to promote inclusive practices in educational systems worldwide. In this line of thought, it is also important to mention that the different types of learning in higher education play a fundamental role in applying them in the current work field (Valencia, Niño Gutiérrez & López, 2023).

Additionally, researchers like Espín and Mera (2019) have examined the difficulties associated with implementing curriculum adaptations for students with special needs, while Luque (2009) has highlighted the importance of addressing basic human needs in inclusive educational environments. Similarly, García (2003) has emphasized the role of questionnaires as data collection tools in studies on educational inclusion.

In this context, the University of Guadalajara has emerged as a relevant case study (Niño-Gutiérrez et al., 2023), with initiatives such as the Stimulus Program for Students with Disabilities and the creation of infrastructures and services adapted to students needs. However, there are areas for improvement identified by authors such as Campana, Velasco, Aguirre, & Guerrero (2014), who emphasize the importance of inclusive physical and social environments for the educational success of all students.

Theoretical Framework

Socioformation is the theory that encompasses the study of the meaningful learning of students at any educational level with an inclusive vision to have access to quality education anywhere in the world. In this sense, the theory that will frame the study is in that regard (Niño-Gutiérrez, 2022). Carol Gilligan, through her research, designed a new paradigm that broadens the horizon of ethics and democracy, allowing the elimination of the hierarchical and binary gender model that has defined the sense and functions of masculinity and femininity throughout history, which she calls the Ethics of Care.

This paradigm arises from the study and analysis of women's feelings and reasoning, discovering the value of care, which has only been developed in homes, where private and domestic life takes place. Thus, in a patriarchal context, care is perceived as a feminine ethic; however, in a democratic context, care becomes a human ethic that includes everyone, regardless of gender, age, or context. That is, it must transcend the limits of the home and manifest itself in all areas where any member of society needs to perform various activities.

Gilligan relates the Ethics of Care to what she calls moral injury and resistance to injustice, emphasizing the need to change paradigms to avoid losing the ability to love and generate trust among each other, an important dimension for individual and social well-being. Currently, the Ethics of Care is threatened because society resists leaving behind the model that excludes the acceptance of differences among equals. Therefore, interpersonal relationships have become rough, hostile, and hypocritical, and democracy based on real equality is not practiced. This generates the need to universalize the obligations of care, since along with assistance, they are matters of human interest, not just women, and empathy is quickly lost.

The ethics of care is characterized by affection, resilience, democratic citizenship, and resistance to moral harm. The internalization of the binary gender model, rooted in patriarchal culture where being a man implies not being a woman or resembling one, undermines the understanding capacity in women and the capacity for concern for others in men. This ethic serves as a guide to act with attention in the human world. Recognizing the validity of the feminine perspective in the formation of moral development implies understanding the importance, for both sexes throughout life, of the connection between oneself and others, as well as the universality of the need for compassion and care.

The Ethics of Justice is based on the premise of equality (everyone should be treated the same), while the ethics of care is based on the premise of non-violence (no one should be harmed). Both perspectives converge in understanding that inequality negatively affects all parties in an unequal relationship, and that violence is destructive for all involved. Therefore, dialogue between equity and care allows for a better understanding of gender relations, as well as a more complete description of adult work and family relationships.

The distinction between the ethical orientation of justice and rights, and that of care and responsibility, allows for an explanation with a different view of moral development aimed at expressing feelings of empathy and sympathy. Therefore, the context, narrative, and specificity of moral judgments should reflect a maturity where the individual recognizes their immersion in a network of relationships with others. Interactive universalism recognizes the plurality of ways of being human and the differences between them, without necessarily validating all pluralities and differences as morally and politically valid; it sees difference as a starting point for reflection and action. Universality is a regulatory ideal that seeks to develop moral attitudes and foster political transformations that produce a viewpoint acceptable to all.

The perspective of generalized otherness implies seeing each and every individual as rational being with the same rights and duties that one desires for oneself. What constitutes moral dignity is not what differentiates one from another, but what they share as rational and acting agents.

The perspective of concrete otherness shows each rational being as a unique individual with a history, identity, and specific affective-emotional constitution. By treating the other according to the norms of empathy and care, not only their humanity is confirmed but also their individuality as a person. Although the perspective of generalized otherness predominates in contemporary psychology and moral theory, a view limited by this perspective becomes incoherent and cannot distinguish between beings.

Conceptual Framework

Defining the term inclusion and understanding its scope is complex, as it is simply understood as being part of something or belonging. However, in the context of social sciences, it refers to creating an environment that fosters a person or group's sense of belonging, so that they feel supported, respected, and valued (National Cancer Institute Dictionary, 2016).

Considering this definition in the realm of inclusive education, it is understood as one that facilitates access to quality education for all individuals, removing physical and social barriers (prejudices) and promoting their participation to achieve better learning. This implies the construction of an educational system with diversified pedagogical practices, allowing students to acquire knowledge in an equitable environment, regardless of their learning difficulties, different physical capabilities, diverse cognitive characteristics, ethnic-cultural background, or socioeconomic situation (Lovari, et al., 2019).

Despite all intentions to address the needs of special education students, "there is no specific methodology for timely curriculum adaptations" (Espín & Mera, (2019). Therefore, constant observation stands out as the most useful tool for making adjustments in teaching work.

It is important to note that when institutions choose to promote inclusion, they do so in line with the principle established in Inclusive Education according to the United Nations Convention, approved by the General Courts and published in the Official State Gazette, where Inclusive or personalized education is established as "a fundamental human right of all students." It is expected, then, that teachers pay greater attention to students' learning, avoiding simulated and inaccurate approaches, as inclusive education promotes authentic and realistic practices.

Although research and new social approaches regarding inclusion seek to facilitate learning in all its forms, it is important to recognize that needs differ among students, which can result in situations of disadvantage and risks of inattention or discrimination. These specific needs require appropriate and specific responses for their attention (Luque, 2009).

Human needs, according to Luque, 2009, are defined as objectives and strategies whose failure to fulfill can cause serious harm to a person's integration into their context and social group. Physical health and autonomy are considered basic human needs. On the other hand, autonomy refers to the ability to make decisions and respond to various situations.

The appropriate response to special situations in the educational field begins with understanding by the relevant authorities. It is known that many people, instead of receiving adequate education, are affected and pressured by various factors, some of which are mentioned below.

Methodological Framework

a) Definition of research design: A research design was established that combined quantitative and qualitative methods to comprehensively address the topic at hand.
b) Development of data collection instruments: Questionnaires were designed for the quantitative part, and interview scripts were developed for the qualitative part.
c) Validation of instruments: The questionnaires and interview scripts underwent pilot testing and validation to ensure their reliability and validity.
d) Participant selection: Specific selection criteria were applied to identify and recruit participants for both the survey and the interviews.
e) Collection of quantitative data: The questionnaires were administered to the selected sample, ensuring representative coverage of the target population.
f) Collection of qualitative data: In-depth interviews were conducted with a selection of key participants to obtain detailed and contextual perspectives.
g) Analysis of quantitative data: Statistical analysis of the data collected through the questionnaires was performed using appropriate tools and techniques to explore patterns and relationships.
h) Analysis of qualitative data: A thematic analysis approach was applied to identify recurrent and significant themes emerging from the qualitative interviews.
i) Integration of results: Quantitative and qualitative findings were integrated to obtain a holistic understanding of the phenomenon under study.
j) Interpretation of results: The results were interpreted in light of relevant literature, and the theoretical and practical implications of the findings were discussed.
k) Discussion of limitations: The study's limitations, including potential biases and methodological constraints that could affect the validity and generalizability of the results, were discussed.
l) Conclusions and recommendations: Conclusions based on the study's findings were presented, and recommendations for future research or practices in the studied area were formulated."

Results

In humans, we distinguish three fundamental dimensions: biological, psychological, and social. By focusing solely on one of them, we incur in inadequate reductionism, as these dimensions are part of a whole and are therefore interdependent (Gutiérrez, 2011).

The affectation of any of the dimensions can generate imbalances in behavior, in the way of acquiring knowledge, motivations, and even in relationships with others. In this sense, people with special needs often face difficulties, and the classroom environment can amplify this process, as it is common for differences to attract attention. However, this imbalance can also serve as a catalyst for seeking a response to a need, which often is not adequately received, especially in the case of adults, resulting in exclusion.

The interaction between these dimensions is undoubtedly complex, as it leads us to consider individuals as part of a set of interconnected factors. For example, (Niembro et al., 2021), mentions:

The psychological factors that must be considered as part of social exclusion, which is more than poverty, and can have greater implications with the absence of social participation and with the lack of access to basic goods and social welfare networks. This causes individuals to live in situations that complicate access to quality education; likewise, this absence of goods and possibilities can be a cause of lack of inclusion, as the student would not feel equal to their peers.

It is evident that the socioeconomic level of families influences all educational levels, including bachelor's degrees:

In some cases, closely linked to the need for student work, in others weighing the real opportunity costs of continuing studying based on future benefits. Thus, the probability of dropping out of school is significantly higher for students belonging to the first two income quintiles in all countries (CIAE, 2024).

It is important to recognize that not all students with special needs receive the necessary support from their families to access higher educational levels, and in some cases, even if they have the opportunity, they may not make the most informed decisions, regardless of individual characteristics.

Furthermore, differences in learning identified by teachers and, even more so, by their classmates, can lead to a series of psychological and motivational factors that can trigger what is known as systematic depression. However, this situation could be resolved simply by providing additional materials or, in some cases, exploring other pedagogical or learning options that better suit the student's abilities.

Moreover, it must be considered that these factors can be further increased if it is considered that in a classroom, students already have significant differences, ranging from gender differences to geographical location, which by mere analysis would already show their needs and the quality of services, not to mention the individual problems that each student may face.

Special educational needs refer to the difficulty an individual has in accessing learning easily. These difficulties can manifest as psychomotor problems, intellectual disabilities, language disorders, attention deficit hyperactivity disorder (ADHD), as well as physical, sensory, auditory, or visual disabilities, and other signs that interfere with learning. The causes of special educational needs can be genetic, environmental, or a combination of both, and they can occur during prenatal, natal, or postnatal stages (UTPL, 2020).

There are different classifications of special educational needs according to experts in the field, which distinguish between two main types: permanent and transient.

Permanent needs correspond to problems that persist throughout the entire school period and a person's life. These can vary in severity, from mild to severe, and include total or partial weakness of the senses (auditory, visual, motor), reduced mental capacity, or communication disorders. On the other hand, transient needs are learning problems that can be overcome over time, such as language disorders, dyslexia, dysgraphia, and dyscalculia, among others.

Another classification of special educational needs includes those associated with disability and those that are not but require accurate diagnoses. Some examples of these classifications are:

i) Learning disorders: generalized or specific difficulties in learning activities such as writing, spelling, or reading.

ii) Emotional difficulties: problems following rules and behaving appropriately in the school environment.

iii) Physical difficulties: medical conditions that limit or slow down the learning process.

iv) Cognitive disability: disorders such as Down syndrome or intellectual developmental disorder.

v) Autism Spectrum Disorders (ASD): pervasive developmental brain disorders that affect social interaction, communication, and behavior.

vi) Social difficulties: problems making friends or relating to others, expressing oneself, or understanding what others say.

These classifications are important for understanding the individual needs of students and providing them with appropriate support for their educational and personal development (UNIR, 2022).

It is true that most people, especially those from past generations, lack a precise diagnosis of their special needs, largely due to previous lack of awareness about these issues. Some individuals may have faced mild problems that they managed to overcome over time, or they simply learned to manage effectively without the need for a formal diagnosis.

In addition to more common special needs, such as learning disorders or emotional difficulties, there are also others like those of so-called gifted individuals. These individuals often have faster-than-average intellectual development, presenting exceptional cognitive abilities and solving problems in various ways. However, they may face challenges in their educational and social environment, especially during childhood, as they require special programs and educational opportunities tailored to their specific needs, such as course acceleration and constant evaluation of their progress.

According to the 2020 census conducted by the National Institute of Statistics and Geography (INEGI), there are a total of 1,590,583 people nationwide who have some mental problem or condition. Of this group, 54% are men and 46% are women.

However, "government data, in Mexico, states that only 2 out of every 10 people with a mental problem or condition that requires attention receive it, and those who do receive it do not always receive the appropriate treatment" (Badillo, D. 2022).

Recent information mentions that in Mexico, 3 out of 10 people suffer from a mental disorder at some point in their lives, and more than 60 percent of the population suffering from any of them do not receive treatment (Robledo, Z. 2023).

It is common for most of these individuals to discover one of these conditions while they are in school; few are diagnosed at an early age. In other cases, conditions that only require mild therapies can worsen due to poor social interaction and a lack of understanding from families. This can result in adults with difficulties in developing individually and adapting, even in environments that promote so-called "inclusion". Higher education entails multiple benefits for individual and national development, making access to it, internationally, one of the most discussed educational policies in the last two decades. On a comparative level, worldwide access to this level has increased considerably during this period, with the gross enrollment ratio between 2000 and 2018 rising from 19% to 38%, respectively (UNESCO-IESALC, 2020).

Despite efforts to promote inclusion, inequalities in access to higher education persist, which can manifest due to various factors such as race, economic situation, gender, or considerations related to different capabilities. One critical problem in the region (Latin America and the Caribbean) is that a high percentage of students who enter higher education programs (HEIs) do not graduate from them, a situation that disproportionately affects those in more vulnerable situations. In the mid-2010s, on average for the region, only one out of every three students completed their degrees on time, while among the population aged 25 to 29 who had enrolled in an HEI program at some point in their lives, only 46% had graduated, 22% had dropped out of their studies, and 32% were still studying. The graduation rate showed enormous heterogeneity in the region, with Mexico and Peru having a rate of 65%, while in Honduras, the Plurinational State of Bolivia, and Costa Rica, it did not reach 40% (Valenzuela & Yáñez, 2022).

Similarly, Mexico shares similar issues with the rest of Latin America. Higher education in Mexico, despite the efforts and advances of the last two decades, must persist in the pursuit of greater equity and educational quality. Both aspects concentrate the greatest difficulties and represent the greatest challenge of the system at the higher level. The main initiatives should focus on expanding educational opportunities for a greater number of young people, mainly in the regions and social groups most disadvantaged, as well as significantly improving their educational offerings.

The most recent data indicates that, in rounded figures, in the 2011-2012 academic year, enrollment in higher education was 2,932,000 students (excluding graduate studies). The Sixth Government Report of the 2006-2012 administration states that "the total coverage of higher education was equivalent to 32.8% of the population of age to attend this educational level (19 to 23 years old)". Additionally, the same report estimates that for the current school year (2012-2013), coverage will increase to approximately 35%, and it notes that the goal of coverage established in the National Development Plan and in the sectoral program, which had set a coverage of 30% for 2012, has been achieved in advance.

Despite significant progress in educational coverage, the fact that only three out of every ten young people of college age are in university classrooms places us well below our trading partners and some Latin American countries (such as Costa Rica, Chile, Argentina, Brazil, Colombia, and Cuba) (UNAM, 2012).

As mentioned, while there has been significant progress in educational coverage, numerous challenges persist that require effective responses, including the issue of dropout rates, which is closely related to the effective implementation of inclusion policies.

At the World Education Forum 2015, organized by the United Nations (UN) in Incheon, Korea, the Incheon Declaration was proposed, which establishes a comprehensive and ambitious agenda with the aim of ensuring inclusive, equitable, and quality education for all, as well as promoting opportunities for lifelong learning. This declaration aligns with proposals for Sustainable Development 2030.

Within the framework of these efforts, the University of Guadalajara has implemented policies and actions aimed at promoting a culture of inclusion, equity, and social justice in its network schools since 2005. Recognizing the challenges this entails, the institution has worked to improve universal accessibility in its facilities, including the installation of ramps, adapted restrooms, guide lines for visually impaired individuals, and supportive railings, among other measures.

Additionally, efforts have been made to make academic programs inclusive by developing learning processes with support staff for students with hearing impairments in various university campuses. A concrete example of this commitment is the creation of the Wixárika Upper Secondary Education School in the 2019 A calendar, with locations in San Miguel Huaixtita and Ocota de la Sierra, in the municipality of Mezquitic, in the Northern Zone of the State of Jalisco. This school offers technical high school options in Clothing Design and Handicrafts, as well as in Agricultural and Forestry. A significant portion of the teachers are bilingual and members of local ethnic groups, while the rest receive training in the community's native language.

In recent years, the university has focused much of its efforts on promoting inclusion in terms of gender diversity, through courses, regulations, and brochures. Additionally, the Extension and Social Action Coordination has been created, proposing initiatives and actions for greater inclusion and equity, in line with human rights within the Institutional Development Plan 2019-2025. These actions aim to strengthen conditions of access, learning, trajectory, and terminal efficiency, as well as to value the richness of diversity in the university community.

The overall objective is to promote inclusion and equity in university activities and spaces to ensure the full development of community members, particularly those who, due to economic reasons, disability, ethnic origin, language or nationality, gender or sexual preferences, or any other cause, have been vulnerable (University of Guadalajara, 2020).

One of these actions is the creation of the Stimulus Program for Students with Disabilities, although it is focused solely on those with physical conditions, such as wheelchair use, visual impairment, or hearing problems. Another objective of the program is to provide training and education to academic and administrative staff of the University on topics related to academic inclusion, such as training of support readers in standardized tests, Mexican Sign Language courses, and training on diversified educational environments, among others.

However, despite the policies outlined in the Institutional Plan should translate into pedagogical, structural, and linkage actions regarding inclusion, social justice, and human rights, there seems to have been a neglect of considering the diverse cognitive conditions of the institution's students. This includes conditions such as attention deficit disorder, individuals with Asperger's Syndrome, or anxiety disorders, among others. Among the most widely accepted instruments in the academic field are the survey, the questionnaire, and the psychometric test. In this case, reference is made to data collection through the questionnaire to obtain the diagnosis of the sample of the 36 participants in this study (Niño Castillo, Hernández & Niño-Gutiérrez, 2020).

In order to obtain a perspective of students on inclusion, 36 questionnaires were administered to students of the Bachelor's Degree in Geography at the University center for social Sciences and Humanities of the University of Guadalajara, as a first information base for the research. The questionnaire was considered a very useful instrument for data collection, especially when subjects are difficult to access due to distance or dispersion, or due to the difficulty of gathering them (García, 2003).

The data obtained from these questionnaires can be classified first as factual data, as they refer to the personal domain of the individuals that make up the social group studied (the students), as well as the environment around them, including school, in addition to relationships and behaviors. They also include opinion data, which can be considered subjective as they reflect points of view. Lastly, there are data related to attitudes and motivations, referring to individual actions. Of the 36 participating students, 20 are female and 16 are male. Regarding age intervals (see figure 1), there are 9 individuals in each of the age groups of 18 to 20 years old and 20 to 22 years old.

Box 1

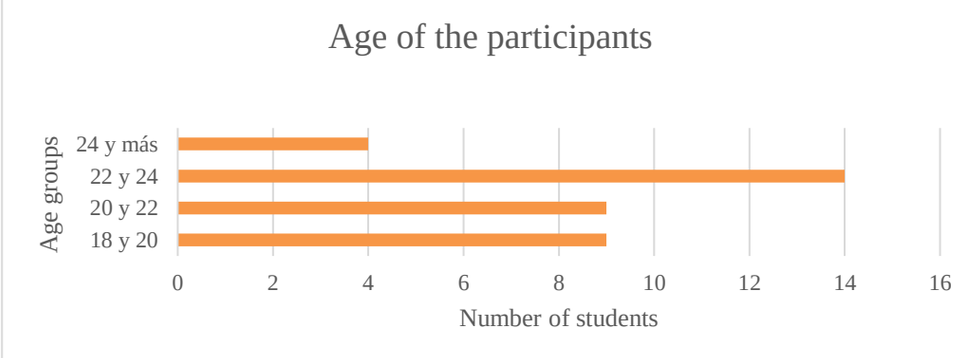


Figure 1

Age of the participants.

Source: Own elaboration based on questionnaire.

To verify the participants' knowledge on the subject in question, they were asked if they had been diagnosed with any psychological or psychiatric condition. Six students responded affirmatively, of whom three mentioned suffering from depression (subjects 7, 15, and 19). Subject 7 also mentioned being evaluated for a possible diagnosis of Asperger's. Subject 12 mentioned being diagnosed with an anxiety disorder. Subjects 24 and 34, on the other hand, only indicated that they had been diagnosed without specifying the condition. The other 30 remaining subjects stated they had no diagnosis of any kind. To better understand the mentioned conditions, we will provide some generalities regarding them:

Discussion

In a depressive episode, a person experiences a depressed mood (sadness, irritability, feeling of emptiness) or a loss of pleasure or interest in activities. A depressive episode is distinct from the usual fluctuations in mood. These episodes last most of the day, nearly every day, for at least two weeks. Additional symptoms may include:

- Difficulty concentrating
- Excessive guilt or low self-esteem
- Hopelessness about the future
- Thoughts of death or suicide
- Sleep disturbances
- Changes in appetite or weight
- Marked fatigue or lack of energy.

Depression can cause difficulties in all aspects of life, including community and home life, as well as work and school. Depressive episodes can be classified as mild, moderate, or severe, depending on the number and intensity of symptoms, as well as their impact on the person's functioning. Depressive episodes can belong to different typologies:

- Major depressive disorder: the person experiences a first and single episode;
- Recurrent depressive disorder: the person has already experienced at least two depressive episodes, and
- Bipolar disorder: depressive episodes alternate with periods of manic episodes, which include euphoria or irritability, increased activity or energy, and other symptoms such as increased talkativeness, racing thoughts, inflated self-esteem, decreased need for sleep, distractibility, and impulsive or reckless behavior" (World Health Organization, 2023).

It is important to note that there are effective treatments for these conditions, many of which include school-based positive coping programs for children and adolescents. However, these approaches have not yet been fully generalized. Additionally, in some cases, medications may be prescribed, but only a specialist can make recommendations in this regard. On the other hand, family support is essential.

In the school context, it would be ideal for tutors to have a clear understanding of their students' needs, which would allow teachers to adjust their approach to avoid triggering severe depressive episodes, foster a trusting environment, and provide the best recommendations for the learning of students with diverse abilities. It would also be important for tutors to inform other teachers about each student's situation and work to minimize any exclusionary attitudes from the rest of the group.

Anxiety disorder, according to the World Health Organization (2023), presents symptoms such as: Excessive fear or worry about a specific situation (such as a panic attack or a social situation) or, in the case of generalized anxiety disorder, about a wide range of everyday situations. They generally experience these symptoms for an extended period, at least several months, and tend to avoid situations that cause them anxiety.

- Other symptoms of anxiety disorders include:
- Difficulty concentrating or making decisions
- Irritability, tension, or restlessness
- Nausea or abdominal discomfort
- Palpitations
- Sweating, trembling, or shaking
- Sleep disturbances
- Sense of imminent danger, panic, or doom.

It is relevant to highlight that drug use can exacerbate these types of conditions; however, it is crucial to identify the specific type of anxiety, as there are several variants, just as with depression, that have different causes.

The types of anxiety disorders, according to the World Health Organization (WHO), include:

- Generalized Anxiety Disorder: persistent and excessive worry about everyday activities or events.
- Panic Disorder: panic attacks and fear of their recurrence.
- Social Anxiety Disorder: high levels of fear and worry about social situations where the person may feel humiliated, embarrassed, or rejected.

- Agoraphobia: excessive fear, worry, and avoidance of situations that may induce panic or make someone feel trapped, helpless, or embarrassed.
- Separation Anxiety Disorder: excessive fear or worry about being separated from individuals with whom one has a close emotional bond.
- Specific Phobias: intense and irrational fears of specific objects or situations that lead to avoidance behaviors and considerable distress.
- Selective Mutism: consistent inability to speak in certain social situations, despite being able to speak comfortably in other settings, primarily affecting children.

It is crucial for teachers to be aware of the symptoms and behaviors associated with these disorders in order to develop appropriate support strategies for both the affected student and the rest of the group. This does not imply excluding the student from activities but rather adapting programs with appropriate considerations.

Teachers should support cognitive transmission and assess if the student is suitable for certain tasks. If not, both school and legal guardians should be informed. This is not a discriminatory action but rather in the student's best interest. For example, if a student with muscular paralysis enrolls in a Geography degree program and faces difficulties with subjects like cartography, this could lead to a depressive state and eventually lead them to withdraw from the program.

Since not all individuals have a proper diagnosis, a question was included in the survey about whether they believed they had any psychological, psychiatric, or learning disorder. Eight affirmative responses were received, which generally expressed issues related to attention and anxiety that hinder their learning. In these cases, educational authorities should provide the appropriate channel to access specialists and obtain an accurate diagnosis, which could easily mitigate mild disorders.

Box 2

Table 1

Responses to question: believe to have any disorder

Question	Answers
Anxiety disorders reflected in academic performance	1
Anxiety sometimes distracts me a lot	2
Attention deficit, hyperactivity	16
Attempts to stop procrastination, emotional blockages	17
ADHD, Anxiety	20
Anxiety because I feel that others understand and I don't, and it frustrates me	25
Anxiety, heart palpitations, and the urge to go to the bathroom	26
Depression and anxiety	36

Source: Own elaboration based on questionnaire

It's interesting to observe how responses to certain survey questions reflect students' perception of inclusion and infrastructure needs on campus.

When analyzing responses to the question of whether they have experienced any different treatment due to their condition, a variety of responses are observed. Some students mention they haven't experienced any of the mentioned behaviors, while others indicate experiencing indifference or negative treatment. The lack of response from some participants may indicate a lack of awareness of discriminatory behaviors or a reluctance to admit them.

Regarding the question of whether special infrastructure is required to receive adequate education, most participants point out the need for changes. Some suggest modifications to physical infrastructure, such as wide windows or dim lights, while others emphasize the importance of changes in others' behavior, such as maintaining order and silence in the learning environment. Additionally, additional services are mentioned, such as having a psychologist on campus and teacher training. On the other hand, some participants believe no specific changes are needed. These responses highlight the importance of creating inclusive educational environments that address the needs of all students, considering both physical adaptations and educational practices and emotional support.

Box 3

Table 2

Behavioral requirements

Behavior	Quantity
Silence	3
Psychologists	2
Order in the classrooms when speaking	1
Teacher Training	1
Quiet Areas	1

Source: Own elaboration based on questionnaire

Box 4

Table 3

Infrastructure adjustment requirements

Infrastructure	Amount
Large Classrooms and Open Spaces	2
Smaller Classrooms	1
Good Ventilation	3
Dim Lights	1
Warm Temperature in the Classrooms	1
Benches in Cooler Areas	1
Leaving Only Two Access Doors for Security	1

Source: Own elaboration based on questionnaire

The design of school spaces fosters a change in performance, the development of creativity, and autonomy in students' tasks. Therefore, it is important for school leaders and teachers to strive to integrate appropriate teaching environments.

According to Campana, Velasco, Aguirre, & Guerrero (2014), school infrastructure plays an important role in academic performance as it serves a motivational and functional function. That is, it generates a more positive attitude in students towards learning and facilitates the teaching-learning process. Individuals with different needs require spaces that provide them with comfort in terms of tranquility and spaciousness, especially those with neurodivergence (neurodiversity is a non-medical term that includes conditions such as autism, dyslexia, dyspraxia, dyscalculia, and ADHD).

Natural light, warm colors, order, diverse furniture, or classroom connectivity are some of the key pieces taken into account when transforming these school spaces. These new places help students and teachers feel comfortable, safe, cozy, and inspired. They then become a structure of opportunities for creation, research, observation, and responsibility. Through the creation of these shared learning spaces, students also increase their knowledge expansion opportunities by having the possibility to work with all classmates of the same age and even different ages (Marchante Goyo, 2022).

It is important to clarify that individuals with different needs do not always feel stressed by others' behaviors, but their mood may be changeable. Therefore, order within the classroom is important for them, as it helps avoid distractions caused by people who talk too much or are nervous. In this regard, it is necessary to discuss with the entire group about the observed behavior in class. Regarding the question, it should be considered that some students may require a specialized format of teaching to learn. Out of the 16 surveyed students, the majority indicated that they do not need a special format but can learn like any other. Only one of the students with a specific diagnosis mentioned requiring a special format. However, seven students expressed the need for a special format of teaching.

Curricular adaptations or just good treatment, any educational institution that declares itself as inclusive must ensure non-discrimination in all its forms. Students with special needs should be evaluated to determine if the proposed activities and objectives of the specialty can be achieved and to what extent. If necessary, their families should be informed and the relevant curricular adaptations should be made, a task that depends on the authorities and the teacher.

There are students who are passed without having reached the skills and competencies established in the program, either because the teacher is unaware of their learning particularities or prefers to work with the majority, without paying attention to individualities. Other students fail because they do not seek help mechanisms or options to resolve the situation.

Conclusions

In conclusion, although the University of Guadalajara has created a program, the Policy of Inclusion for applicants and students at the University of Guadalajara has been limited, as the relevance of those with different cognitive abilities or learning difficulties has not been considered. This limitation is reflected in the lack of a diagnostic system for first-time students, resulting in teachers being unaware of their students' situations, both generally and individually.

Furthermore, there have been no courses implemented to train teaching staff in handling specific cases or in recommending and implementing appropriate pedagogical strategies for such students. In some cases, part of the faculty has taken courses on their own initiative outside the institution, sought external advice, or researched the situations they face.

For example, within the program, 4 students with Asperger's Syndrome have been identified, of which 2 arrived without a previous diagnosis. In these cases, they were referred to the University Center for Health Sciences to assess their situation and receive guidance, and so that the corresponding tutors and professors could generate recommendations regarding their curriculum path.

In conclusion, both at the University of Guadalajara in general and in the geography degree program in particular, there is still a long way to go to develop a comprehensive and truly broad inclusion program. Therefore, recommendations are made by teaching staff and students for there to be a policy that also encompasses this diversity among members of the university community.

All of this suggests that the Ethics of Care has not been applied within the studied institution, as it is not recognized as a social responsibility to effectively and appropriately attend to current and future students with different learning styles or cognitive characteristics. It is understood that such actions would improve the quality of life not only for these individuals but also for society as a whole.

Recommendations

a) Awareness of discriminatory behaviours: Implement awareness programs to increase awareness of discriminatory behaviours and promote an inclusive environment on campus.

b) Improvements in physical infrastructure: Make modifications to the campus physical infrastructure, such as installing wider windows or regulating lighting, to meet the specific needs of students with particular conditions.

c) Expansion of support services: Expand support services available on campus, such as the presence of psychologists and teacher training, to ensure that students receive the necessary support for their emotional and academic well-being.

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

Arellano-Amaya, María de los Dolores: Carried out primary research, gathered data and information, and drafted sections related to the ethical perspective for care and social inclusión in the university.

Macías-Huerta, María del Carmen: Focused on the administrtion of questionnaires among geography undergraduate students

Niño-Castillo, Jacob Elías: Contributed to translating the text from Spanish to English, as well as providing specific contributions to the chapter text to ensure it aligns with the 2024 handbook template.

Availability of data and materials

Availability of data: The collected data as well as supplementary materials accompanying the publication of this research are accessible to other users. Through request to the authors.

Availability of materials: The authors specify that the materials are freely available for other users to use without any restrictions or conditions associated with access to them. This means that the materials, such as data sets, experimental protocols, software code, or other resources, can be accessed and utilized by anyone interested in the research without requiring permission or facing any limitations. This commitment to open access promotes transparency, reproducibility, and collaboration in research, allowing others to verify findings, replicate experiments, or build upon the work without barriers.

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Abbreviations

ADHD: Attention Deficit Hyperactivity Disorder
ASD: Autism Spectrum Disorders
HEI: Higher Education Programs
UN: United Nations
WHO: World Health Organization

References

Background

Campana, Y., Velasco, D., Aguirre, J., & Guerrero, E. (2014). *Inversión en infraestructura educativa: una aproximación a la medición de sus impactos a partir de la experiencia de los colegios emblemáticos.* Lima: Consorcio de Investigación Económica y Social.

Espín, A., & Mera, M. (2019). La Inclusión desde un enfoque de Derechos Humanos en estudiantes con Necesidades Educativas Especiales Asociadas o no a una Discapacidad. *Revista Publicando, 6*(21), 34-47.

García, M. (2003). *El cuestionario como instrumento de investigación/evaluación.*

Universidad de Guadalajara, (2019). *Coordinación de desarrollo Académico*.

UTPL Blog, (2020). *Importancia de la detección temprana las necesidades educativas especiales. Colombia.*

Basics

CIAE (Centro de Investigación Avanzada en Educación), (2024). *10 factores para la exclusión escolar, en Trayectorias educativas. Universidad de Chile*.

Diccionario Instituto Nacional del Cáncer (NCI) (2016). *Diccionario del Cáncer, Washington, USA.*

Estado Mental del Mundo (2021). *Explicación del estado mental del mundo.*

Niembro, G., Gutiérrez, L.; Jiménez, R. & Tapia, C. (s/f) *La Inclusión Educativa en México, Centro Universitario Zumpango*. Universidad Autónoma del Estado México, Zumpango, Mex.; México.

Organización Mundial de la Salud (2022). *Transformando la salud mental.*

Support

Gilligan, Carol (2013). *In a Different Voice*, in Ethical Theory: An Anthology, 2o. Edition. Ed. Russ Shafer-Landau. (pp. 692-698).

Gutiérrez Domingo, Elena (2011). Evolución y Desarrollo del Concepto de Anormalidad. La Educación Especial, Diplomada en Magisterio Infantil. *REVISTA DIGITAL ENFOQUES EDUCATIVOS*, *73*(1), 44-63.

Lovari, et al. (2019). *Coordinación Nacional de Educación inclusiva. Fundamentos y Prácticas para la Inclusión.* Ciudad Autónoma de Buenos Aires: UNICEF Argentina.

Luque Parra, Diego Jesús (2009). Las necesidades educativas especiales como necesidades básicas. Una reflexión sobre la inclusión educativa. *Revista Latinoamericana de Estudios Educativos (México)*, *XXXIX*(3-4), 2009, 201-223. Centro de Estudios Educativos, A.C. Distrito Federal, México.

Robledo, Z. (2023). *La punta del iceberg.*

UNESCO-IESALC, (2020). Comprender el acceso a la educación superior en las últimas dos décadas.

Universidad Autónoma de México (UNAM), (2012). *Plan Educativo Nacional.*

Discussion

Badillo, D. (2022). *En México se ignora a ocho de cada 10 personas con algún problema o condición mental.*

Fardella Rozas, José Salvador & Niño Gutiérrez, Naú Silverio (2017). ¿Cómo optimar la integridad de los líderes?: Una visión desde la UAGro para el 2027. En Sánchez Gutiérrez, José y Mayorga Salamanca, Paola Irene (Coords). *El valor del conocimiento y efectos en la competitividad*. (pp.1609-1625). Guadalajara: Red Internacional de Investigadores en Competitividad (RIICO)-Universidad de Guadalajara.

La Gaceta, (2020). *Universidad de Guadalajara*.

Marchante, Goyo (2022) *Los espacios escolares como elemento facilitador del aprendizaje*.

Niño-Castillo, Jacob Elías, Juárez-Hernández, Luis Gibrán & Niño-Gutiérrez, Naú Silverio (2020). Diseño y validación de un instrumento para evaluar los trabajos finales universitarios desde la socioformación. *International Journal of Science Academic Research, 1*(7), 481-488.

Niño-Gutiérrez, Naú Silverio (2022). Socioformación y sustentabilidad en tiempos de incertidumbre sanitaria. *Ecocience International Journal*, *4*(6), 5-10.

Niño-Gutiérrez, Naú Silverio, Macías-Huerta, María del Carmen, Andrade García, María Dolores and Amaro-López, José Antonio (2023). Conflicts the land of tequila: a geographical approach to the socio-spatial challenges in Guadalajara. *Journal of Social Researches*, *9*(23), 1-9.

UNIR (Universidad en Internet), (2022). *¿Qué son las necesidades educativas especiales? (2022).*

Valencia Gutiérrez, Marvel del Carmen, Niño Gutiérrez, Naú Silverio and López Méndez, María del Rosario (2023). Correspondence of the Honey-Alonso learning with the VAK channel applied to higher level students. *International Seven Journal of Health, 2*(4), 1-13.

Valenzuela, Juan Pablo & Yáñez, Natalia (2022). *Trayectoria y políticas de inclusión en educación superior en América Latina y el Caribe en el contexto de la pandemia. Dos décadas de avances y desafíos.* CEPAL. Publicación de las Naciones Unidas LC/TS.2022/50.

Tutoring in higher education: Students assessment of their tutors

Tutorías universitarias: Evaluación de los alumnos a sus tutores

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Key Handbooks

One of the most relevant phenomena of the contemporary world is the unusual value that knowledge has acquired, as an indispensable condition for the development of people. Currently, the knowledge society is characterized because the basis of production is data, images, symbols, ideology, values, culture, science and technology. The most precious asset is not infrastructure, machines and equipment, but the capabilities of individuals to acquire, create, distribute and apply creatively, responsibly and critically (with wisdom) knowledge, in a context where the rapid pace of Scientific and technological innovation quickly makes them obsolete. Tutorship is an important resource in current education, therefore knowing how it is carried out and identifying the problems it faces allows us to identify the key areas to work on and therefore it is intended with this work to contribute to advances in this area which, being humanistic must evolve with the society it serves. Tutoring is a right of students, however, in this study it was observed that this right is not exercised by students, often due to mistrust or lack of interest. Tutorials contribute to a better teaching-learning process, guidance, advice, training and development of students individually and in groups. New strategies in addition to the induction course should be considered to promote the importance of tutoring and improve student engagement. The fact that students show little interest is an indicator that they appreciate the program less and less, so it is necessary to make changes in order to make the tutoring program more interesting for students.

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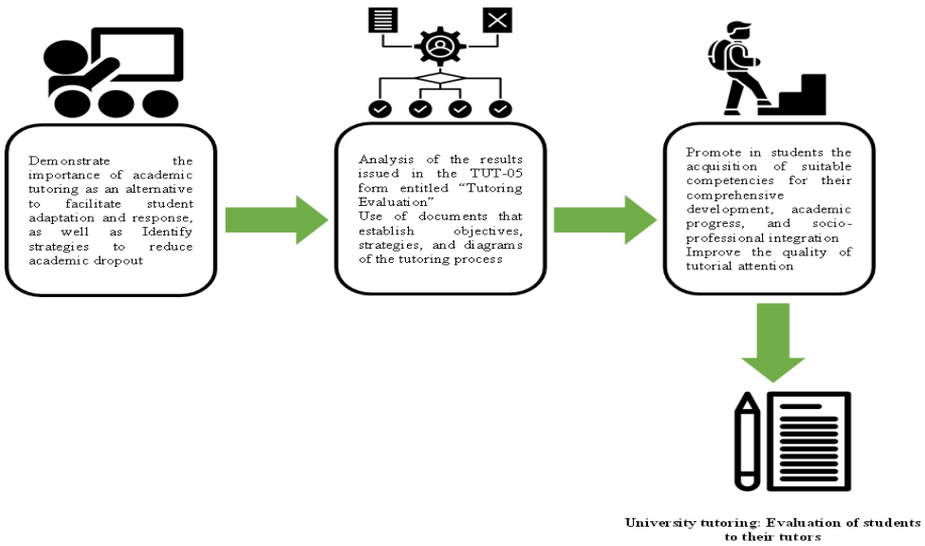
Abstract

Since 2000, tutoring programmes have been initiated in higher education institutions, with the aim of improving the quality of education, due to the low academic performance reached in the indicators and which made it necessary to develop strategies to address the problem. This led to the design of tutorial action programs, with the participation of directors, teachers, and students, among others. Therefore, it is important to evaluate programs to determine their effectiveness. The present study is of a descriptive statistical type, whose objective is to analyze the opinion of the tutored (students) regarding the tutorial attention provided by their tutors (teachers). The survey was used as an evaluation instrument called R-AGC-tut 05, used for the evaluation of the institutional tutoring program of the Autonomous University of Campeche. The section analyzed in this work consists of 15 questions in total, the first section dedicated to the identification of the student, followed by six questions on a Likert scale (Totally agree, agree, disagree, strongly disagree and I have not required) which are the ones that evaluate the performance of the tutor in terms of the support given to the assigned student (normativity, paperwork, guidance and academic trajectory, study techniques, active listening, channelling and other services).

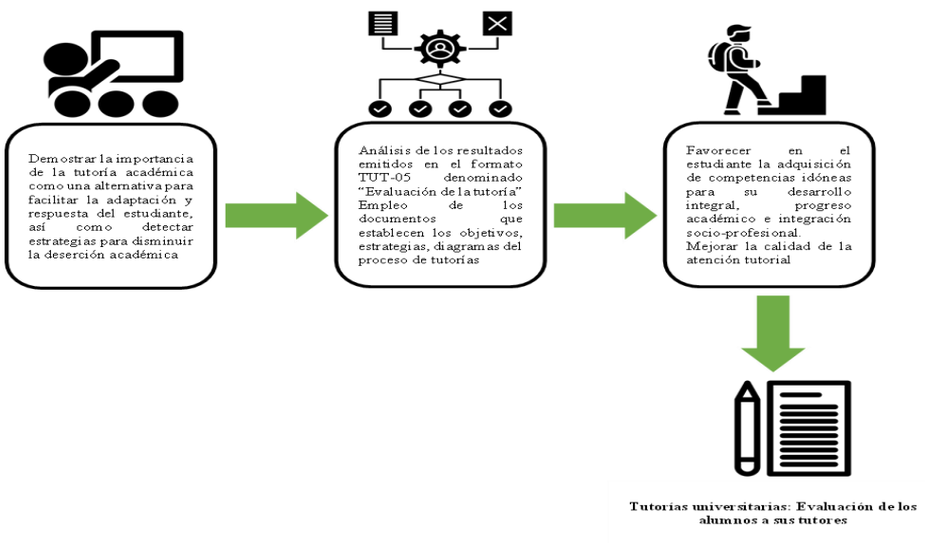


University tutoring: Evaluation of students to their tutors

Attrition, Academic Tutoring, Quality

Resumen

Desde el año 2000 se han iniciado programas de tutoría en instituciones de educación superior, con el objetivo de mejorar la calidad de la educación, debido al bajo rendimiento académico alcanzado en los indicadores y que hizo necesario el desarrollo de estrategias para abordar el problema. Esto llevó al diseño de programas de acción tutorial, con la participación de directivos, docentes y estudiantes, entre otros. Por lo tanto, es importante evaluar los programas para determinar su efectividad. El presente estudio es de tipo estadístico descriptivo, cuyo objetivo es analizar la opinión de los tutorizados (estudiantes) respecto a la atención tutorial brindada por sus tutores (docentes). La encuesta se utilizó como instrumento de evaluación denominado R-AGC-tut 05, utilizado para la evaluación del programa de tutoría institucional de la Universidad Autónoma de Campeche. El apartado analizado en este trabajo consta de 15 preguntas en total, el primer apartado dedicado a la identificación del alumno, seguido de seis preguntas en escala Likert (Totalmente de acuerdo, de acuerdo, en desacuerdo, totalmente en desacuerdo y no he exigido) que son las que evalúan el desempeño del tutor en cuanto al apoyo dado al alumno asignado (normatividad, trámites, orientación y trayectoria académica, técnicas de estudio, escucha activa, canalización y otros servicios).



Tutorías universitarias: Evaluación de los alumnos a sus tutores

Deserción, Tutoría Académica, Calidad

Introduction

The tutoring process is not something new and throughout history we find great personalities who used tutoring as a strategy to guide their students, (Confucius, Socrates, Plato, Quintilian, Bell and Lancaster); enhancing the talent of their disciples, based to a large extent on individual and personalized training, thus constituting the essence of mentoring as a relationship between a novice or in the process of training and an expert or consolidated person in the profession or discipline (De la Cruz Flores et. al, 2011). For the 21st century, universities face challenges with the characteristics of the society in which they are inserted within a volatile and uncertain environment, where stability and certainty have lost meaning, as well as personal, professional and scientific development; Universities must be able to offer diverse and flexible responses to the training needs that arise (Rodríguez-Espinar, 2018).

It is important to reflect on and modify traditional teaching methods in higher education, focusing efforts on responding to the learning needs of students (Pérez, Quijano y Muñoz, 2018). In this way, academic tutoring emerges as an alternative to facilitate the adaptation of the student to the school environment and improve their study and work skills, increasing the probability of success in their studies so as to reduce school dropout and increase terminal efficiency -TE- (ANUIES 2000), which by 2016 reached 66% in Mexico.

This indicator is important for Higher Education Institutions (HEIs) because it allows to evaluate part of the functioning, achievement and participation of an institution in the performance as a member of an educational system, in addition to being a reference for the particular study of the student's school behavior (Gómez, 2021); since according to Toscano de la Torre (2016) "Research on this topic has identified a variety of factors that influence a student's achievement of TE, such as: the educational model, the student's profile, failure, responsibility, obsolete curricula, place of residence, lack of English proficiency, economic, psychological and physiological factors, family, academic trajectory, attachment to the institution, among others."

The purpose of university tutoring is to offer personalized attention to university students and promote their comprehensive development in terms of academic, personal, and professional progress (Martínez-Clares et al., 2020; Álvarez González, 2017). It thus becomes one of the differentiating elements that advocates for the quality and equity of training (Álvarez y Álvarez, 2015; Cano, 2009; Lobato y Guerra, 2016; Martínez, Pérez y Martínez, 2014) and that responds to the different needs of guidance, support and accompaniment of students through its different modalities and areas of action. Understood as a process, tutoring facilitates academic development in a complex context in which university activities have diversified exponentially (electives, itineraries, internships, final projects, etc.), along with a fundamental change in teaching methodologies, which require students to use more elaborate learning strategies and a higher level of prominence compared to those used in previous levels.

Mentoring can facilitate the acquisition of transversal skills, which stand as one of the essential pillars for both the personal development and future employability of graduates (Martínez y González, 2018). Studies show, in general terms, a problematic development of tutoring in educational practice, as it is usually relegated to an academic issue, ignoring the professional and especially the personal part.

For this reason, it is necessary to develop a comprehensive tutoring model that addresses the multiple needs of guidance and tutoring of students, as well as different methodological (group, individual, virtual) and organizational approaches to it, from the centers themselves in coordination with the other services or guidance units, so that a designed and coordinated response is offered to the need for comprehensive training of university students (López-Gómez, 2017).

In this way, the process of university tutoring has become an aspect of great relevance for the quality of education in institutions. There are many universities in the world that are implementing tutorial action procedures to favor and enhance the integral development of their students as part of their training, promoting reflection and decision-making on different aspects that affect their personal, academic and socio-professional development, inside and outside the university institution itself (Klug y Peralta, 2019).

The antecedents of tutorial models can be traced throughout history in most nations. For example, in Anglo-Saxon universities, individualized education is pursued, seeking depth and not so much breadth of knowledge, in North America and in some European countries, orientation centers in universities are instances of great importance in the tutorial process.

Computer-assisted tutoring has even been implemented through the use of tutorials that encourage self-study (Universidad de Guadalajara, 2004). In general, there are three models of tutorial care (Robles, 2017):

1. The German mentoring model; focused on academic training. Also known as Humboldtian, its essential objective is scientific training. Under this model, the training of people with sound scientific knowledge would be sufficient to achieve social development. The tutor in this model is a teacher who guides the student on the path of scientific research and academic development. The fundamental axis of this approach focuses on the development of academic tutorials, that is, the interest of the whole process lies in offering, on the part of the person who carries out the action (tutor), support and help in the teaching-learning process of the student. In short, the role of the tutor is to guide and accompany their student throughout all the learning processes

2. The French mentoring model: Its main objective is training for the profession. Universities, as a state institution, have the mission of training the professionals that the State needs. It is related to the so-called professional development model. The tutor collaborates with the student's professional training. For this university model, the tutor is the professor who accompanies the student in their professional training, adjusting it to the demands indicated by the labor market.

3. The Anglo-Saxon mentoring model: Its essential objective is human development. In this model, universities assume the mission of training ethical citizens, with a broad culture, who manage to insert themselves responsibly into society. The role of the tutor in this model is to guide their students assigned for tutoring, in aspects that influence their personal trajectory as a student at the university.

The latter is the model that is currently sought to be consolidated in the Mexican territory, since it is the one that allows the development of the three types of knowledge in the current educational model of competency-based learning (Torrecilla et.al., 2013)

Institutional Tutoring Programs in Mexico

Mexican higher education institutions have taken as their basis and main reference the proposal to implement an Institutional Tutoring Program, published at the beginning of the 21st century by the ANUIES, and each educational institution has made adjustments to implement and operate in accordance with its philosophy and educational model through a Tutorial Action Plan (TAP), which is the instrument through which the content and execution of the program is designed. Tutoring in Higher Education (Romo, 2011).

The TAP is a script that establishes the lines of action and guidelines that teachers must follow in their day-to-day work. In this way, the tutoring is managed, planned and all the actions and processes to be carried out during the development of the training action are specified (Figure 1).

The development of a TAP in institutions has the limitation that the time and dedication required for tutoring to be carried out effectively is not usually contemplated in the teaching management plans of university centers (Sobrado, 2008).

Box 1

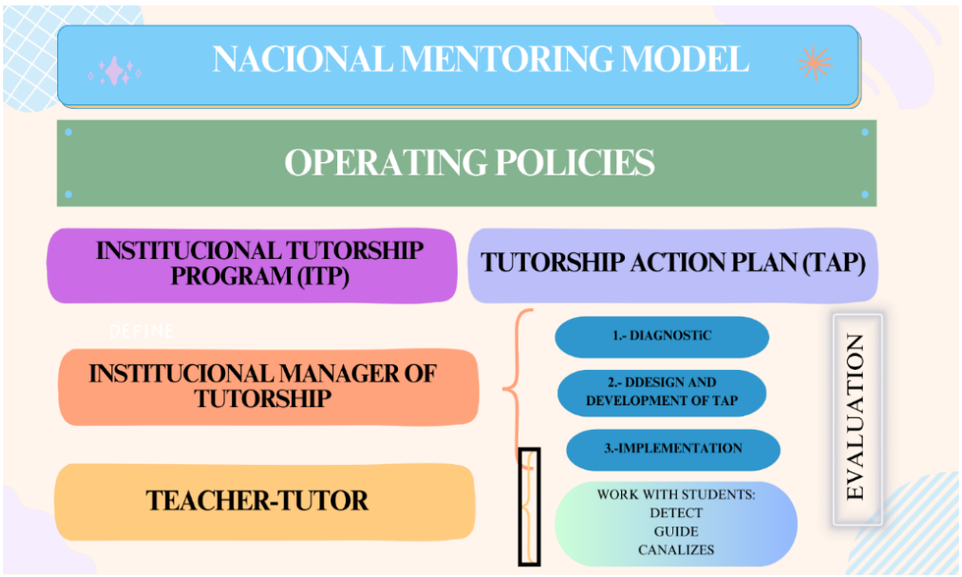


Figure 1

Diagram of the tutoring model proposed by ANUIES.

Source [Modified from https://www.uttehuacan.edu.mx/web/seccion.php?id=435]

In general, the institutions' TAPs are divided into four phases (see Figure 2):

1. The first phase is the analysis or diagnosis of existing needs and starting conditions in order to adapt the process to them. Various studies propose differentiated moments during the course of the career, and that propose these three essential times (incorporation into the university, permanence and completion of studies), which entail different needs for accompaniment (Bausela, 2004; O'Delly y Eisenberg, 1989) and therefore to a different analysis and needs for each phase of the student's school career.

2. The second phase refers to the design and elaboration of the action plan and in which the objectives and actions to be carried out, methodologies and evaluation criteria are defined. The time and resources to be used are allocated and the action plan and consensus are shared for approval. It is in this phase where various interpretations have arisen that have a lot to do with purposes or "urgencies", due to a frequent omission of an adequate planning and organization framework, generating the proliferation of modalities, without great support, of medium quality and unclear, especially for those who exercise it: the tutors; and for its users: the students (Romo, 2011).

3. The third phase consists of the implementation of the action plan. The tutorial intervention model is closely linked to the potential of human and material resources that each of the institutions has for the attention of its students (Lopez, 2004). In general, tutoring at the undergraduate level has been implemented as comprehensive support for students aimed at:

a) Adapt and integrate the student to the University and the school environment.

b) Face difficulties in learning and academic performance.

c) Evaluate the student and channel them appropriately

1. The fourth phase, an evaluation of the quality of the process that allows us to know how the action plan has been developed, satisfaction of the agents involved, registration of incidents. The evaluation of the TAP is for the continuous improvement of the program.

Box 2

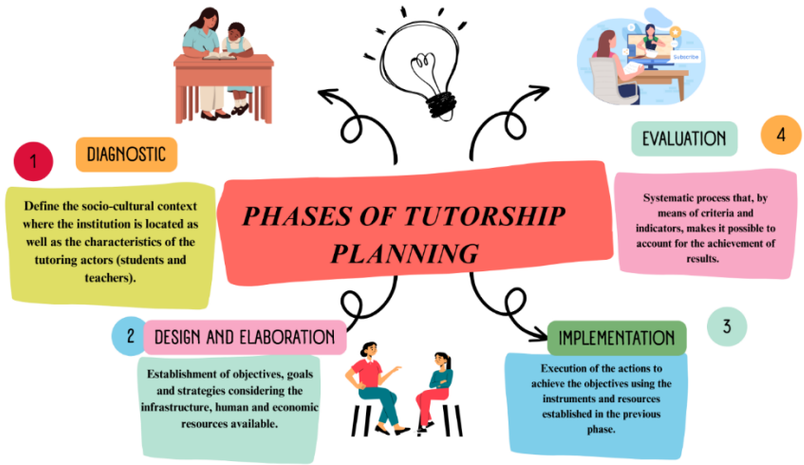


Figure 2

Phases of the implementation of a Tutorial Action Plan (PAT) carried out by an Institutional Tutoring Program (PIT).

Source [Own]

Evaluation of Institutional Tutoring Programs

La ANUIES points out the need to "evaluate with critical judgment" the results of said intervention in such a way that a significant improvement in the quality of education can be verified through attention to lag and dropout in higher education. There are various instances that evaluate the IES in all its components, including tutoring; Such is the case of the Interinstitutional Committees for the Evaluation of Higher Education (CIEES) and the Council for the Accreditation of Higher Education (Copaes). The latter, for example, has specific criteria that allow evaluating the operation of the Institutional Tutoring Program (Ceballos, et.al. 2016).

The evaluation of a mentoring program, designed for the bachelor's level, requires methodologies and instruments to determine its effectiveness (Universidad de Guadalajara, 2004). It is important to assess the needs for tutoring in the university environment from the perspective of the students, the teacher and the school (Álvarez y Álvarez 2015), This will allow a better knowledge of the reality and needs of the students and will offer better feedback on the teaching-learning processes that are carried out. The tutorial action therefore has three elements to evaluate (Torrecilla; et.al., 2013):

1. Evaluation of the tutoring process from the point of view of the student and the tutor. From the universities, tutoring has not been considered as a necessity or as a substantial resource of the same, although it has been considered as a teaching function (Torrecilla; et al., 2013), hence the importance of the evaluation of the process through all those involved, including the administrative part of the institution.

2. The tutor's assessment (from the student's point of view and from the tutor's self-assessment). Evaluating tutors is not only a fundamental step in the planning of an academic process such as tutoring, but also a starting point to understand its development, its scope and limitations (Ponce et. al., 2022). However; The evidence of the evaluation of the role of tutors is still limited, which forces us to think about the design of new mechanisms for assessing those who exercise it (Ponce et.al., 2022), In addition, the mentoring function is complex, and not all teachers are in a desirable position to do so or have the skills to do so (Sobrado, 2008) hence, in all LAPs, the continuous training of the tutor is one of its strategies of action, since the tutor must be a competent person in different aspects: "Personality with the ability to positively influence others; sensitivity to grasp and understand youth problems, ability to establish affectionate and cordial relationships with others" (Torrecilla; et al., 2013). On the other hand, it is necessary to consider the student's point of view to assess the extent to which the actions taken have a sufficient impact on their perception and school performance (Torrecilla et. al., 2013)

3. Evaluation of the institutional mentoring program in terms of impact (achievement of indicators). As mentioned above, one of the objectives for which ANUIES implemented the tutoring programmes at the national level is that "a high proportion of them complete their studies within the expected time frame by achieving the training objectives established in the study plans and programmes" (García-López et. al., 2012) therefore the impact can be measured with the significant improvement of the indicators of school dropout and terminal efficiency and even academic performance (García-López et al, 2012b). However, there are no concrete results from the implementation of tutoring programs in Mexico in terms of their impact on improving the quality of education (Sánchez, Vales y Galván, 2005): In 2013, despite the title of the work by Rosas Chávez et. al., (2013) called "The Impact of Tutorials", the scope of the work is only of the descriptive type, just like a bachelor's thesis carried out in 2017 at the Benemérita Universidad Autónoma de Puebla (Gallegos, 2017); however, the bibliographic research work of Paredes (2023) stands out , with 20 recent articles where the selected authors highlight the effectiveness of academic tutoring as a tool to improve student performance in higher education.

In recent years, interesting research experiences have been developed around Institutional Tutoring Programs, even so, it is necessary to delve into the perceptions of those involved in the tutoring processes, teachers and students (López-Gómez, 2017). It is from this need for feedback and to have the vision of those involved that the following objective is proposed, to know the evaluation of students towards their tutors in favor of an improvement of the tutorial action.

Tutoring at the Faculty of Agricultural Sciences of the Autonomous University of Campeche

By belonging to the ANUIES; The University Autonomous of Campeche (UAC) has its Institutional Tutorship Program (ITP) which presents an organizational chart as shown in figure 3. The ITP of the UAC began in 2003 and has undergone several changes over time to adapt to the various socio-cultural and educational contexts, in addition to the recent problems due to the COVID-19 pandemic.

Box 3

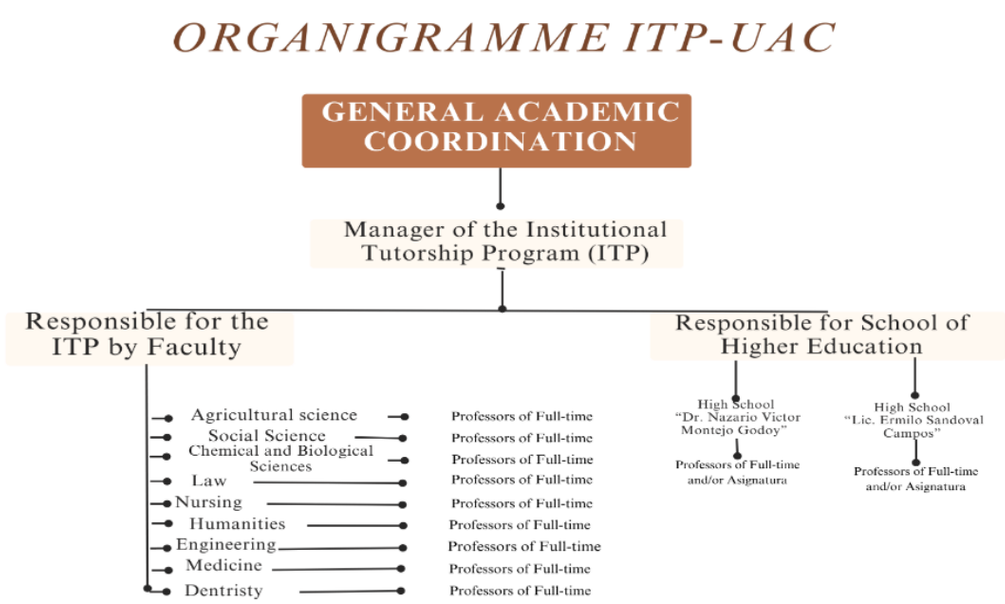


Figure 3

Organizational chart of the Institutional Tutoring Program (PIT) at the University Autonomous of Campeche (UAC)

Source [Own]

Currently, the ITP at the UAC works under the approach of a comprehensive tutoring model in which the tutoring procedure for all faculties/schools of the UAC is as follows:

1. Each school phase: the head of the ITP by school or faculty asks the academic secretary for the list of current enrolled students for the semester.

2. For new students, each of the current tutors is randomly assigned.

3. Students from the 2nd to the 9th semester (or more if they are irregular) are only verified for their validity since each tutor is assigned throughout the student's academic career. At the same time, students can make changes of tutor up to two times during their academic life by means of a letter of reasons to the head of the ITP and prior authorization of the new tutor to avoid overloading students.

4. In the Faculty of Agricultural Sciences (FACIA) a presentation is made with the students of the first semester so that they get to know the tutor and start working with him. Until today, each tutor has freedom in their tutorial work with the premise of having at least three interviews with each mentee as recommended by Can-Valle et.al (2016), in the case of FACIA one of them is the option of carrying out a group tutoring called "Café tutor" which has served as an icebreaker strategy in some situations and in others to promote tutor-mentee trust (Duarte-Ubaldo et. al. 2015).

5. As part of the UAC, the tutoring process at FACIA is supported by workshops or courses to train teachers-tutors in tutorial work, these courses or workshops are offered by the General Academic Coordination of the UAC each semester. On the other hand, the ITP has several useful formats for the fulfilment of the tutorial activities (figure 4) that include the tutor's report, the report of the tutor manager and a questionnaire made to the students, which have been used for the evaluation part of the ITP in the UAC including the measurement of the impact. Until before the pandemic, these documents were answered manually; but because of the 2020 pandemic, the formats were digitized using the Google platform through transcription and adaptation to forms, which makes it easier to obtain results and analyze them.

Box 4

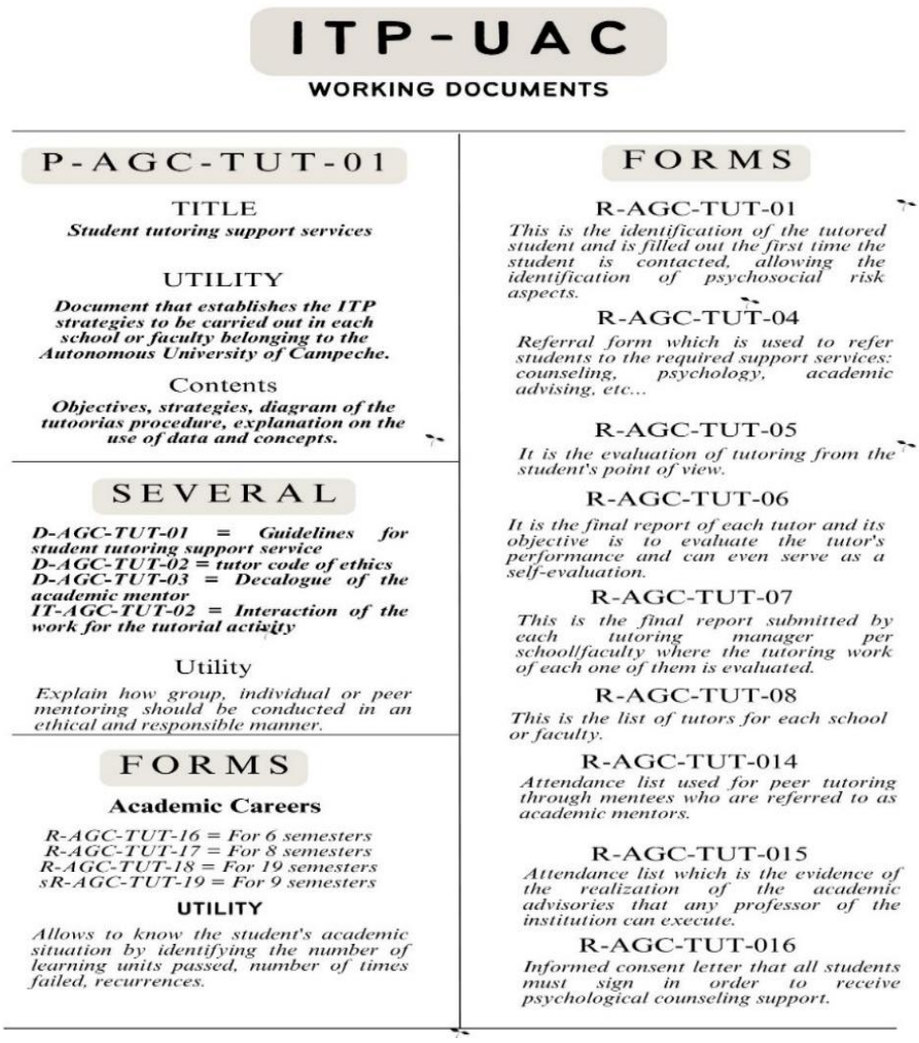


Figure 4

Documents that support the Tutorial Action Plan in the Faculty of Agricultural Sciences as an institution belonging to the Autonomous University of Campeche

Source [Own]

The pandemic changed the tutorial work at UAC, migrating towards virtual tutoring, which in FACIA increased the number of students served; however, this returned to its historical records of less than 40% of attention in the semesters after the pandemic, so that in order to provide alternatives and know the factors that may be influencing the tutorial process of the faculty, it was considered to make an analysis of the results issued in the TUT-05 format called "Evaluation of tutoring" with the aim of knowing the evaluation of students towards their tutors in favor of the students. of an improvement of the tutorial action for this faculty.

Methodology

An exploratory descriptive study was carried out to identify trends and the results are provided through frequencies and percentages obtained from the institutional form used for the evaluation of the institutional tutoring program of the Autonomous University of Campeche named R-AGC-tut 05 put into operation since the COVID-19 pandemic.

Instrument

The support instrument is the institutional form R-AGC-tut 05, constituted of 30 questions, some of which have four items on a Likert scale and others are open-ended. These questions are arranged in four sections:1) with the first section dedicated to the identification of the student; 2) followed by the section on the evaluation of the tutor, 3) another section on the perception of the institutional tutoring program and 4) finally the section that tries to know the impact on the academic trajectory of the student. This form is completed every six months online in the days following the final exam and closes after the referral exams. The section analysed in this work consists of 15 questions in total, with six of them on a Likert scale (Strongly agree, agree, disagree, strongly disagree and I have not required) which are the ones that evaluate the performance of the tutor in terms of the support given to the assigned student.

Procedure

The data presented cover from January 2021 to December 2023 (6 schooling periods: 20-2, 21-1, 21-2, 22-1, 22-2, and 23-1) and the section of the format that includes the level of satisfaction of the tutored with their tutors, therefore a numerical scale from 6 to 10 is considered. The results of the evaluated tutors were: a low ranking (rating 6 and 7). Similarly, on the Likert scale used, the answers "strongly agree and agree" are considered to indicate that the tutor performed his or her job correctly, and the answers "strongly disagree and disagree" indicate that the student did not receive this type of support from the tutor. Additionally, it was reviewed that the students who evaluated with 6 and 7 were students who attended at least once with their tutor and their free answer explaining why the grade is awarded.

Results

At the Autonomous University of Campeche the entire student population is enrolled in the tutoring program and has the opportunity to be attended by a tutor individually or collectively, so the questionnaire should be answered by all students, however, only a proportional part of the total number of students answers the form since the answer is not mandatory. For this reason, there are fewer and fewer students who answer this form when analyzing it over time and there is the possibility that these answers are not completely with the necessary honesty and are only answered for the fact of fulfilling a task.

Box 5

Table 1

Data on the student population in terms of total enrollment, total respondents by gender, and their change before and after the pandemic at the Faculty of Agricultural Sciences of the Autonomous University of Campeche.

	Pre-pandemic			Post-pandemic		
	20-2	**21-1**	**21-2**	**22-1**	**22-2**	**23-1**
Total student	172	205	185	226	212	264
Surveyed	97	90	88	78	68	73
Women %	59,8	63,7	61,4	70,5	67,6	64,8
Men %	40,2	36,7	38,6	29,5	30,9	35,2
Other %					1,5	

Source [Own]

During the last few years in the career of Veterinary Medicine of FACIA-UACAM the number of women in the enrollment has increased, so it can be observed that the female gender is the one who answers the form in the highest percentage, in this survey inclusion is sought because the response in gender of another is considered, However, it is not yet important how many respondents consider this answer. It is observed that the number of students who responded before the pandemic was higher and that this event apparently influenced the number of people interested in tutoring and answering the form Figure 5.

Box 6

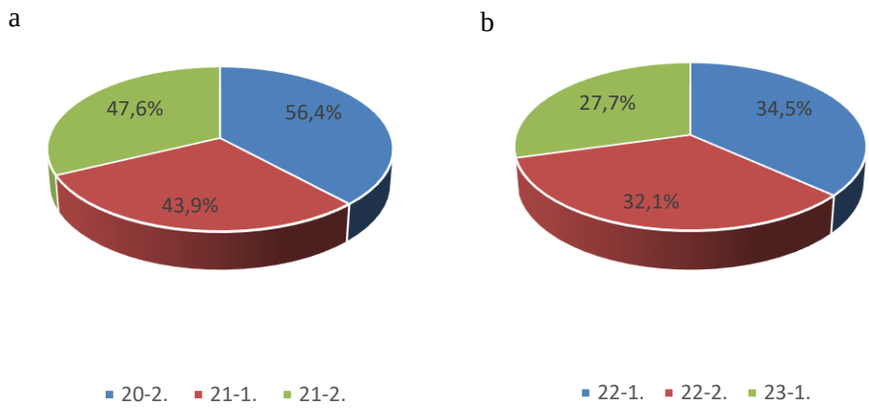


Figure 5

Percentage of (a) pre-pandemic and (b) post-pandemic students who answered of the total enrolled by semester cycle.

Source [Own]

Regarding the grade that students give for tutorial care, it can be seen in figure 6 that the percentage of tutors evaluated positively (grade from 8 to 10) is similar in the pre-pandemic school cycles and the percentage of tutors with this grade increased after the pandemic. Likewise, the tutors who were evaluated with unsatisfactory grades (6 and 7) do not exceed 10% in all school cycles, even so, we proceeded to identify the possible failures of the tutors who received these grades.

Box 7

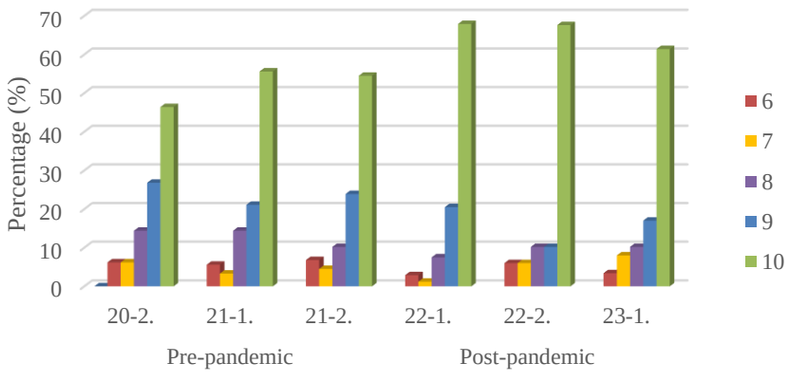


Figure 6

Pre-pandemic and post-pandemic score assigned to the tutor per semester cycle.

Source [Own]

In relation to tutors with a grade of less than 8; It can be seen that most of the responses are concentrated on the answer of "I have not required the service", as can be seen in figure 7 in the purple columns, this factor being greater at the beginning of the pandemic when the modality of teaching was changed from face-to-face to virtual. In the same way, it can be observed that in the results of the 22-1 school year, which was the resumption of face-to-face classes, the survey shows a good performance of the tutors when the students answered that the tutor supports them with various tasks (answers "agree" and "totally agree") and there are no answers considered as poor performance of the tutor (disagree and totally disagree).

On the other hand, figure 7 shows that for the recently concluded school year (phase 23-1) the support in terms of study techniques was much lower than in the previous phases, including those carried out during the pandemic. It highlights that there is a large percentage of "agree" responses, indicating that students perceive that there is support in the different areas that the tutor is responsible for and that contrasts with the low grade given by the tutored student towards his tutor.

Box 8

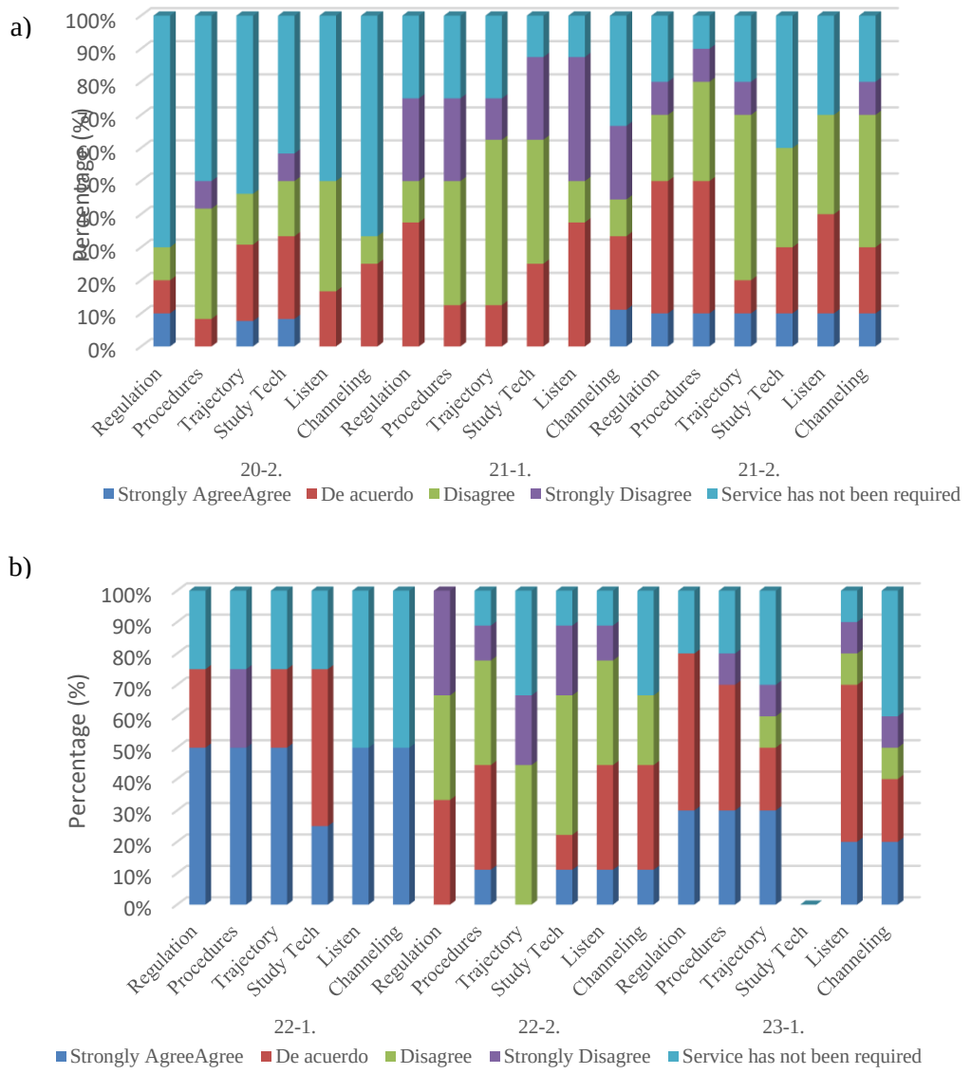


Figure 7

Students' perception a) pre-pandemic and b) post-pandemic, in relation to the guidance provided by tutors with results of 6 and 7 in their evaluation.

Regulation=Know the institutional regulations; Procedures= Teach and support in the elaboration of academic procedures; Trajectory =Academic trajectory; *Study tech =Teach study techniques*; *Listen=Attend actively and with full awareness and interest in what the tutor comes to express verbally, Channelling = Refer to different organizations or experts according to the needs of the tutor (vocational guidance, psychological counselling, external psychology, academic counselling, etc.)*

Source [Own]

It is important to mention that of the total number of responses in Figure 5 (n=52), only 32% have attended tutorials. Of these 52 free responses, 9.6% were unanswered, plus 15% referred to little or no need for tutoring, 5.7% with problems of lack of trust with the assigned tutor. The 13.4% whose answer speaks well of their tutor is striking, so there is no consistency with the grade awarded.

The remaining 56% indicate the absence of tutorial work or that it is only done once at the end of the semester and, on the other hand, the need of students to be attended to virtually and the lack of trust with the assigned tutor.

Box 9

Table 2

Free answers in relation to the reason for the grade of 6 or 7 awarded to the tutors.

Semester cycle	In relation to your previous answer, please explain why:
2020-2	Because I haven't required much of your help
	I haven't spoken to him
	I didn't requiere
	There is only attention to the student at the end of the semester as well as counselling, and since the semester is over, something can no longer be solved if it is required.
	We haven't had a session with him and since the semester is over, he asks us if we had any doubts or any problems with any teacher or subject
	I've had almost no contact
	There has been no counselling in this last semester that was taken, nor did he give information about the academic mobility that was presented through the angel doctor
	Well, I wish I could be more informed
	Good person
	I haven't had a single class with my tutor, he never answers my questions
	I haven't been able to establish a good tutor-mentee relationship.
2021-1	Cause he doesn't seem to like to explain
	because he usually answers late and, in his subject, he almost doesn't explain what oceanic tasks are as he wants them and because of the following it goes wrong
	He has not given me specific information about the procedures I have had to carry out
	Why did he never hold a meeting to explain certain doubts to us?
	...
	I didn't require the tutoring service
	Because since the beginning of the pandemic, when he most needed© the tutor for academic and other issues, he almost never connected or was not at the service. Only recently in 2021, two sessions were held, of which for my doubts and questions, were already resolved by movements (calls, emails,) that I made.
	The teacher doesn’t even answer the messages, doesn’t read them, and doesn’t give us any information
2021-2	We have not received from you so much advice regarding issues of registrations and communications.
	He is a very bad teacher, he should listen to complaints, we don't care about our future and he has made it too difficult
	I would like us to have more meetings in a row to clarify doubts at the moment and not at the end
	because we only had one consultancy, maybe it's busy
	Absent
	Because it has helped me.
	Because I haven't had any meetings with him since he became my tutor.
	.
	There is no good relationship, doubts or intrigues remain.
	Because sometimes he doesn't send us important information
2022-1	I haven't had the opportunity to talk and get my bearings
	It's the best
	Maintains contact with their mentees.
	Well, I haven't required most of the things, so I don't know if my tutor will do all of that above in case I need anything
2022-2	For how little I've required it
	Very attentive
	The teacher is very closed and doesn't inspire me with enough confidence to tell her about the problems I have at school and other situations
	I don't even seem to have a tutor
	When I have required certain services, I do not give you continuation
	I don't get that
	I haven't applied for tutoring
	Many times, it is not explained well or simply scolds us
	The doctor totally ignores my messages, only paying attention to me when I physically look for him
2023-1	Respond instead of leaving in sight.
	He hasn't given any tutor coffee and the doubts I've expressed to him haven't helped me
	Yes
	Because it solves my doubts
	It has instructed me in the race
	Why did I ask him for support on one occasion about a problem with a teacher who gave me unexcused absences and only helped me to get my percentage of absences and told me that it did pass and not to worry but in the end it was no use
	I have not required advice
	I haven't had much contact with him

Source [Own]

Discussion

According to Vela (2023), in order to achieve the comprehensive training that a mentoring program implies; This, in addition to being planned and executed, must be evaluated. These evaluations have been carried out from different perspectives: of the directors, teachers and/or students depending on the needs of the institution. This work covers only the perspective of the students since there is an institutional tool that allows such analysis and because the FACIA tutor staff recognizes their interest in the realization of the tutoring.In this work, it is clearly observed that at the beginning of the pandemic there was a higher percentage of participation in tutorial evaluation, this is explained by the virtual attention that students demanded in response to the confinement due to COVID-19, since this generated a great deterioration of the physical and mental health of students (Del Carpio Toia, et. al., 2024) coupled with the concern of health sciences students about not being able to develop the practical part of their courses normally in laboratories, amphitheaters, hospitals (Reyes-Ruiz et. al., 2024) and the presentation of low personal fulfillment, exhaustion and depersonalization in students (Sandoval-Caraveo et-. al., 2024).

Likewise, the rating given to the return from the pandemic stands out, being the highest of all the periods studied, which is explained by the fact that during the pandemic social integration changed due to the restrictions on meetings between people (Del Carpio Toia, et. al., 2024; Reyes-Ruiz et. al., 2024), so the need to socialize made that semester the students were more involved in tutoring since in addition to the physical sequelae of the disease that some suffered (Jiménez et. al., 2024), in the post-COVID-19 period, it is accepted that there were several sequelae in mental health, as a result of the confinement and the tension generated by the pandemic (Aguirre et. al., 2024), and it is also explained by the fact that in the following post-covid phases, participation in tutorial assessment decreases since "as the pandemic is extinguished and school returns to the conventional way of working, the demands on the psychological system of the students decrease and they undergo a rebalancing" (Aguirre et. al., 2024).

As in other studies (Bautista Valdivia et.al. 2022; Almedina 2016, Montes, et.al., 2015, Martínez Clares et. al., 2016), attendance at tutorials is scarce and does not exceed 50%, in addition in these studies it was observed that they only attend for consultation and information needs and almost never on a periodic basis as recommended for the institutional tutoring program of the UAC in the work of Can-Valle et. al., (2016). This low attendance may be due to the fact that tutorials are not considered mandatory despite the fact that student regulations mention it as such (Martínez Clares et. al., 2016, FMVZ UNAM 2007).

In this regard, in the PIT Committee at the UAC, representatives have proposed that tutoring be part of the student's curricular map, such as at the Technological Institute of Hermosillo, where the first two semesters constitute a subject within the curriculum (Ángulo and Urbina, 2021) or at the National Autonomous University of Mexico; where tutoring is integrated as a mandatory extracurricular requirement to enroll at a certain level in the Study Plan but without value in credits and for example in the Faculty of Veterinary Medicine of the National Autonomous University of Mexico in its regulations establishes that "In the event that the tutor has taken the subjects from the first to the fourth semester and did not participate in the mandatory tutoring, will not be able to enroll subjects from the fifth semester of the Study Plan (FMVZ-UNAM, 2007). Likewise, in studies on the perception of tutors about the tutoring process, strategies are proposed such as encouraging mentees and even evaluating participation in the PIT by awarding a grade (Santes, 2010).

As in this work, the studies of Bautista Valdivia et.al. (2022), Cruz-Nuñez. (2018); Almedina (2016), Montes, et. al., (2015) and Gómez-Collado (2012); women are the ones who participate in the highest proportion of the tutorial assessment. In this regard, Montes et. al. (2015) proposes that male students, for idiosyncratic or cultural reasons, do not accept accompaniment by tutors as easily, as doing so could seem a weakness. However; It is also explained by the reason that female enrollment in the Faculty of Agricultural Sciences of the UAC has increased in the last decade, as in other countries that have reached up to 80% of women in their enrollment (Gordon et-al-. 2023: Lepé-López et.al. 2018).

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It is interesting the good rating in general that is given to tutorial work in all school cycles, which on the one hand indicates the good conception that students have regarding tutoring, results similar to the work of Bautista Valdivia et.al. (2022) which makes a compilation of several studies where it is observed that in general tutorials are well rated and with a high degree of satisfaction on the part of students of each institution.

In the case of tutorials at FACIA, it may be due to the fact that the Institutional Tutoring Program and the Autonomous University of Campeche in general have an "Institutional Program of Pedagogical and Disciplinary Training of the UAC" in which it offers semester courses and curricular diplomas on pedagogical and specific aspects for tutorial work. since tutors must acquire skills to facilitate the support, monitoring and comprehensive and professional training of students still felt training needs on the part of the teacher-tutors that must be evaluated and considered in the tutoring project. Specifically for FACIA, which has the limitation of being far from the headquarters where the Faculty of Psychology is located, limiting itself to emotional support through psychological first aid - a diploma that was not specified by the tutor staff - and the support of virtual assistance by counseling that has worked for some, but not for all.

Regarding the analysis carried out with respect to the tutors evaluated with 6 and 7, that is, with a score considered negative, there is an ambiguity as to the reason for this rating. In this regard, it is shown that some students did not understand the question because their answers are positive for the tutor. It also highlights that a large percentage of these students did not attend tutorials, however; rate the tutor and do so negatively, which may be due to the fact that in the evaluations made by the students; the variables or criteria to determine the effectiveness of teachers are related to the process, omen (treatment) and scarcely with the learning results or products, with the omen criteria being those associated with the perceived quality of the teachers' interaction, interest and motivation to teach (García-Garduño et.al., 2014).

Based on this, it would be interesting to investigate whether, in these cases, the student is evaluating the relationship with the teacher and even if there is an evaluative relationship of the course involved and the student has lost objectivity, which is also in agreement with what is expressed in the work of Ángulo (2021) "students respond to university tutoring based on the learning principles that they themselves identify, and build their appreciation of what really happens in the tutorials based on their experience and what they do or do not achieve in them", or evaluate them according to how they did in the course (Petra Micu et. al., 2010);

In addition, students argue that they do not go to tutors because they do not need it (Yon-Guzman et, al., 2019), so students continue to recognize tutorials as a space for resolving doubts and difficulties about the subjects of study; but at the same time they do not see the possible usefulness that this space can have as an opportunity to better learn about both the academic and professional options of the degree. as well as a possible help to promote their personal development (Giménez-Costa et-al., 2018) and; in the case of students in FACIA, it has been observed that several students attend only when due to their academic performance they are in the situation of being withdrawn due to the scope of the plan or because it is their third recourse, academic moments in which it is impossible for the tutor to have tools to support them.

Another of the problems that students mention to give negative grades to tutors is the scant attention given because they only have one session a semester and, even worse, it is at the end of it, however, similar studies indicate that it is one of the problems with more tradition in the relationship between teachers and students at the university (Martínez-Clares et. al., 2016).

In this regard, Gómez and Palomo (2013) argue that "For teachers, the task of tutoring their students sometimes and in many cases involves a bureaucratic procedure, a schedule to be covered that, in most cases, is dedicated to resolving exam complaints or advising individual or group work", in addition to this it can also be mentioned that the scarce provision of tutorials is related to tutor-mentee time incompatibility (Martínez-Clares et. al., 2020).

Both explanations are adequate for the case of FACIA-UAC tutors, which also implies the absence of a culture of tutorial action in both actors of the process, as mentioned in his work by Solaguren-Beascoa, et.al. (2016). In this regard, the National Autonomous University of Mexico emphasizes that in order for the tutor to be able to perform the functions that the tutoring process requires, it is essential that, among the different conditions that must be satisfied, he or she uses various techniques and instruments to know and understand the characteristics of the students, their performance throughout the academic process and their results in the educational institution (Orduño and Velasco, 2009), which is a complex task that requires offering continuous training in different topics to teachers-tutors and never forgetting that tutoring must be personalized to meet the specific needs of each student.

For example, a student who is struggling academically may need support in a specific area, while a student who is struggling social-emotionally may need support in developing their communication skills (Zamata et. al., 2024). Therefore, "this task cannot be just a function and an objective of each individual teacher [or an isolated element]. In this sense, tutorial action establishes new responsibilities and ways of doing things that require the involvement of the university institution at all levels (Venegas-Ramos & Gairin, 2020)

Another aspect that is talked about is the lack of virtual communication, which seems to be an important aspect nowadays since the use of socio-formative virtual platforms can be used to generate motivation in students and, in this way, contribute to the implementation of new educational methodologies (in this case tutorials) congruent with our temporality (Mounkoro, 2024), so that tutorials are not taking advantage of the available communication channels that can make the process more fluid and use non-face-to-face systems that are more comfortable, accessible and faster, both for teachers and students and that students are demanding (Martínez-Clares et. al., 2020). In this regard, scheduling rules should also be established because, at least in the FACIA-UAC, there have been cases of communication at late hours of the night and that resembles what happened during the pandemic where the teaching working day increased by up to more than 5 hours (López et. al., 2021)

Another aspect evaluated is "active listening", which refers to the tutor's willingness to listen to their mentees, which is largely explained by the fact that "not all mentees feel confident in expressing private situations to their tutor and stay on the sidelines" (Gómez-Collado et al, 2012), a problem also observed in the study by Martínez-Clares et. al. (2020) and Rubio and Martínez (2012). Although this aspect in some studies remains in last place in the importance for mentees (Napa et al., 2019); the figure of the tutor must exude a human spirit that inspires confidence and invites students to participate in tutoring, considering it a space that can help them throughout their time at the university (Martinez-Clares et. al., 2020).

In this regard, Rubio and Martínez (2020) emphasize the importance of induction work, which allows students to be informed about what tutoring is, how it can be carried out and what it is for; however; In the Tutoring Program of the Autonomous University of Campeche, an induction course is held at the beginning of the 1st semester in which there is a space to explain the tutorial process and what it involves. Therefore, other different strategies should be considered to promote the importance of tutoring and, above all, the participation of the mentees. In this regard, it stands out that the answers "I have not required" are the ones with the highest proportion, which according to the work of Giménez Costa et. al., (2018) indicates that the tutors appreciate the program less and less and there is an urgent need to make changes, so that it does not only remain in good intentions on the part of the university authorities.

Conclusions

Finally, citing Napa et al. (2019); It must be recognized that "tutorial action is essential, otherwise social skills are not properly developed and are vital for professional performance". Tutoring as a response to today's university is a right of students that gives quality to higher education, contributing to a better teaching-learning process, guidance, advice, training and development both individually and in groups, favoring the comprehensive and autonomous development of students (Martínez-Clares et al (2020), For this reason, in the FACIA-UAC tutoring program, other actions must be implemented that allow a better understanding of the tutorial action for teachers and students, where both managers and administrators must be involved for the continuous improvement of this process.

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

*Duarte-Ubaldo, Ivonne***:** Investigation, Methodology, Writing – review & editing, Supervision.

Vargas-Magaña, Juan: Conceptualisation, Writing – review & editing
Méndez-Ortiz, Francisco: Investigation- Writing – review & editing, Supervision
Suárez-Suárez, Lady: Review & editing.

Availability of data and materials

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Abbreviations

CIEES = Interinstitutional Committees for the Evaluation of Higher Education
COPAES = Council for the Accreditation of Higher Education
FACIA = Faculty of Agricultural Sciences
HEIs = Higher Education Institutions
PIT = Institutional Tutoring Program
TAP = Tutorial Action Plan
UAC = University Autonomous of Campeche

References

Antecedents

ANUIES (2000). Programas Institucionales de Tutoría. Una propuesta de la ANUIES para su organización y funcionamiento en las instituciones de educación superior, México, Colección Biblioteca de la Educación Superior, Serie Investigaciones, ANUIES.

Álvarez, M. y Álvarez, J. (2015). La tutoría universitaria: Del modelo actual a un modelo integral. *Revista Electrónica Interuniversitaria de Formación Del Profesorado*, *18*(2), 125-142.

Álvarez González, M. (2017). Hacia un modelo integrador de la tutoría en los diferentes niveles educativos. *Educación Siglo XX1*, 35(2), 21-42.

Bausela, E. (2004). La función orientadora en el marco de la universidad. *EduPsykhé*, 3(1), 109-120.

Cano, R. (2009). Tutoría universitaria y aprendizaje por competencias: ¿Cómo lograrlo? *Revista Electrónica Interuniversitaria de Formación Del Profesorado*, 12(1), 181-204.

De la Cruz Flores, G., Chehaybar y Kuri, E. y Abreu Hernández, L.F. (2011). Tutoría en la educación superior: una revisión analítica de la literatura. Revista de la Educación Superior. XL(1):157, 189-209.

García López, R. I., Cuevas Salazar, O., Vales García, J. J., & Cruz Medina, I. R. (2012). Impacto de la tutoría presencial y virtual en el desempeño académico de alumnos universitarios. Revista Iberoamericana de Educación. 58(2): 1-11.

García López, Ramona Imelda, Cuevas Salazar, Omar, Vales García, Javier José, & Cruz Medina, Isidro Roberto. (2012b). Impacto del Programa de Tutoría en el desempeño académico de los alumnos del Instituto Tecnológico de Sonora. Revista electrónica de investigación educativa, 14(1), 106-121.

Klug, M. A., & Peralta, N. S. (2019). Tutorías universitarias. Percepciones de estudiantes y personal tutor sobre su uso y funcionamiento. *Revista Electrónica Educare*, 23(1), 319-341.

Lobato, C. y Guerra, N. (2016). La tutoría en la educación superior en Iberoamérica: Avances y desafíos. *Educar, 52*(2).

López A. R. (2004). La incorporación de los programas de tutoría en las instituciones de educación superior. Colección Documentos. ANUIES. México.

López-Gómez, E. (2017). El concepto y las finalidades de la tutoría universitaria. Una consulta a expertos. *Revista Española de Orientación y Psicopedagogía,* 28(2),61-78.

Martínez, P. y González, N. (2018). Las competencias transversales en la universidad: propiedades psicométricas de un cuestionario. *Educación XX1*, 21(1), 231-262.

Martínez, P., Martínez, M. y Pérez, J. (2014). Tutoría Universitaria: entorno emergente en la Universidad Europea. Un estudio en la Facultad de Educación de la Universidad de Murcia. *Revista de investigación educativa*, 32(1), 111-138.

O'Delly, F. y Eisenberg, G. S. (1989). Helping students make important transitions. *The school comiseher*, 36, 286-292.

Pérez, M., Quijano, R. y Muñoz, I. (2018). Transición de Secundaria a la Universidad en estudiantes de los títulos de maestro de Educación Infantil y Primaria de la Universidad de Jaén. *Aula Abierta*, 47(2), 167-176.

Ponce Ceballos, S., García Cabrero, B., Romo López, A. M., & Aviña Camacho, I. (2022). Caracterización de los instrumentos de evaluación de tutores universitarios en México. Perfiles Educativos, XLIV(176), 45-64.

Robles, R. (2017). Acción tutorial y educación personalizada. En M. Bertella, F. Daura, M. Grebe, M. Montserrat, J. Nubiola, & R. Robles, El asesoramiento académico personalizado en la universidad, Universidad Austral. Buenos Aires 13-29.

Romo-López, A. (2011). La tutoría: una estrategia innovadora en el marco de los programas de atención a estudiantes. Colección Cuadernos Casa. ANUIES. México.

Rodríguez Espinar, S. (2018). La Universidad: una visión desde "fuera" orientada al futuro. *Revista de investigación educativa*, *36*(1), 15-38.

Sánchez, P., Vales, J. y Galván, L. (2005). Necesidades de orientación en estudiantes de licenciatura. Diferencias regionales. Revista de Orientación Educativa, 4, 7–11.

Sobrado Fernández, L., (2008). Plan de acción tutorial en los centros docentes universitarios: el rol del profesor tutor. Revista Interuniversitaria de Formación del Profesorado, 22(1), 89-107.

Torrecilla Sánchez, E. M., Rodríguez Conde, M. J., Herrera García, M. E., & Martín Izard, J. F. (2013). Evaluación de calidad de un proceso de tutoría de titulación universitaria: la perspectiva del estudiante de nuevo ingreso en educación. Revista Española de Orientación y Psicopedagogía, 24(2), 79-99.

Toscano de la Torre, Beatriz. (2016). La Eficiencia Terminal como un Indicador de la Calidad en la Educación Superior en México.

Universidad Autónoma de Guadalajara. (2004). La tutoría académica y la calidad de la educación. UDEG México. UNAM.

Basic

Almedina, M. I. A. (2016). Evaluación de la orientación y la tutoría en la Facultad de Ciencias de la Educación de la Universidad de Córdoba. Educatio Siglo XXI, 34(1 Marzo), 93-112.

Ángulo Moreno, Angel de Jesús. (2021). Indicadores de la tutoría integral desde la percepción de los estudiantes de universidades públicas de México. Dilemas contemporáneos: educación, política y valores, 8(2), 00004.

Can-Valle R., Mass-Ortegón L.M. y Rosales-Raya M. (2016). Trayectoria académica como estrategia para abatir la deserción escolar en dos licenciaturas de la UACAM. Memorias 7o encuentro Nacional de Tutorías. Universidad de Guanajuato. Guanajuato.

Ceballos, S. P., Cabrero, B. G., Soto, Y. M., Cervantes, D. I., Villanueva, Y. A., & Garduño, C. M. (2016). Aproximaciones sobre la evaluación de las tutorías en Educación Superior: experiencias y reflexiones. Revista Intercontinental de Psicología y Educación, 18(1-2), 229-246.

Cruz-Núñez, F. (2018). Percepción de los estudiantes de enfermería sobre las tutorías académicas. UVserva,(3).

Garcia-Garduño, J. M., & Shej, A. M. (2014). Los criterios que emplean los estudiantes universitarios para evaluar la ineficacia docente de sus profesores. Perfiles educativos, 36(143), 124-139.

Paredes, C.I. (2023). Evaluación del impacto de programas de tutoría académica en el desempeño estudiantil en educación superior. Revista Boaciencia. Educación y Ciencias Sociales, 3(1): 85-100.

Petra Micu, I., Talayero Uriarte, J. A., & Aguilar García, M. L. (2010). Eficacia del profesor: Actitudes y opiniones de los alumnos del curso de formación de profesores de psicología médica y psicología médica clínica. Revista de la Facultad de Medicina, 4(4):241-248.

Supports

Aguirre, E. I., Lizárraga, E. I., & Guzmán, Y. L. S. (2024). Cansancio emocional y rendimiento académico en estudiantes universitarios durante el retorno a clases presenciales. IE Revista de Investigación Educativa de la REDIECH.

Ángulo Moreno, Á. D. J., & Urbina Barrera, F. (2021). Implementation and challenges of comprehensive tutoring: Indicators and students' perception in three universities in northern Mexico. Revista latinoamericana de estudios educativos, 51(3), 201-229.

Del Carpio Toia, A. M., Ankass, L. A., Guillen, C. S., Huanqui, M. G., Zegarra, J. S., Puma, M. C., & Vargas, L. F. R. (2024). Salud Mental en estudiantes universitarios en aislamiento social durante la Pandemia COVID-19. Arequipa, Perú. Medicina Clínica y Social, 8(1), 11-19.

Duarte Ubaldo I. E, García Ramírez M-J., Vargas-Magaña J.J. (2015). El café-tutor como estrategia rompe-hielo en la relación tutor-tutorado. Impactos y retos de la tutoría. Universidad Autónoma de Yucatán, México. 1086-1094.

Encalada, M. L. S. (2016). Formación de tutores como estrategia para mejorar el rendimiento académico de los estudiantes universitarios. Integración Académica en Psicología., 4(12).

FMVZ-UNAM. (2017). Reglamento del programa de tutoría para la licenciatura de la facultad de medicina veterinaria y zootecnia de la Universidad Nacional Autónoma de México. México.

Giménez Costa, J.A., Cortés Tomás, M.T., y Motos Sellés, P. (2018). ¿Cómo valoran los estudiantes los procesos de tutoría universitaria? REDINE (Ed.), Innovative strategies for Higher Education in Spain. (pp. 27-38). Eindhoven, NL: Adaya Press.

Gordon, S.; Parkinson, T.; Byers, S.; Nigito, K.; Rodriguez, A.; Werners-Butler, C.; Haynes, J.; Guttin, T. (2023). The Changing Face of Veterinary Professionalism Implications for Veterinary Education. Educ. Sci. 13(2): 182.

Gómez E. B. (2021). Estudio de la eficiencia terminal de los alumnos a partir de la visión docente desde la teoría de sistemas: el caso de la Universidad Autónoma Metropolitana. Tesis Maestría en Políticas Públicas Comparadas. Facultad latinoamericana de Ciencias Sociales (FLACSO). México.

Gómez, M. C. A., & Palomo, M. M. (2013). Evaluación de la tutoría en la Universidad de Huelva desde la perspectiva del alumnado de psicopedagogía: propuestas de mejora. *Tendencias pedagógicas*, (21), 163-176.

Jiménez, Y. L., González, M. E. C., & Olivé, K. I. (2024). Post-covid-19 en jóvenes universitarios. Medicina e Investigación. Universidad Autónoma del Estado de México, 12(1): 23-27.

Lepe-López, M. A., Franco, G., Lepe, P., García, F., Dávila-Hidalgo, A., Villeda-Retolaza, L., & Arenales, E. (2018). Incremento del número de estudiantes del género femenino egresados de la carrera de medicina veterinaria en Guatemala. Ciencias Sociales y Humanidades, 5(2), 31-38.

López, G. G., Vásquez, A., Caviativa, Y. P., Ospina, P. A., Chaves, V. T., Carreño, L. M., & Vera, V. J. (2021). Tensiones y realidades de los docentes universitarios frente a la pandemia Covid-19. European Journal of Health Research, 7(1): 1-13.

Martínez-Clares, Pilar, Pérez-Cusó, Javier, González-Morga, Natalia, González-Lorente, Cristina, & Martínez-Juárez, Mirian. (2020). La Tutoría universitaria vista por sus alumnos: Propuestas de mejora. Revista de la educación superior, 49(195), 55-72.

Montes, J. F. C., Alcántar, M. D. R. C., Padilla, A. A. J., & Pulido, I. P. (2015). Actitudes de los estudiantes universitarios ante la tutoría. Diseño de una escala de medición. *Revista de la educación superior*, *44*(173), 103-124.

Mounkoro, I. (2024). Las plataformas Virtuales Socioformativas como Herramientas de innovación en las Prácticas Educativas. Ciencia Latina Revista Científica Multidisciplinar, 8(1), 4598-4615.

Napa J, Anthony Johnson, Santa María Relaiza, Héctor Raúl, Norabuena Figueroa, Roger Pedro, & Jara Jara, Nolan. (2019). Tutorial Action for the Development of Social Skills in University Students. Propósitos y Representaciones, 7(1), 185-192.

Reyes-Ruiz, L., Andrade-Mariano, Y., Baldovino-Leon, C. A., Rodriguez-Parra, Y. N., Carmona-Alvarado, F. A., Yaneth, R. (2024). Impacto del Covid-19 en los Estudiantes Universitarios. Tejidos Sociales, 6(1): 1-11.

Sandoval-Caraveo, M. del C., Surdez-Pérez, E. G., & Pérez-Sandoval, A. G. (2024). Burnout por covid-19 durante las clases en línea en estudiantes universitarios. RIDE Revista Iberoamericana para la investigación y el desarrollo educativo, 14(28).

Rosas-Chávez, P., & Ramírez-Martínez, M. A. (2013). El impacto de la tutoría en las instituciones de la Región Centro Occidente de la ANUIES. Guadalajara, Jalisco. Universidad de Guadalajara.

Santes, J. (2010). La pertinencia de la tutoría académica en la facultad de pedagogía de la Universidad Veracruzana, región Xalapa. Tesis Maestría. Facultad de estadística e informática. Universidad Veracruzana.

Venegas-Ramos, Luis, Gairín Sallán, Joaquín. (2020). Aproximación al estado de la acción tutorial en universidades chilenas. Perfiles educativos, 42(167), 103-118.

Zamata, F. R., Miranda, M. A. L., Ramos, J. V. O., & Huari, M. Y. A. (2024). Prácticas innovadoras de tutoría en la Unidad Académica de Estudios Generales de una Universidad Privada. South Florida Journal of Development, 5(1), 43-55.

Differences

Gómez-Collado, Martha Esthela. (2012). La percepción de los estudiantes sobre el Programa de Tutoría Académica. Convergencia, 19(58), 209-233.

Rubio, P. P., & Martínez, J. F. (2012). La acción tutorial desde la perspectiva de los alumnos de la Universidad Autónoma de San Luis Potosí. Perfiles educativos, 34(138), 28-45.

Solaguren-Beascoa Fernández, M. y Moreno Delgado, L. (2016). Escala de actitudes de los estudiantes universitarios hacia las tutorías académicas. Educación XX1, 19(1), 247-266.

Discussions

Bautista Valdivia, J., Ramos Zuñiga, B., Ortega Torres, N. I., Morales Villegas, R., & Suarez Rodriguez, C. del P. (2022). El programa de tutorías: un reto educativo post-pandemia. Ciencia Latina Revista Científica Multidisciplinar, 6(4), 1307-1333.

Gallegos, A. A. (2017). El impacto de la tutoría académica en el nivel superior. Tesis de maestría. Benemérita Universidad Autónoma de Puebla.

Martínez Clares, P., Martínez Juárez, M., & Pérez Cusó, J. (2016). ¿Cómo avanzar en la tutoría universitaria? Estrategias de acción: los estudiantes tienen la palabra. Revista Española de Orientación y Psicopedagogía (REOP), 27(2), 80-98.

Orduño, E., & Velazco, F. (2009). Evaluación de la efectividad del programa tutorías en una institución de educación superior en México. X Congreso Nacional de Investigación Educativa. 10:1-9.

Vela, W. B. C., & Tafur, R. S. (2023). Programa de tutoría para la formación integral de estudiantes universitarios. Revista Science Evolution, 1(5):117-122.

Yon Guzmán, Silvia Estela, Hernández Marín, Gloria del Jesús. (2019). Tutoría en la educación superior: análisis de la percepción de profesionales y estudiantes en una universidad pública. RIDE. Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 9(18), 717-747.

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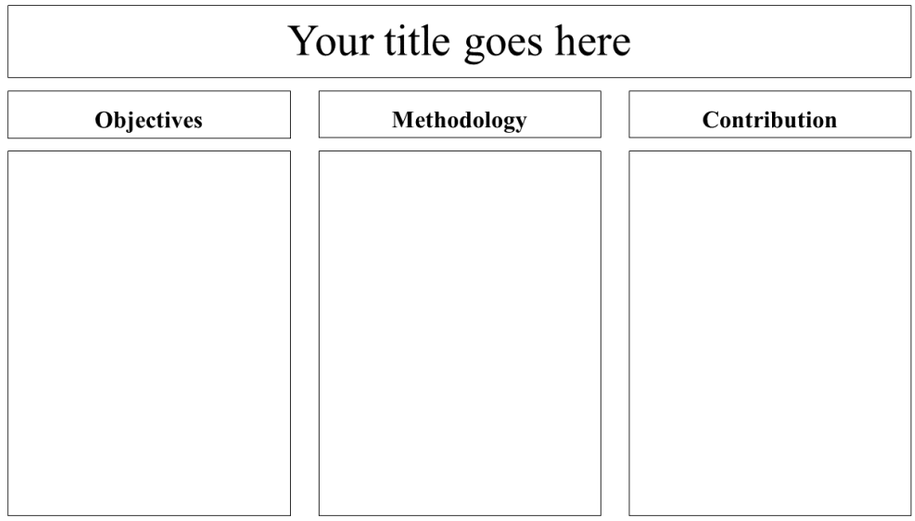

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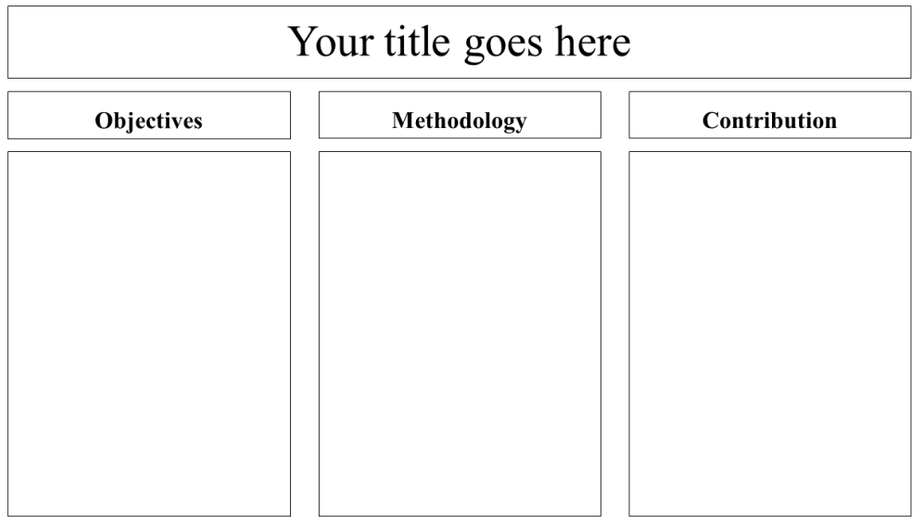

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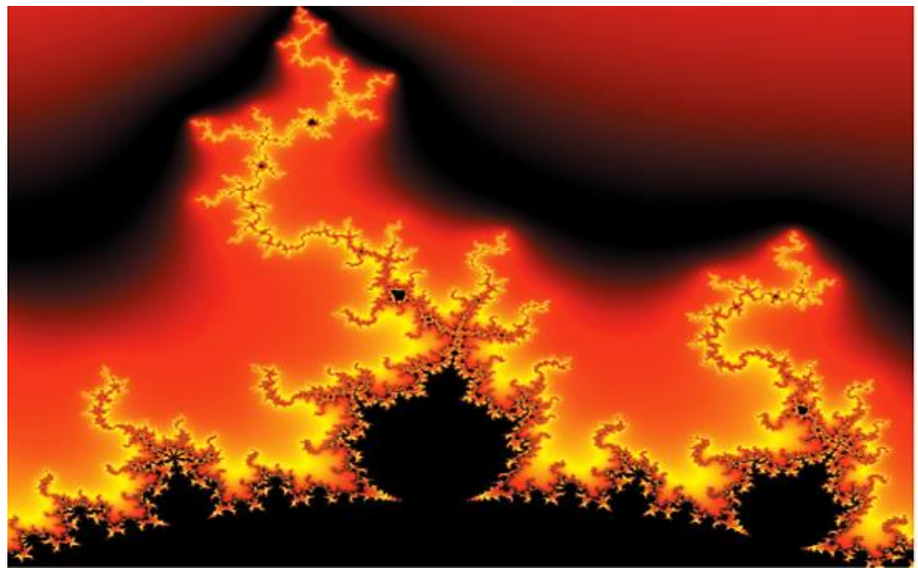

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