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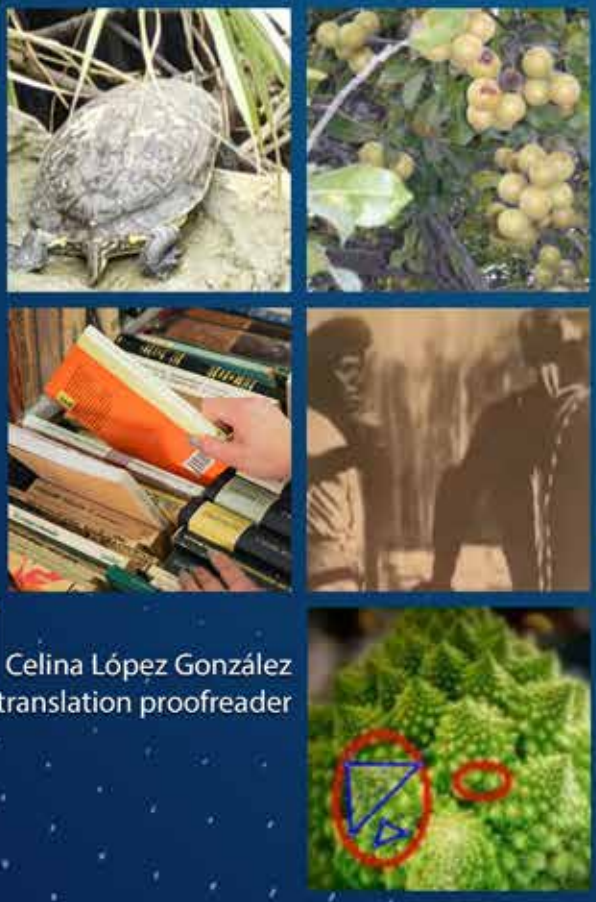

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EDITOR'S LETTER

Dear community of the journal Espacio I+D Innovación más Desarrollo from the Benemérita Universidad Autónoma de Chiapas, we are pleased to present Issue 42, Vol. 14 of this publication. With this issue, we celebrate our thirteenth year of regular publication. Over these thirteen years, we have navigated a rapidly evolving landscape: that of digital publishing. Today we face another significant change: the integration of AI into contexts such as academia and research. This situation has presented us with challenges as editors, authors, and even readers.

We are confident that we will handle this change in the best possible way to ensure the quality of our publication and the proper handling of the content entrusted to our publishing house; therefore, over the coming weeks, we will be adjusting our editorial policies and reception processes.

We conclude this volume with a regular, multidisciplinary issue featuring the following articles from various universities and institutions: *Actions for the Control and Eradication of Alien Species Invaders in the Sumidero Canyon National Park, Antiprotozoal activity of Mexican ethnomedicinal plants against Trichomonas tenax, a protozoan associated with periodontal disease, Humanities Research Methodology. Literary Art in Pandemic Times, Types of bilingualism in Cucapá among teaching and administrative staff at an indigenous elementary school in Mexicali, Baja California, Design of a Didactic Situation with Lateral Thinking to Favor the Learning of the Riemann Sum*. In addition to two academic papers titled: *Fear among people of sexual diversity for expressing their sexual and gender orientation in Jalisco* and *Case Study of the Academic Body "Health Promotion and Education" of the Universidad Autónoma de Chiapas*.

We hope this issue reaches an eager readership and that the knowledge shared here proves useful to the people of Chiapas.

Silvia Álvarez Arana
Editor

Espacio I+D, Innovación más Desarrollo journal.

"*Por la conciencia de la necesidad de servir*"
Benemérita Universidad Autónoma de Chiapas

ARTICLES

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Actions for Controlling and Eradicating Invasive Alien Species in the Cañon del Sumidero National Park

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— Abstract—

Recently, in the Parque Nacional Cañon del Sumidero, activities have been undertaken to identify, control, and eradicate the invasive alien species present there. To date, activities have been intensified for the attention of jaragua grass (*Hyparrenia rufa*), African nun orchid (*Oeceoclades maculata*), and mosquitoes of medical importance of the Culicidae family, devil fish (*Pterigoplychthys* sp.), red-eared turtle (*Trachemys scripta elegans*), and feral species (dogs and cats). The actions carried out by the Committee for the Attention of Invasive Alien Species of the Cañón del Sumidero National Park were analyzed from 2018 to date. Articles and internal documents generated from investigations on these species were reviewed. Advances are recognized in the prevention, dissemination, and awareness actions carried out, inside and outside the National Park, which will allow the proliferation and effects of invasive alien species to be contained.

Keywords:

Jaragua grass; African nun orchid; mosquitoes; devil fish; red-eared turtle; feral species.

Invasive Alien Species (IAS) are considered to be those originating from a non-native population, which is outside its natural range, that is able to survive, reproduce, and settle in natural habitats and ecosystems, which threaten native biological diversity, the economy, and public health (DOF, 2010). Invasive alien species affect ecosystems, environmental services, and, consequently, animal and human well-being (Espinosa-García & Villaseñor, 2017). IAS have a great capacity for adaptation since they generally have a generalist diet, reproduce rapidly, proliferate in progeny, and have a high tolerance to adverse climatic conditions (Martin et al., 2009). For this reason, they establish and appropriate sites where they reproduce and disperse without control, generate fertile offspring, and compete with native species, which causes damage to the environment, health, and economy (CONABIO, 2023). The introduction of IAS is considered among the first causes that threaten the extinction of biodiversity in the world (Clavero & García-Berthou, 2005).

The presence of IAS contributes to the degradation of aquatic and terrestrial environments and can cause the extinction of native populations and species, with greater effects on aquatic species, which are particularly sensitive, because their presence increases the transformation capacity of habitats and eutrophies (Gallardo et al., 2016). In the terrestrial environment, IAS affect 30% of birds, 11% of amphibians, and 8% of the world's mammals (CONABIO, 2023).

The greatest impact of IAS occurs in freshwater, due to the development of global aquaculture, based on the introduction of exotic species. In Mexico, this activity focuses almost entirely on seven introduced species: carp, tilapia, catfish, trout, prawn, Japanese oyster, and mussel (Mendoza, 2001). Other aquatic IAS have entered our territory due to aquarism, such as plecos and lionfish (Alfaro et al., 2014). It is estimated that around 798 IAS live in our country: 665 species from exotic plants, 77 from fish, 10 from amphibians and reptiles, 30 from birds, and 16 from mammals (CONABIO, 2023).

In Chiapas, information on the presence and effects of IAS is scarce. However, it is estimated that there are around 330 species in the state. In the Parque Nacional Cañon del Sumidero (PNCS), there are 68 IAS registered. The main causes of introduction are irregular settlements within the limits of the protected natural area, and even within it, as well as livestock activities, aquaculture, and tourism.

THE COMMITTEE FOR THE CARE OF INVASIVE ALIEN SPECIES OF THE PNCS

In September 2018, as a result of the problems detected in the PNCs regarding the presence of IAS, the Committee for the Care of Invasive Alien

Species (CAEEI) was created. The initiative is part of the national project, key GEF 00089333, named "Increase national capacities for the management of invasive alien species through the implementation of the National Strategy", which aimed to improve the integral management processes of IAS and train local actors in the National Park. As shown in Figure 1, this interdisciplinary body meets quarterly and aims to work and coordinate actions with different sectors, including academia, government, private initiative, the productive sector, the commercial sector, and local communities, to detect, control, and eradicate IAS from the protected natural area.

Note. Photo by Irma de Jesús Serrano-Sánchez, CONANP, Parque Nacional Cañon del Sumidero.

Figure 1. Committee for the Management of Invasive Alien Species of the PNCS

The CAEEI has three subcommittees: Research, Outreach, and Control and Management. The committee has developed a short-term, medium-term, and long-term work program with specific activities for each subcommittee, and it is part of the Advisory Council for the Protected Natural Area. Its creation and functions are based on the proposals outlined in the National Strategy on Invasive Alien Species in Mexico (CANEI, 2010) and the applicable regulations on the subject. It is based on the Political Constitution of the United Mexican States (Articles 1, 4, paragraph five, and 133), the provisions established by international treaties (Principle 10 of the 1992 Rio Declaration on Environment and Development), which establishes the Principle of Citizen Participation (Article 8, paragraph h) of the Convention on Biological Diversity, and Resolution No. VII/14 issued by the Scientific and Technical Review Panel (STRP) of the Convention on Wetlands of International Importance (Ramsar).

Among the national regulatory instruments for addressing IAS are Articles 72, section XIII, and 77, section I, of the Internal Regulations of

the Ministry of the Environment and Natural Resources; Articles 15, sections XII and XV, 47, 79, section I, and 80, section IV, of the General Law of Ecological Balance and Environmental Protection; Article 5, section III of the Regulations of the General Law of Ecological Balance and Environmental Protection on Protected Natural Areas; Articles 5, sections III and V, 10, section X, 15, and 27 Bis, last paragraph, of the General Wildlife Law; Article 21, section I, of the General Law of Sustainable Forest Development; the conservation objectives established in the Decree creating the Parque Nacional Cañon del Sumidero (PNCS), published in the Official Gazette of the Federation on December 8, 1980, and the National Strategy for the Eradication of Invasive Alien Species (EEI). Specifically, for the management of IAS detected in the PNCS, there is an Early Detection and Rapid Response Protocol that outlines the set of recommendations to be followed for their control and eradication, as proposed by the United Nations Development Program and the Commission for Protected Natural Areas (CONANP) (UNDP-CONANP, 2016).

METHOD

The actions carried out by the CAEEI of the Parque Nacional Cañon del Sumidero from 2018 to date were analyzed. Internal articles and documents generated from research conducted on IAS, considered priority areas for attention [jaragua grass (*Hyparrenia rufa*), African nun orchid (*Oeceoclades maculata*), medically important mosquitoes of the Culicidae family, devil fish (*Pterigoplychthys* sp.), the red-eared slider turtle (*Trachemys scripta elegans*), and feral species (dogs and cats)]. Finally, the general prevention, dissemination, and awareness-raising actions carried out by the CAEEI, both within and outside the protected natural area, were identified.

RESULTS

Research conducted

Jaragua grass (H. rufa). In 2019, actions were implemented in the PNCS to control and manage jaragua grass, as well as to protect and restore the habitat affected by this species. *H. rufa* is an invasive species that, during low water periods, is so resilient that it can take advantage of the stress on native vegetation and colonize new areas. This grass is gradually displacing native species, which are more sensitive to fire. Furthermore, it represents an adverse condition for the landscape in a scenario of exotic grasses spreading over well-preserved habitats, exacerbated by the advance of climate change (PNUD, 2023).

From 2019 to 2023, manual clearing (removal of rhizomes and stumps), prescribed burning, herbicide application, soil conservation works, reforestation with native species, and reforestation management were carried out on 15 hectares of the banks of the Rio Grijalva. Between 2020 and 2023, the management and control actions for *H. rufra* continued on 10 hectares along the banks of the Rio Grijalva and on 250 hectares of the Loma Larga property in Tuxtla Gutiérrez, where prescribed burns, firebreaks, fuel management, natural regeneration management, and reforestation with native species are carried out, as shown in Figure 2. CONANP reports that the development of *H. rufra* has been halted and its growth has been reduced by 70%; in contrast, the development of native plants has increased by 95%.

Note. Photo by Víctor Arturo Villatoro-Álvarez, CONANP, Parque Nacional Cañon del Sumidero.

Figure 2. Management for the control of Jaragua grass (*H. rufra*)

African nun orchid (O. maculata). Between 2021 and 2022, the Colegio de la Frontera Sur (ECOSUR) carried out the project "Initial detection of the African nun orchid (*O. maculata*) and control proposal in the PNCS," which aimed to assess its distribution and abundance within the protected natural area and describe the ecological effect on local populations of native orchids to contribute to the design of a control method. *O. maculata* is a terrestrial orchid with invasive behavior, broad tolerance to diverse environments, and high seed productivity that favors its reproduction (CABI, 2023).

For this project, 13 transects were established in the PNCS, where we detected 231 individuals of the following species: 71.4% vegetative and 28.6% reproductive, as shown in Figure 3. Based on observations made of other plant species present in the park, a list of native orchids with potential for impact was generated during the project.

Note. Edith Belén Jiménez Díaz, Naturalist, https://www.naturalista.mx/observations/9958604

Figure 3. Specimen of African nun orchid (O. maculata), at the PNCS

About *O. maculata*, it is noted that, after determining its distribution and abundance, supporting studies should be carried out to characterize the microenvironments where it thrives, its demography, reproductive strategies, and mycorrhizal associations, to provide an in-depth explanation of the invasive behavior of this terrestrial orchid and to be able to design efficient control strategies (Riverón-Giró et al., 2017).

Mosquitoes (Diptera: Culicidae). During the same period (2021-2022), the "Study on Mosquito Diversity (Diptera: Culicidae) of medical importance in the Parque Nacional Cañon del Sumidero" was conducted to determine the diversity and abundance of mosquitoes of the Culicidae family that affect human health. Culicidae belong to a family of dipterans colloquially known as mosquitoes, which includes 39 genera and 135 subgenera (Reinert, 2001).

The results identified 8 genera and 11 species present in the park, with the genus *Aedes* being the most abundant and the subspecies *Aedes aegypti* sumidero having the highest number of records. Species of this genus possess characteristics that give them adaptive advantages over others, making them successful invaders, as their eggs are more or less resistant to desiccation

and can be more easily transported by humans, achieving high effectiveness in transmitting diseases such as dengue fever by reproducing successfully (Rey & Lounibos, 2015).

Devilfish (Pterigoplychthys sp.). During the same period as the studies mentioned above, the project "Regional Strategy for the Management and Control of Devil Fish in the PNCS" was carried out by the Institute of Biological Sciences (ICBiol) of the Universidad de Ciencias y Artes de Chiapas (UNICACH). The objective of this research was to develop a regional management and control strategy for the species. This research has identified sites where devilfish occur in the main channel of the Rio Grijalva, in the middle basin of the Cañon del Sumidero, where the presence of *Pterigoplychthys disjunctivus* (Velázquez et al., 2022) has been confirmed.

To date, biometric data has been collected from individuals captured in the Rio Grijalva, and workshops are planned with local PNCS fishermen to raise awareness about the problems caused by the species and about recording, capture, and measurement techniques. As a preventive measure, specimens of devilfish have been removed from the PNCS, as shown in Figure 4, and from the possible entry point, known as "Parque Joyyo Mayu," on the western side of the city of Tuxtla Gutiérrez, Chiapas, which has direct storm drainage connections to the Grijalva River that runs through the PNCS.

Note. Picture by Javier Díaz- Náfate, CONANP, Parque Nacional Cañon del Sumidero.

Figure 4. Management for the control of the devilfish (P. disjunctivus)

Red-eared slider turtle (T. scripta elegans). The project "Presence of the Loggerhead Sea Turtle (*T. scripta elegans*) in the Central Depression of Chiapas," was developed by ECOSUR. The work is regional in nature, and it is assumed that the species is widely distributed in the Rio Grijalva and may be distributed in the PNCS (Reyes-Grajales, 2021). The presence of this species is considered one of the greatest threats to the diversity of aquatic flora and fauna in this region (ISSG, 2020).

This study indicates that the site with the highest number of sightings is Parque Joyyo Mayu, as shown in Figure 5, and, as is believed to be the case with the devilfish, this may be the route of entry for this species into the PNCS. Furthermore, it should be noted that the three localities registered for the municipality of Tuxtla Gutiérrez are interconnected by the Rio Sabinal, which flows into the Rio Grijalva, which in turn flows into the protected natural area. During the rainy season, these bodies of water tend to overflow considerably, causing the spread of red-eared sliders.

Note. Picture by Eduardo Reyes-Grajales, ECOSUR, Unidad San Cristóbal.

Figure 5. Sighting of a red-eared slider turtle (T. scripta elegans)

Preventive measures

The most frequent preventive actions have been carried out by institutions and associations allied with CAEEI, such as Kelam A.C., the Municipal Health Secretariat of Tuxtla Gutiérrez, through the Directorate of Protection against Health Risks, the Health Secretariat of the Government of the State of Chiapas, through the Directorate of Zoonoses, and the Universidad Autónoma de Chiapas, in coordination with the Faculty of Veterinary Medicine and Animal Husbandry. Activities have focused on preventing problems that directly affect the population surrounding the PNCS, such as

the introduction of domestic species that become feral within the protected natural area. These species consist of dogs and cats, which have been detected within the protected natural area, causing attacks on wildlife (e.g., white-tailed deer). The lack of attention to dogs and cats can become a health problem within the National Park, as they are potential carriers of diseases such as rabies and toxoplasmosis (Mayo, 2014). Controlling their birth rate is an important part of ecology and public health, as it can affect all known mammals, including humans (Castillo-Neyra, 2016; Murcia et al., 2023).

Between 2018 and 2023, rabies vaccinations were administered as a preventive measure, benefiting a population of 1,028 people in eight neighborhoods on the southern outskirts of the PNCS (Las Granjas, Delegación Granjas, Nueva Jerusalén, and Agua Azul). Likewise, between 2018 and 2023, 525 sterilizations were performed, benefiting 418 inhabitants of seven neighborhoods in the area of influence of the protected natural area. The participation of civil associations, together with government and academic institutions, has made it possible to expand the geographical coverage of vaccination and sterilization campaigns to other neighborhoods in the municipality of Tuxtla Gutiérrez (Los Ángeles) and in the municipality of Chiapa de Corzo, in the Julio Cesar Ruíz Ferro neighborhood, as can be seen in Figure 6.

Note. Photo by Irma de Jesús Serrano-Sánchez, CONANP, Parque Nacional Cañon del Sumidero.

Figure 6. Vaccination and sterilization campaigns for dogs and cats

Outreach activities

The CAEEI was responsible for disseminating the actions carried out in various conservation and management forums, as shown in Figure 7. The results obtained from projects carried out by CAEEI for jaragua grass (CONANP, 2019), devilfish (Velázquez, 2022), and red-eared slider turtles (Reyes-Grajales, 2021) have also been published in scientific and popular science journals. In addition, information has been posted on a website (Facebook) with the aim of widely disseminating information to the people of Chiapas about the actions taken and the results obtained. The information presented there ranges from the CAEEI's creation, interviews, news, participation in events, regulations, and infographics on the species. In addition to being presented digitally and reaching a general audience, infographics are used in awareness workshops for local residents and service providers who have direct contact with IAS, such as boatmen and guides who serve tourists visiting the PNCS.

Note. Photo by Irma de Jesús Serrano-Sánchez, CONANP, Parque Nacional Cañon del Sumidero.

Figure 7. Dissemination of actions taken to eradicate invasive alien species

Awareness-raising activities

Another strategic line of action is to raise awareness among the population of the neighborhoods in the National Park's area of influence about responsible pet ownership (dogs and cats), as well as the negative effects that IAS have on wildlife, ecosystems, and human health, as shown in Figure 8. Awareness

talks have also been held for tourism service providers and fishermen in the municipalities of Chiapa de Corzo and Osumacinta on the negative effects of the devilfish (*Pterygoplichthys spp.*) on native fauna, ecosystems, and the local economy. These activities are carried out in coordination between the technical staff of the protected natural area and the Institute of Biological Sciences at UNICACH.

In total, between 2018 and 2023, 48 awareness talks were given to children and young people in the PNCS's area of influence, in eight neighborhoods. Likewise, awareness was raised among community brigades and young people doing social service in the protected natural area, fishermen, and tourism service providers. A total of 620 people were treated in this area, of whom 317 were men and 303 were women.

Note. Photo by Irma de Jesús Serrano-Sánchez, CONANP, Parque Nacional Cañon del Sumidero.

Figure 8. Awareness campaigns on the effects of invasive alien species.

FINAL THOUGHTS

Five years after implementing actions to control and eradicate IAS in the PNCS, encouraging results have been achieved toward their future removal from the protected natural area. The success achieved to date with the control of jaragua grass demonstrates the potential for achieving the same with other species. However, because the mechanisms used differ from one another, the results could be different.

The mechanism implemented by the CAEEI for research, prevention, dissemination, and awareness-raising appears to be the most appropriate

way to address the specific problems of each of the species selected and considered to be priorities for attention. Working together under this organizational structure has a significant impact on decisions regarding the management of the Reserve, as the Committee is part of the Park Advisory Council, which is the forum where the various stakeholders involved in the conservation and management of the Reserve agree on the actions to be taken. The CAEEI formalizes institutional commitments among its members, coordinates and cooperates in solidarity to achieve the objectives set out in the eradication of IAS, recognizes the strengths and limitations of social actors, and communicates institutional achievements in order to develop a plan toward achievable goals.

Controlling and eradicating IEDs in the PNCS is a difficult task that requires working and coordinating actions with different environmental and social sectors, including academia, government, private initiative, the productive sector, the commercial sector, and local human communities. Joint actions carried out from a committee perspective, based on scientific and precautionary principles and taking social participation into account, will be essential in order to continue the work carried out so far in the PNCS.

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Antiprotozoal activity of Mexican ethnomedicine plants against *Trichomonas tenax*, a protozoan associated with periodontal disease

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— Abstract—

Objective: To evaluate the antiprotozoal activity of extracts of *Cordia dodecandra*, *Gaultheria odorata*, *Tagetes nelsonii*, and *Talisia oliviformis*, plants used in Mexican ethnomedicine, against *Trichomonas tenax*. Materials and methods: The study plants were collected in the state of Chiapas, Mexico. Hexanolic and methanolic extracts were prepared using the sonication-assisted maceration technique. The extracts were dissolved in DMSO (0.25 % v/v finally). The trichomonodal activity of the extracts was evaluated *in vitro* at concentrations between < 500 µg/mL. Metronidazole was employed as a positive control. The percentage inhibition was estimated from cell counting with a manual hemocytometer using an untreated control culture as a reference. The assays were performed in triplicate in two independent experiments, and the IC_{50} was determined by Probit regression analysis. Results: The results were interesting for the hexane extract of *G. odorata* and *T. nelsonii* with an IC_{50} < 200 µg/mL. Conclusion: This work constitutes the first report of Mexican ethnomedicinal plants in the investigation of natural products against *T. tenax*. In addition, it enriches the ancestral knowledge of herbal resources for the treatment of infections by parasites and diseases of the oral cavity.

Keywords:

Oral health; anti-T; tenax activity; medicinal plants.

Globally, the oral health situation is alarming; diseases such as caries, gingivitis, periodontitis, and lack of teeth are considered important public and private health problems, despite being preventable. These oral pathologies are serious and debilitating, manifested in experiences of pain, inability to eat, limited communication, and low self-esteem due to the loss of function and aesthetics of the stomatognathic system, hurting the general health and quality of life of those who suffer from them[1]. As of 2021, the WHO estimated just over 3.5 billion cases of oral health conditions worldwide, making them more widespread than mental disorders, heart disease, diabetes, and cancer[2].

Among oral pathologies, periodontal disease is the second cause of oral discomfort after dental caries, with a prevalence of 19% worldwide and with a higher occurrence in the population of productive age. In Mexico, the prevalent rate is 50% of the population between 35 and 79 years of age. In 2019, this represented an economic burden between 11 and 50 US dollars per capita. Cases prevail in regions with limited access to public health services, education, social programs, and with average economic income[2,3].

Periodontal disease is a chronic inflammatory condition that is characterized by a progressive destruction of the tissues surrounding and supporting the teeth, including the gums, alveolar bone, and periodontal ligaments, leading to tooth loss if not properly treated. These include gingivitis and periodontitis. As a primary etiological factor, the formation of microbial dental plaque is reported, which, with the participation of additional factors of local, immunological, and systemic origin, causes contamination, inflammation, and destruction of the periodontium[1,4,5].

Often, the causative agent has been categorized as bacterial in origin. However, the high incidence of protozoa such as *Entamoeba gingivalis* and *Trichomonas tenax* in the conditions has led some researchers to consider them etiological agents of the disease, pointing out that the increase in the incidence of these protozoa constitutes an indicator of progression of periodontal disease[6-8].

T. tenax is a flagellated commensal protozoan that lives in the cavity of decayed teeth, between tartar and in the gingival margins of the gums of people with poor oral hygiene. It is transmitted through direct contact, saliva droplets, and contaminated fomites. When it spreads beyond the oral cavity, it can cause sinusitis, tonsillitis, and pulmonary trichomoniasis[9,10]. Its pathogenicity has been linked to the presence of tissue adhesion proteins and proteolytic activity similar to those of *T. vaginalis*[11,12].

Although Trichomonas infections are generally treated with metronidazole, reports of metallic taste, acquired resistance, and mutagenicity have been reported, ultimately exposing the need for new therapies to treat trichomoniasis[13].

In this regard, various natural products derived from ethnomedicinal plants have played an important role in controlling diseases caused by protozoa that affect human health[14,15]. However, the study of locally available medicinal plants to treat infections caused by *T. tenax* is limited. In relation to this, the plant species *Cordia dodecandra*, *Gaultheria odorata*, *Tagetes nelsonii*, and *Talisia oliviformis* are used by the indigenous Mexican population to treat gastrointestinal problems caused by bacteria and/or parasites[16,17], as shown in Figure 1. Previously, our working group demonstrated that organic extracts exhibit antimicrobial activity[18]. Therefore, in order to establish its integral use in therapies to maintain oral health, this work aims to determine *in vitro* the anti-*Trichomonas tenax activity* of *C. dodecandra, G. odorata, T. nelsonii*, and *T. oliviformis*.

Note. A) Cordia dodecandra (Cupapé); B) Gaultheria odorata (Arrayan); C) Tagetes nelsonii (Chilchahua), and D) Talisia oliviformis (Guaya).

Figure 1. Southeastern Mexican ethnomedicinal plants

MATERIAL AND METHODS

Chemical

Dimethyl sulfoxide (DMSO 99.5% for cell culture) and metronidazole (analytical standard grade) were purchased from Sigma-Aldrich Corp. (St. Louis, MO, USA). The chemicals employed in the preparation of the TYI-S-33 medium (Ascorbic Acid, Ammonia Ferric Citrate, Cysteine, Sodium Chloride, Yeast Extract, and Glucose from Sigma Aldrich; Potassium Monoacid Phosphate, and Potassium Diacid Phosphate from JT Baker and Casein Peptone from DIBICO) and those employed in the extraction process (n-hexane and Methyl Alcohol from JT Baker) were of analytical grade obtained from the Fisher Scientific Chemical brand.

Obtaining plants and preparing crude extracts

The plants were collected during the winter of 2021, in Tuxtla Gutiérrez (*C. dodecandra* at 16° 43′ 46.2′′ N, 93° 06′ 0.87′′ E and *T. oliviformis* at 16° 43′ 45.7′′ N, 93° 06′ 0.70′′ E) and Zinancatán (*G. odorata* and *T. nelsonii* at 16° 45′ 34.0′′ N, 92° 43′ 18.0′′ E), Chiapas, Mexico. The specimens were identified at the species level by professional staff of the FCB-UANL herbarium, being registered as: *C. dodecandra* (025879), *T. oliviformis* (025881), *T. nelsonii* (025883), and *G. odorata* (025884). The plant material was cleaned, cut, dried at room temperature without direct lighting, and crushed, using a hand mill. Hexane and methane extracts were obtained by maceration, mixing 50g of plant material and solvent in a 1:10 ratio for 18 days at room temperature and without stirring, performing extraction processes every six days with hexane and applying sonication for 15 minutes, followed by extraction with methanol under the same conditions. On each occasion, the extracts were filtered and concentrated under reduced pressure using a Yamato Model RE2000. rotary evaporator. Finally, they were dried in an oven at 40°C until they reached a constant weight to calculate the percentage yield. The extracts obtained were stored at 4°C until they were used.

T. tenax Culture

Trophozoites of T. tenax strain ATCC-30207 were grown in TYI-S-33 medium supplemented with bovine serum to a concentration of 10% v/v. The culture was maintained under axenic conditions. For the bioassays of antiprotozoal activity, trophozoites were used in their exponential phase.

Antiprotozoal activity

A series of *in vitro* bioassays was performed to determine the antiprotozoal activity of the crude extracts [19]. Briefly, an inoculum of $1x10^5$ trophozoites of *T. tenax*/mL was incubated at 37 °C for 24 h in TYI-S-33 medium supplemented with bovine serum and in the presence of different concentrations (18.75 to 500 µg/mL) of the crude extracts and metronidazole (0.015 to 0.25 µg/mL) as a positive control. Briefly, 30 mg of each extract and 10 mg of metronidazole were first independently dissolved in 250 µL of DMSO and diluted with sterile deionized water, and inoculated into the medium to the desired concentration. The final concentration of DMSO did not exceed 0.25% v/v in the tested dilutions. Each assay had a blank (inoculated medium).

Two independent trials were performed in triplicate. In each assay, the extracts, metronidazole, DMSO (at the established concentrations), and a blank (inoculated medium) were evaluated. After incubation, a 1:10 dilution of each sample was prepared with formalin. The number of parasites was counted with a hemocytometer, and the % inhibition with respect to the blank tube was determined.

Statistical analysis

The concentration that inhibits trophozoite growth by 50% (CI_{50}) was determined by Probit linear regression, as seen in Figure 2. In addition, the data were subjected to a bifactorial analysis of variance, and the Tukey test was applied to determine the statistical difference between treatments, using SPSS Statistics Version 18.0 (IBM SPSS Statistics for Windows, Armonk, NY).

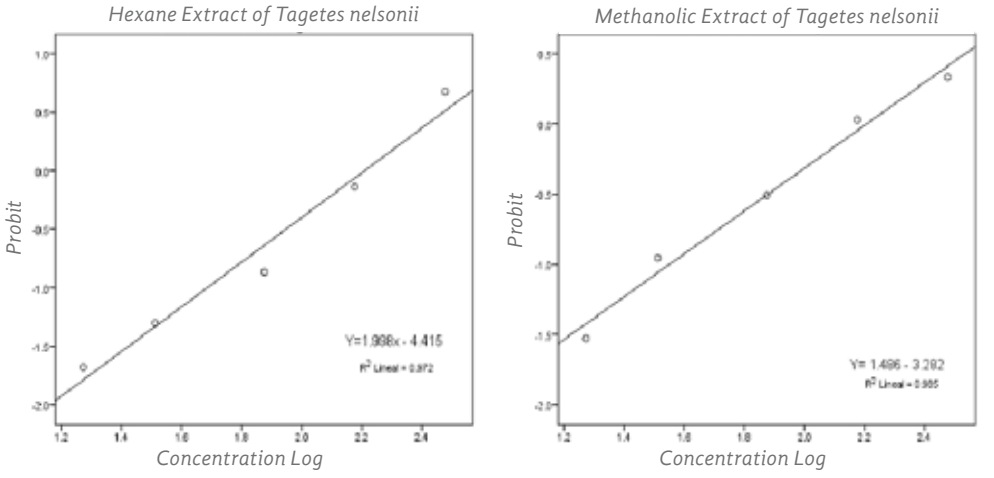

Figure 2. Probit graphs of the anti-protozoan activity of Tagetes nelsonii extracts versus T. tenax

RESULTS

A total of eight crude extracts, four methanolic, four hexanic, and metronidazole, were evaluated against *T. tenax*. The extraction yield and *in vitro* antiprotozoal activity (CI_{50}) of the extracts obtained from the four medicinal plants evaluated are shown in Table 1. The results show a higher extraction yield when using methanol as solvent, with yields between 5,0% for *C. dodecandra* and 14% for *G. odorata*. Statistical analysis revealed significant effects of both plant type ($F= 151.54$, $p < 0.05$), extract type ($F= 61.08$, $p < 0.05$), and their interaction ($F= 27.57$, $p < 0.05$) on antiprotozoal activity. Multiple comparisons using Tukey's test showed a significant difference ($p < 0.05$) between the plants tested. In particular, *T. nelsonii* exhibited the highest anti-*T. tenax* activity was significantly higher than the rest of the species, while *T. oliviformis* showed the lowest activity. The results suggest that both the plant species and the type of extract have a significant influence on antiprotozoal activity, and that there is a specific interaction between these two factors.

Table 1
Antiprotozoal Activity of selected medicinal plants on T. tenax

Plant Name (Family)	Part of the Plant Used*	Antiprotozoal Activity (CI50= µg/mL)			
		%**	Hexane	%	Methanolic
Cordia dodecandra (Boraginaceae)	C y T	0.4	315.83 ± 16.55^{c}	5.0	323.42 ± 22.11^{c}
Gaultheria odorata (Ericaceae)	H	1.6	185.00 ± 19.57^{b}	14.0	243.44 ± 19.54^{b}
Tagetes nelsonii (Asteraceae)	C y T	0.7	162.90 ± 5.26^{a}	6.9	161.70 ± 13.87^{a}
Talisia oliviformis (Sapindaceae)	H	2.4	278.46 ± 20.75^{d}	8.0	449.71 ± 23.64^{d}
Metronidazol					0.013 ± 0.003

*C= bark, H= leaves, T= stem; **dry matter yield %; Results: Mean + DS, means followed by different letters are statistically different, $p<0.05$.

DISCUSSION

This study demonstrated the antiprotozoal activity of extracts from selected plants used in Mexican ethnomedicine against *T. tenax*. It is important to mention that research into medicinal plants for treating *T. tenax* infections is almost nonexistent. However, anti-*Trichomonas* activity of *Origanum mejorana* has been reported on *Pentatrichomonas hominis*, a human commensal protozoan causing intestinal *trichomoniasis*[20], as well as *Carica papaya*, *Cocus nucifera*, and *Persea americana* against *Trichomonas vaginalis*, a causative agent of human vaginal trichomoniasis[21,22].

Regarding *T. tenax*, anti-*Trichomonas* activity of *Punica granatum* ethanolic extract has been reported with an effective concentration of 12.5 µg/mL[23]. Likewise, the antiperiodontitis activity of *Punica granatum* has been confirmed [24]. The *in vivo* study of *Eugenia cariophylla* infusion on *T. tenax* has been reported to be effective at a concentration of 300 mg/mL[25].

On the other hand, the anti-gingivitis activity of *Aloe vera*, *Camellia sinensis*, *Punica granatum*, and *Salvadora persica* incorporated into dentifrices has been reported with a notable reduction in periodontal disease[26].

The above points out the relevance of the results obtained in this research, since the four plants evaluated showed anti-*T.tenax* effect, being interesting the activity shown by *T. nelsonii* and *G. odorata*, whose biological property could be extended towards the systematic search for trichomonicidal metabolites through a biodirected fractionation that increases antiprotozoal activity and its subsequent use in the development of dentifrices, oral antiseptics, and mouthwashes for oral health care.

In relation to this, the potential of the *Tagetes* plant is highlighted. Research indicates that this genus harbors species that exhibit insecticidal, antimicrobial, acaricidal, antifungal, and anthelmintic activity, attributed to the presence of terpenes such as: allylenasol, β-caryophyllene, *trans*-anethole, and tagetone[27-29]. In addition, it has been determined in *T. nelsonii* essential oil to *cis*-tagetenone, β-tagetone, and dihydrotagetone as major compounds and, to a lesser extent, the occurrence of α-terpineol, *trans*-β-ocimene, limonene, α-pinene, myrcene, mesitylene, α-terpinene, eucalyptol, linalool, and β-copaene[30]. Eugenol, carvacrol, menthol, and thymol have been found in the essential oils and organic extracts of *Tagetes*; their antiprotozoal activity could be related to changes in the permeability of the cell membrane [31]. On the other hand, the presence of gallic acid, quinic acid, syringic acid, ellagic acid, quercetin, kaempferol, patuletin, isorhamnetin, axillarin, and their glycoside derivatives has been documented in methanolic extracts of *T. erecta* compounds with potent chelating activity of Fe^{+2} ions, an essential cofactor of Fe-S proteins, which participate in the energy metabolism of trichomonads.[32, 33] Sesquiterpenes, sterols, triterpenes, and tetraterpenes

have been isolated from the leaves of members of the Asteraceae family and have been reported to prevent the growth progression of *Leishmania amazonensis*, *Plasmodium falciparum*, and *Trypanosoma brucei* possibly by alteration of mitochondrial activity[34], perhaps a similar effect occurs in the hydrogenosomes of *T. tenax* of finding this type of metabolites in the hexane extract.

Regarding *C. dodecandra*, the occurrence of phenylpropanoids such as rosmarinic acid, syringin, and salvianolic acid B; flavonoids derived from quercetin and alkaloids such as allantoin in extracts[35] has been evidenced. It is possible that anti-*T. tenax* activity exhibited by *T. nelsonii* and *C. dodecandra* extracts in this work is due to a particular metabolite or the synergistic activity thereof. Regarding *G. odorata* and *T. oliviformis*, the chemical composition of their extracts is still unknown.

CONCLUSION

Considering the multi-microbial origin and health and economic impact of periodontal diseases on human health, new strategies and adjuvants are needed to maintain oral health. In this regard, this study adds to the scientific knowledge of natural products with anti-*T. tenax* activity, showing *T. nelsonii* to have the best trichomonacidal effect, and as a candidate for the search for possible compounds with antiprotozoal activity. In addition, the results obtained enrich the ancestral knowledge of herbal resources in Mexican ethnomedicine for the treatment of parasitic infections and diseases of the oral cavity.

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Humanities Research Methodology. Literary Art in Pandemic Times

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— Abstract—

In this article I will address in the first instance the relationship between methodology and research in the humanities, and then focus on literature as an object of study. Second, I will touch on some fundamental challenges that we face in the analysis and interpretation of the new Mexican literature. Specifically, I will focus on texts by three authors who have written during or about COVID 19 (Daniela Tarazona, Karla Montalvo and Guadalupe Nettel), to reflect on the representation of the pandemic. To do this, I will be guided by the hermeneutical vision of Roman Ingarden, Hans George Gadamer and Paul Ricoeur.

Keywords:

Methodology; research; humanities; mexican literature; pandemic.

The mimesis' issue or representation of reality in literature is perhaps, what most makes us think about the difficulty of establishing a dialogue between humanities and the physical or natural sciences. The objects of study are different, but so are the methods used to approach them, which continue to be viewed with an abysmal distance. Following the positivist legacy that survives in many academic circles, the objectivity/subjectivity dichotomy is still viewed with suspicion, in keeping with the old distinction between the natural sciences and the humanities. However, the path to truth in both depends, as Hans George Gadamer would say, on the nature of our object of study. In fact, the German philosopher asserts that what we have "is not a difference in methods but a difference in the objectives of knowledge" (Gadamer, 1988, p. 11). In this regard, the method will be marked by the hermeneutic approach as a practice that begins with the recognition of the assumptions or prior information we have, as beings embedded in a tradition, and our dialogue with the object of knowledge.

But what is the relationship between methodology and research in humanities? How is research conducted in literary studies? How do we understand the relationship between real-world problems and what we "solve" through literary criticism? This study reflects on these questions, before tackling the fundamental challenges of analyzing and interpreting new Mexican literature, based on three contemporary authors who have written about the COVID-19 pandemic (Daniela Tarazona, Karla Montalvo, and Guadalupe Nettel). To reflect on the representation of the pandemic in the works of these authors, we are guided by the hermeneutic vision of Roman Ingarden, Hans George Gadamer, and Paul Ricoeur.

METHODOLOGY AND RESEARCH IN HUMANITIES

The twenty-first century has brought to the forefront of universities the need to educate individuals from a comprehensive and humanistic perspective, teaching them to be supportive and responsible towards others and their environment. Research generated within the educational sphere, in dialectical relation to teaching, has also changed. It seeks new paths through inter, multi-, and transdisciplinarity to examine problems that impact human integrity. So the question posed by hermeneuts such as Gadamer arises once again: what is the method for arriving at this multifaceted truth that concerns us? What is the path for producing and accessing knowledge? The relationship between methodology and research thus becomes clear. Our object of study and the objectives we pursue mark the critical path for advancing in our search, increasingly with the support of other strategies, of perspectives that, from other areas, illuminate our steps as researchers. But it is not only the humanities that justify their research practices with

support from other areas; the natural sciences—medicine, for example—also draw on other approaches, humanistic and social, and even ancestral community practices that serve as support for their research work.

Thus, we find that today's research is conducted in a more horizontal manner. Terms such as “participatory research” and “informant-researcher” emerged in what has been called interculturality or intercultural research. This broadens the fields of action in the knowledge ecosystem and blurs the positivist pedestal on which the researcher was seen as the sole owner and master of knowledge.

Science has changed in this ecosystem, in this “knowledge society”; today it must adhere to international parameters and agreements in favor of a better understanding of society. But other sectors of the population must also change along with the sciences and humanities. As Beatriz Pescador asserts:

> Knowledge can no longer be limited solely to academic circles. It must be part of the agendas of national, regional, local, and urban governments, non-governmental organizations, health officials, entrepreneurs, producer associations, environmentalists, and consultants (Pescador, 2014, p. 6).

Only in this way can the knowledge society contribute to regional development. But how can humanities guide and orient this development? How can humanistic research influence public policy? What problems does literature solve, and, even more so, literary criticism?

On the other hand, we must consider that conducting research nowadays, in any field of knowledge, implies facing new technological challenges. Whether as project managers or as trainers of new researchers, we see at least three aspects worth considering: 1) The need for new skills to search repositories, data bases and files of various kinds; 2) The relevance and management of digital tools in the analysis of information; and 3) Time management that is increasingly fragmented in the research exercise.

Both initial aspects require a reformulation of what it means to be a researcher in the humanities field and demand urgent digital training for those of us who have experience in other forms of research practiced before the pandemic. In this sense, both teaching and humanistic research have been pushed to seek solutions in recent years to read, analyze, and judge their objects of study with new tools and from other perspectives.

Regarding the timing of the research, we face a hurdle characteristic of the twenty-first century. We live in a scattered, fragmented, ephemeral time, typical of the contemporary culture, as Machado points out.

> To this we must add, as George Steiner reminds us, the hypertrophy of technological and mathematical language —often used only in its superficial

> aspects— to create the illusion that all knowledge is univocal, that it always has unique and exact meanings, without admitting discrepancies, contradictory or opposing arguments, or logical expositions (Machado, 2006, p. 125).

This leads us to turn our attention to the role of the humanities. We conduct research to explain ourselves, to understand ourselves and our environment. Seeking meaning in our daily lives is a task for the humanities, for art as the primal expression of myths. That is why it is necessary to conduct and disseminate research from social sciences and humanities. This helps «to foster critical thinking among the population» (Figueroa as cited in Gutiérrez, 2021). In times of pandemic, we also «need a humanistic vaccine, doses of philosophy, sociology, anthropology and economics to spark interest and raise awareness among the population» (Sierra, as cited in Gutiérrez, 2021) about complex problems such as «increased levels of suicide levels, frustration and domestic abuse, migration, the impoverishment...» (Gutiérrez, 2021).

Literary research

When we talk about research in literature, we must make it clear that our object of study is part of a very broad spectrum that we can call the literary phenomenon. But without a doubt, it is the literary work of art that generates the theoretical and critical ecosystem that makes us wonder about the author and their environment, the textual structure, the themes represented, or what happens to the reader when faced with a novel, a poem, etc. Like all research, humanistic research —and literary research in the case we are addressing— seeks to answer questions and build knowledge about an object of study.

Twenty-first-century Mexican literature is no stranger to the various social problems and as an object of knowledge it reveals answers to the inquiry into the problems represented there and their relationship with reality. In fact, art in general analyzes and criticizes, highlighting various cultural practices that denigrate human beings. But, although it seems obvious, we must ask ourselves whether art today fulfills a social function and what its role is. This is because we must not forget that the reality represented in literary works is purely intentional, that it has its physical basis in language, as Roman Ingarden points out. As close as it may seem, as "real" as it may seem, we only have a *habitus* of what we experience outside the work of art. In other words, it's essential to remember that reality, no matter how vivid it may be, is a literary truth, not a historical or social one. However, as Paul Ricoeur affirms, as a metaphorical truth, the reality of the work points to our reality; this second-degree reference provokes us, makes us identify with it and experience it as if it were real. In *Aesthetic Experience*

and Literary Hermeneutics, Hans Robert Jauss discusses the roles of identification that arise at the moment of reading, during the aesthetic experience. This experience of «as if» is what makes it possible to understand our reality and ourselves through art, as Gadamer points out in *Truth and Method*.

The representation of reality and the pandemic in three contemporary Mexican female authors

To reflect on the mechanisms of representing reality in Mexican literature, we approach, by way of example, three contemporary Mexican authors who have written about the pandemic and during the pandemic. Although texts by other authors are mentioned, our focus is on a brief but significant sample by Daniela Tarazona, Karla Montalvo, and Guadalupe Nettel.

Daniela Tarazona

Letters from Lockdown (March 2020) marks the epistolary genre as the space from which Daniela Tarazona will open a dialogue not only with her interlocutor Karla Zárate, but also with others, with readers, and with her otherness that emerged during the COVID-19 pandemic.

The second installment of the exchange between the Mexican authors is imbued with vampire allusions and the extraterrestrial world, in a clear inclination toward the strange that touches on the narrative and the real.

The correspondence enlivens a genre that is already dead and buried on paper, at least in our culture, and not precisely because of the technological boom, but because of Mexico's terrible postal service. However, these letters are not sent by mail; they are published in a magazine, Nexos, even with a certain fear of exposing themselves to other readers, as Karla Zárate says.

The epistles of both writers that chose one another for this experiment "soften" the isolation of confinement due to the COVID-19 pandemic. In her letter dated March 30, 2020, Daniela Writes: «Have you gotten your results yet? Please let me know. They say that a high percentage will be infected with the virus, although that doesn't mean they will get sick. Will we be infected or will we get sick?» (Tarazona, 2020). The tests, vaccines, the causes of the disease are discussed amid the uncertainty caused by misinformation. The first thing that emerges from the representation of the pandemic is the cause of its origin, which takes on a fantastical tone. Overpopulation of the planet seems to trigger everything else. «There are too many of us on the planet, Karla. Anything could trigger a pandemic. Bat poop or rotten grapes from a vineyard» (Tarazona, 2020). Bat excrement shows, on the one hand, the scatological nature of the world represented and, on the other, the intrigue of the strange and terrifying, such as the realm of the vampire.

> Bat excrement is part of the breath of anyone sick who contracts the virus. It's an exaggeration, I know, but bats feed on blood, and our reality has been vampirized. So let's stay at home, unless we want to start sleeping upside down tomorrow [...] A hug from Dracula. Daniela (Tarazona, 2020).

Karla has the test, but it is not enough to overcome the anemic mood of the pandemic. Contagion, the fear of being different, entering that strange world, becomes vital. It is the edge of madness that gives way to stigmatization. Here we see how the problem represented concerns multiple disciplines, as it touches on aspects of physical and mental health, emotions, feelings, and reasoning that disrupt the way we perceive the world.

> Dear Daniela with a D for Dracula, thank you for asking: the email with the test results has arrived. I open it, I don't open it [...] I can tell you: I'm not infected with the dreaded virus. This does not reassure me, and I am still worried. To feed my paranoia and delusions, there's a final note: a negative result does not rule out the possibility of infection (Zárate, 2020).

In this space, we see how Daniela recognizes herself and is recognized by the "D" for Dracula, because although irony is the motive behind the representation, the identity label works in this transformation of individuals. The reference and meta-reference thus become a recurring literary strategy, more so than at other times in Mexican literature. Everything takes on new meaning, becoming associated with other texts, authors, moments, illnesses, circumstances. In her letter, Karla reveals the multiple connections between the COVID-19 pandemic and other pandemics and moments in history: «I don't know if we have returned to the plague of Athens, to the scurvy of the Middle Ages, or if we have reached a future with brain chips and chemical weapons controlled by *cyborgs*» (Zárate, 2020).

Daniela defined this time of the pandemic as transformative, not only in terms of life, but also death. Yes, death changes; this *modus operandi* of death leaves the living shaken, making them feel its sharp edge due to the overwhelming nature of its actions.

> Now that times have changed, we might think that death takes on new meanings. Isn't it amazing that death, illness, and love are always something new? That's why, I think, quarantine is more shocking than the fall of a medium-sized meteorite. (Tarazona, 2020)

What we see in this impact of illness and death is being stripped of all the aspects that previously defined them as human. Karla highlighted What we see in this impact of illness and death is a being stripped of all the

needs and desires in the face of the restrictions imposed on life: « We need flavors, smells, textures, lips without masks, flesh, skin, caresses, and glances without screens in between. Today I am content with cyber affection and three-dimensional French kisses» (April 5, 2020). But the fear and uncertainty, the nostalgia caused by the involuntary separation we see in *Letters from Lockdown*, gave way to doubt and courage; political criticism of the pandemic emerged.

Outside the fictional space of the letters, Daniela Tarazona shows what remains as the effects of this pandemic; that is, the disarticulation of the subject:

> In the realm of the new normal, personal data matters little. In other words, since we have become products to be bought and sold in digital life, surveillance has focused on our bodies. Our sweaty, salivating organisms, our mucus, are now the only source of truth. The cells that do matter, the abrasions that always tell the truth. The gene, the spit, the unique information of living bodies (Tarazona, 2021).

The third table shows the different foreign investments through international companies in the three cities. Singapore is the leader in this indicator, and Querétaro, although every year more international companies of different branches open in the city, still does not reach high levels of foreign capital.

Karla Montalvo

Karla Montalvo, who chose to share her texts on a blog and directly referred to her writing as *Words of the Pandemic* on the digital platform, built a link between the pandemic and art, based on everyday life: cooking, wearing pajamas. In her text “Slippers,” we see the notion of illness not only physically, but also as another dimension that consumes us spiritually. Montalvo described the atmosphere, the feelings that arise inside and outside the body.

> Today I stayed in bed most of the time. An ordinary time. Fleeting. Insignificant. A time of oblivion, in a way. A time of crumpled tissues, glasses of water, *tylenol*. But with my slippers on, so I can rest and allow my body to suffer the virus, its final ravages before it leaves. That's on the outside. On the inside, what my body is suffering is part of the process of returning to the ordinary (Montalvo, 2020).

The empty time of so long not being, settles in the subject; that time that weighs like filth also takes hold of objects, the environment, houses. In the kitchen, the stove moves the narrator. «I confess that during this pandemic I have let my stove become filthy beyond belief. More than once. Never in my

life had I reached such dishonorable, such unworthy extremes» (Montalvo, July 17, 2020). In "Times of Pandemic: The Screen," Montalvo alluded to the representation of the body and the role that technology has taken on in our daily lives. The literary essay allowed reflection on what the pandemic implies as a disease spread by the body, as in "Slippers". Similarly, the inhabited space was observed in "Stove," and we can think about its scope in work and technology in "Screen."

> The screen in quarantine may be the limit of self-representation. Its extreme experience. It forces us to realize that we are not the image it reproduces we are not totalized or exhausted in that frame, in that face. The experience of the screen-death, of the screen-madness, is also a return to the unfinished self, prone to change, to flow. A living self. A living me. Vertiginously alive (July 2, 2020).

The unfinished, the void, the madness, are added to the neo-existentialist vision of everyday death. But death is no longer intimate, it is public, it is displayed. Death is long, agonizing. In this time of pleonasm, Montalvo found himself surprised by the only way out, writing that promises to be long: «This essay will be long. A warning so that you don't end up like me with the lockdown: I imagined it would last three or four months, and we've already been at it for nine, and there are days when I thought I had reached my limit» (Montalvo, January 7, 2021).

In *Times of Pandemic*, Montalvo presented a meta-writing; there, the act of writing is an essential activity. During confinement, the body is not inhabited because life remains outside, suspended. There is an I, a Me, who desires it, who thinks of life as something external that will resume at a given moment. But life is interrupted by confinement, and confinement, which is no longer known to be voluntary or involuntary, has lost its limits.

> During the first months I put my life on hold. As lockdown unfolded and imposed its routine, its different way of working and living in spaces, my life was outside, waiting for me to pick it up right where I had left off. The lockdown was a pause; it wasn't going to last long, and every night I could watch — even with genuine interest — the conference on the pandemic (Montalvo, January 7, 2021).

Confinement is the motive behind the unfinished. Additionally, it became symbolic of a gestation of emptiness when the writer refers to the waiting period, which up to that point had been nine months. Those nine months that "normally" concern the new life that will arrive with hope, here become madness as hope is lost, boundaries are blurred. The author states: « Nine months later, it would be crazy of me to believe that I will pick up

my life where I left off » (Montalvo, January 7, 2021). Because lockdown is no longer seen as a pause, unlike previous minor confinements, which were viewed almost as a break. In this part, as Rivera Garza stated, there is a forced landing. In the waiting we transform ourselves, we begin to spin around, seeing that there is no way out. The life that we believed was outside, after all those months, is now sought within, recognized as part of the illness. « It is here, tired of being forced to change course so radically. The pandemic is part of it, with its danger, with the suffering it has brought to so many people, and with the lockdown dragging on and on » (Montalvo, January 7, 2021).

For Montalvo, confinement controls new, intimate, threatening confinements. On the one hand, it is the mechanism that pushes us toward a new life dominated by fear of the other, as Jorge Volpi also notes; and on the other, the uncertainty of the ghostly brings a mysterious, fantastical dimension to this new life.

> At this point, confinement is not a matter of walls; it is a matter of limits. Even those who go out and party and hug each other, are they really not confined? Even if they don't believe in the coronavirus, the coronavirus is real. And it even mutates. A friend who has to go out to work receives news of people dying from COVID and lives with a doctor, suddenly overcome with emotion, she told me, I feel surrounded by death. Another lockdown. Of a different kind. And one without being able to hug (Montalvo, January 7, 2021).

The micro-lockdowns mentioned by Montalvo give rise to small bubbles that seem to get lost in the new everyday life, anchored in nostalgia, in memories, in brief desires dampened by the urgency of being, of saving oneself, of confining oneself from head to toe. For Montalvo (2020), the time of the pandemic inaugurates lockdowns within the lockdown. But the pandemic also led us to new rhythms, after the forced landing and the false delight of recess that turned into suspense. Now there is a staggering, grinding acceleration.

> I believe that the pandemic has not brought us a time of contemplation, as Rita Segato calls it. On the contrary, productivity has subjected us with greater intensity. It would be very easy, as the protagonist of Kindred noted, to end up sleeping in our uniforms, just like Gregorio Samsa's father does. We must imagine ways out. Draw lines of flight, as Deleuze and Guattari would say. Smell the ingredients we use to prepare our food. (Montalvo, January 7, 2021)

Guadalupe Nettel

In addition to writing about the pandemic herself, Guadalupe Nettel compiled a book in which various writers leave their mark in the form of a diary. There, we find texts by Cristina Rivera Garza, for whom the pandemic has meant an emergency brake for humanity. With this metaphor, which indicates the extent of the impact of the COVID-19 pandemic, Rivera showed that we must be conscious of our relationship with the environment. In this case, the voice of the *Diary* lent greater veracity to the author's demand.

> The pandemic is not a heaven. Much less a time of peace. We have certainly come to a screeching halt, and although it is clear that the hand that pulled the brake is a human hand —climate change and the alteration of terrestrial ecologies are the very form of the savage capitalocene— it is less clear whether that brake will be enough to transform an economic system that, in its quest to produce the greatest possible profit, has systematically devastated the Earth. (Rivera, as cited in Nettel, 2020, p. 73)

The author agreed with Jorge Volpi, for whom metaphors of illness have been triggered by incarceration and the regimented, extremely controlled life of these times. Fear, panic, and mistrust have taken hold of humanity. Thus, we live with "the specter of the viral apocalypse" (Volpi, as cited in Nettel, 2020, p. 12). We are a society in a coma, as activities that define even culture have become non-essential.

In this regard, apparently literature is not relevant, because it does not offer a solution to any problem, such as the COVID-19 pandemic. So why write? We could say that it is to survive, to comfort. «That is the comforting function of narrative, the reason why people tell stories and have told stories since the beginning of times» (García, as cited in Gutiérrez, 2021). And, precisely through literary criticism, we can realize and understand that today, as in other eras, art serves as a hinge between reality and identity-based hope, if we want to call it that. Narrating these extraordinary moments frees not only the writer, but also the reader. In what sense does art liberate? From what? Because it is a process that has to do with the liberation of feelings and emotions, which make a person hopeful. Art is not a medicine that we can take in small doses, as Jaime Sabines illustrates in his poem:

> La luna se puede tomar a cucharadas
> o como una cápsula cada dos horas.
> Es buena como hipnótico y sedante
> y también alivia
> a los que se han intoxicado de filosofía (Sabines, 2017).

Art brings reconciliation to the human condition from a metaphorical platform. And literary criticism makes this reconciliation evident. In other words, what literary criticism resolves is a problem of knowledge. It makes evident what art makes evident. And Guadalupe Nettel and Jorge Volpi took on the task of making visible the terrible circumstances of humanity in this *Diary of the Pandemic*.

> Given the impossibility of telling — or explaining — the total shock of the pandemic, we could at least break it down little by little. At the end of March 2020, Guadalupe Nettel and I began to search for witnesses who, from different parts of the world and from different perspectives, were willing to share with us one of their days during this extraordinary time (Volpi 2021, p. 24).

Diary of the Pandemic is something very personal, an intimate an intimate yet social record of a period in time, of something that concerns us, from a social perspective. It shows the need to turn our eyes toward the community, toward the diversity of voices that crowd together in times of emergency.

The work as a whole is a historical document about the fear of these years, a record of the unease we are experiencing. We are all entangled in the polyphony of voices. Nettel asserts that just as we continue to talk about World War II, a long time will pass, and the subject, the trauma of the pandemic, will remain in everyday narrative. *Diary of the pandemic* highlighted the need for reflection on society, reflecting global pain, death tolls, the spread of disease, the many ways in which we face death in the absence of a cure, and even the inability to bury the dead. « We don't know how many have died; we are left with the statistics. The tragedy is of unprecedented proportions» (Nettel, 2021). Nettel spoke of a suspended time in which she gradually realizes the transformation of human beings. Through her narrative, as readers we relive aspects of the pandemic, the initial circumstances, the uncertainty, the fear of fear, as she calls it.

The week before I went into quarantine was giddy. I had been living in a hurry, stressed out, for three years, and during those days I did so even more. I had the feeling that a big door was about to close, and before that happened, it was essential to deal with the most urgent matters, as I didn't know how long I would be isolated or what would happen next. During one of those last days of freedom, my aunt came to visit us. I remember that during lunch, she sneezed at the table and blew her nose with a paper napkin, which she then placed in front of her plate. No one was wearing masks yet but seeing her made my hair stand on end. Was it possible that she had been infected and would infect us all? That fear began to spread to my neighbors and colleagues at work. I felt guilty, but at the same time, I couldn't help it. I was not only afraid of contagion, but also afraid of my fear of others (Nettel, 2021, p. 259).

As with the COVID-19 pandemic, new Mexican literature depicts aspects of violence in its various forms, migration, and other intertwined problems in these turbulent times. Through literary criticism, we see how literary art reveals itself as a cog in the wheel of society. It is the hinge that allows access to that world through language, as Hans George Gadamer would say in *Truth and method*.

CONCLUSION

Twenty-first-century Mexican literature faces realities that generate change both in the media in which its ontological nature is inscribed (from innovations in print to digital, Facebook, Twitter, etc.) and in its structure (fragmentary, palimpsestic, hybrid) and themes (violence, war, confinement, disease). This represents feelings such as fear, uncertainty, anger, and despair, while projecting a fragmented identity. In art during the pandemic, reality is seen as something immediate, as if there were no mediation with words, as if language were the same violent reality it represents. All of this calls for new ways of conducting literary research, new ways of creating aesthetic distance to see ourselves and escape the harshness of the disease, of the diseases that surround us as an agonizing society. As today, reflection is closer to creation, and literary criticism must become creative, taking on roles that were previously marginalized. In this sense, literature in times of pandemic requires, more than ever, the critical eye of the reader as co-creator, because where the work takes shape, as Ingarden saw it, is also where the investigative work begins.

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Types of bilingualism in Cucapá among teaching and administrative staff at an indigenous elementary school in Mexicali, Baja California

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— Abstract—

Bilingualism is generally understood as dichotomous —one is either a balanced bilingual or not bilingual at all—. This article is part of a broader study that analyzes the meanings that teachers and other actors attribute to Intercultural and Bilingual Education. The present study aims to identify the types of bilingualism among two Cucapá speakers and one Paipai speaker, from the specialized literature; therefore, it addresses the meanings ascribed to bilingualism by the three participants: two teachers from the only elementary school in Mexico that serves the Cucapá people and their supervisor. The meanings were identified using a qualitative methodology with semi-structured interviews and observation; Interpretative Phenomenological Analysis was used. Once the meanings were identified, Wei's (2000) typology of bilingualism was used to categorize the three participants. Given that it is the teachers' responsibility to implement educational policies in the classroom, the meanings they attribute to bilingualism can shed light on the current situation of this language, which is at high risk of disappearing. Our findings indicate that the participants' understanding of bilingualism differs from what educational authorities claim. The results demonstrate that the meanings that indigenous teachers attribute to their language skills can directly influence their teaching practice in terms of teaching indigenous language. Therefore, these should be considered by those who design educational policies. Given that this is a qualitative study, it is not intended to generalize the results; however, given the particularity of the school, it becomes crucial to understand how the teachers working in that context give meaning to their experience, as this will guide their teaching practice in the classroom.

Keywords:

Bilingualism; cucapá language; indigenous language; meanings; language endangerment.

In this document are presented the types of bilingualism identified in two teachers and one person in a head teacher position at the only school in Mexico where the Cucapá language is taught. This helps to address the gap between what the educational authorities in Baja California report about indigenous education teachers in the state, especially in Mexicali, in terms of bilingualism.

With the aim of establishing strategies to strengthen indigenous languages in the country, the General Directorate of Indigenous Education (now the General Directorate of Intercultural and Bilingual Indigenous Education) modified the Bilingual-Bicultural Indigenous Education Program, and in 1996 it launched the Intercultural Bilingual Education Program (Zolla & Zolla, 2010). However, in recent decades, the number of speakers of the Cucapá language has declined considerably, with estimates not exceeding thirty (Pascacio & Reyes, 2025). Thus, despite the objectives and guidelines of this educational policy, it has not been possible to promote bilingualism in the classrooms of the primary school in question, with Spanish being the mother tongue of the students and, consequently, the language of instruction.

The relevance of this article lies in its analysis of the types of bilingualism identified in two teachers at the Alfonso Caso Andrade primary school, which is a multigrade school, and in the person responsible for supervising the area to which the school belongs. Given that teachers are the ones in front of the class, identifying the type of bilingualism becomes important, especially since they are the ones responsible, according to the educational authority, for teaching the Cucapá language. On the other hand, the types of bilingualism of the person responsible for supervision provide a broader picture of bilingualism. Identifying these types of meanings can shed light on the current situation of this language, which is at high risk of disappearing (INALI, 2012), as well as serve as a starting point for teachers to recognize their own bilingualism and act accordingly.

Moreover, a contextualization of the Cucapá people and their language is presented, along with some official figures regarding the status of this language. The relevant literature on bilingualism and its types is also addressed.

Finally, in the results and discussion section, an analysis of the types of bilingualism identifies is presented.

LANGUAGE PLANNING

Language planning is defined as deliberate and intentional efforts to influence the behavior of others in terms of the acquisition, structure, or functional assignment of their linguistic codes (Cooper, 1989). Before Cooper (1989), language planning was divided into two types: corpus planning and status planning. Examples of corpus planning include the coining of new terms

and changes in the spelling of words, while elevating a language to official or co-official status is an example of status planning. Cooper (1989) coined a third type of language planning: *language acquisition planning*. The relevance of adding this third type of language planning is evident, since actions aimed at promoting the acquisition and learning of a certain language are also required. In other words, it is a path toward bilingualism.

In the field of applied linguistics, language acquisition planning has been referred to as *educational language planning or educational linguistic planning* (Pereira, 2013). This research addresses the latter, language acquisition.

According to the definition proposed by Cooper (1989), *language acquisition* planning is the set of organized actions and efforts to promote language learning. These actions are not limited to the field of formal or informal education. Cooper even points out that economic policy measures to prevent the emigration of speakers of certain languages are examples of this type of language planning.

Cooper (1989) identifies two broad categories within this type of language planning: objective and method. In terms of objectives, Cooper points to three objectives of this type of planning: (a) acquisition of a language as a second or foreign language; (b) reacquisition of a language by communities in which it was once spoken; and (c) maintenance of a language (acquisition of the language by subsequent generations).

Regarding the method to achieve the objectives mentioned in the previous paragraphs, Cooper (1989) distinguishes three types: (a) those designed to create incentives or improve existing ones for learning a language; and (c) those designed to create both opportunities and incentives or improve existing ones simultaneously.

EDUCATIONAL POLICIES

For Paulston (1997), educational policies related to language are a subgroup within language planning that takes place in an educational system. The educational system can be defined as the "set of actors, structures, and mechanisms for initial and continuing training in National Education and the concerted private sector" (Michel, 1996, p. 15).

According to Sánchez-Santamaría and Espinoza (2015), educational policies can be measured in terms of three aspects:

(a) Political rhetoric, which is linked to the educational goals expressed in speeches given by political leaders. These speeches summarize the educational intentions that inspire a particular policy.
(b) Policy as a legal regulatory framework, that is, those found in decrees and laws that define explicit standards and guidelines for the National Education System, for example, the General Education Law.

(c) Policy as practice, which is "the implementation of policy as rhetoric and as a legal framework, since through the translation of concrete actions and measures, the aim is to respond to the needs generated within the educational system" (Sánchez-Santamaría & Espinoza, 2015, pp. 386–387).

In Mexico, the Secretariat of Public Education (SEP, 2020) is the main educational authority at the national level. In the field of indigenous education, there is the General Directorate of Intercultural and Bilingual Indigenous Education (DGEIIB)[1] at the federal level; and at the state level, with the State Coordination of Indigenous Education (CEEI) in Baja California. These educational authorities are responsible for the design, implementation, and monitoring of educational policies.

In line with the above, Bentancur and Mancebo (2012) add that educational policies are the set of courses of action designed, decided upon, and effectively implemented by the educational authority within its sphere of competence in an educational system. In addition to actions, Bentancur and Mancebo consider that intentional inactions or omissions, mainly by educational authorities, are also educational policies. An example of this is the official policy of Castilianization, but also the *de facto* educational policy that continues to exist in the Mexican context (Canuto, 2013).

INTERCULTURALITY

Interculturality refers to the dynamics of relationships established in a context of cultural diversity (Barabas, 2014) and occurs when two or more groups, whose cultures are different, come into contact, either in a hostile or friendly way (Borboa-Trasviña, 2006). For Iño (2017), interculturality "adopts a position of respect for difference, dialogue with oneself, the interrelation between the local and the interior of a culture, the interrelation between cultures and their exchange, and trans-relationships" (p. 42) between diverse groups that coexist in the same geographical area; a locality such as El Mayor in Mexicali, even a school or a classroom, are examples of these trans-relations, as Iño calls them.

In the words of Tubino (2013), interculturality is concerned with the formation of intercultural citizens" committed to the construction of an authentic multicultural democracy that is inclusive of diversity" (p. 3). We

1 The DGEIIB was created from the merger of the General Directorate of Indigenous Education (DGEI) and the General Coordination of Intercultural and Bilingual Education (CGEIB). Published in the Official Gazette of the Federation on September 15, 2020.

must highlight the word *multicultural* that Turbino refers to. Actually, this word should not be so unfamiliar, given that Mexico is a melting pot of cultures and languages. As for languages, in addition to Spanish, Mexico has 68 linguistic groupings and 364 linguistic variants belonging to this set of groupings: the national indigenous languages (INALI, 2008). In addition, there are other languages that are not native to Mexico, such as Chipileño Veneto (a linguistic variant from in Italy) and Low German (a Germanic linguistic variant spoken by the Mennonites).

THE CUCAPÁ LANGUAGE AND THE CUCAPÁ

According to INEGI statistics (2021), although 7.97% of the population in Baja California identifies as indigenous, only 1.3% are speakers of some indigenous language; the most common being the Mixtec, Zapotec, Nahuatl, Triqui and Tarascan languages.

However, there are many other indigenous languages in the state. The indigenous population is divided into migrant and native groups, with the Yuman peoples, such as the Cucapá, forming part of the native population (Sariego, 2016; Velasco & Rentería, 2019). It should be noted that there are also other indigenous peoples in Baja California: *Kiliwa*, *Ku'ahl*, *Kumiai*, and *Paipai* (INALI, 2008). Nonetheless, this paper only deals with the Cucapá people, as they are the only indigenous people present in Mexicali, Baja California.

The Cucapá language, also known as *kuapá* [kua'pa] and *koipai* (INALI, 2008; Moctezuma et al., 2013), belongs to the Cochimí-Yumana family, which geographically ranges from southern California and western Arizona, in the United States; northern Baja California and northwestern Sonora, in Mexico (Ibáñez, 2015). In Baja California, it is spoken in the municipality of Mexicali and also in San Luis Río Colorado, Sonora (INALI, 2008).

This language does not have a standard writing system. According to Eberhard et al. (2023), the language is not taught or used among Cucapá children and is not used in everyday life (Velasco & Rentería, 2019). INEGI (2021) reported 124 Cucapá speakers in Mexico; 21 of them in El Mayor, Mexicali (Baja California), but some studies suggest that the actual number could be much lower. Although official data puts the number at over a hundred, the actual number could be much lower in Baja California.

Alvarado et al. (2017), for instance, noted that there were only four speakers in the community of El Mayor. With the recent loss of important figures, such as the traditional leader Doña Inocencia González Sáinz and Doña Raquel Portillo, the number would have fallen to two. On the other hand, in meetings that have been held with Cucapá speakers in Baja California and Sonora, they calculated that there are approximately twenty Cucapá speakers in both states; as mentioned before, Pascacio and Reyes

(2025) pointed out that the number could be around thirty. As with other indigenous languages at high risk of extinction, it is older adults who speak the Cucapá language most fluently (Pascacio & Martínez, 2021).

Fieldwork has made it possible to establish contact with fluent Cucapá users such as Ms. Margarita McLeish in Baja California, the Pesado Majaquez brothers, Ms. Aurelia, Ms. Rosa, and Ms. Amelia Chan in Sonora. Most of the people with whom contact has been established do not speak the Cucapá language with the same fluency as they do, but they have knowledge, especially isolated vocabulary, phrases, greetings, among other things. The situation poses challenges for the preservation and strengthening of the Cucapá language in the region.

Now, with regard to the teachers participating in this study, the Baja California Secretariat of Education reported that they have a basic knowledge of the indigenous language, noting that both teachers and students "have a basic knowledge (Level 1) about the language of their community, they know words such as numbers, fruits, colors, forms of greetings and farewells, imperative orders, songs and phrases" (Secretariat of Education, 2020, p. 3). This can be seen in Table 1.

Table 1

Elementary teachers speaking Yumana languages in Baja California

School/Community	Teacher	Indigenous language	Level of proficiency [a]	Other indigenous language	Level of proficiency
Elementary School/ La Huerta	Teacher 1	paipai	I[b]	kumiai	I[b]
	Teacher 2	paipai	I[b]	kumiai	I[b]
Elementary School/ Santa Catarina	Teacher 1	paipai	I[b]		
	Teacher 2	paipai	0[c]		
Elementary School/San Antonio Necua	Teacher 1	kumiai	I[b]		
	Teacher 2	Spanish	0[c]		
Elementary School/San José de la Zorra	Teacher 1	kumiai	I[b]		
	Teacher 2	kumiai	I[b]		
Elementary School/El Mayor Cucapá[d]	Teacher 1	kumiai	I[b]		
	Teacher 2	cucapá	I[b]		

Note. Adapted from the Secretariat of Education (2020).
a There are no descriptions for the proficiency levels.
b I = Incipient.
c It is unclear why the SE reports this value.
d This is the name used by the SE for the community.

Although the educational authority reports an incipient level of proficiency, it cannot be stated (nor ruled out) that this nomenclature derives from Wei's typology (2000) or from a more holistic perspective of bilingualism

(Baker & Wright, 2021; Valdés, 2003). Notwithstanding, knowledge of numbers, fruits, colors, greetings, and farewell phrases is unlikely to promote effective communication.

BILIGUALISM

Bilingualism, generally understood as the ability to speak two languages with equivalent proficiency, is considered more the exception than the rule according to Crystal (2010). Although there are more bilingual than monolingual people in the world (Bhatia & Ritchie, 2013) and one in three inhabitants of the planet uses two or more languages for work, family or other reasons (Wei, 2000), most of them have different degrees of language proficiency (Baker & Wright, 2021).

Cohen (1970) emphasizes that bilinguals tend to be conceptualized in a dichotomous manner, without considering the various conditions and domains in which a person uses each language. Nonetheless, the specialized literature has now adopted the term "bilingualism" to include cases of people who speak more than two languages (Baker & Wright, 2021).

Valdés (2003) described bilingualism as a continuum with varying degrees of *proficiency*. As can be seen in Figure 1, it should be clarified that the concept of proficiency refers to the ability demonstrated in the use of a foreign language and can be applied both to the global use of the language and do that of a single linguistic skill in particular (Martín-Peris et al., 2005). Baker and Wright (2021) offer a representation of that continuum.

Language A													**Language B**
Monolingual in A	A_b	A_b	A_b	Ab	Ab	AB	BA	Ba	Ba	B_a	B_a	B_a	Monolingual in B

Note. Uppercase letters represent the dominant language. Lowercase letters of different sizes represent the user's proficiency levels. Adapted from Baker and Wright (2021).

Figure 1 . Degrees of proficiency of a bilingual person

Different levels of proficiency can be influenced by various factors, such as growing up in a bilingual environment, learning a second language (L2) in different contexts and at different ages (Henning & Pentón, 2016), whether it was learned after a certain age —although there is no evidence of a critical period for learning an L2, there is evidence that some periods are more advantageous than others for this purpose (Baker & Wright,2021) — or the degree of exposure to the L2 (Baker & Wright, 2021; Feltes, 2020). The combination —or absence of one or more— of these factors will result in a continuum in terms of the degree or level of bilingualism of a language user, rather than a dichotomy between being bilingual or not. Cook (2011)

emphasizes that definitions about bilingualism can vary historically, culturally and individually, even allowing for a subjective definition at the individual level.

This means that there may be a definition of who is bilingual, even at the individual level, and in a subjective manner. For this reason, the following section presents a broader and more comprehensive definition of types of bilingualism, moving away from the dichotomous perspective to explore the open question: who is a bilingual?

Types of bilingualism

There is a simplistic view of bilingualism (Baker & Wright, 2021). This may originate due to the use of the four basic language skills (speaking, listening, reading, and writing) to refer to someone as bilingual. These basic skills are further subdivided into receptive skills (listening and reading) and productive skills (speaking and writing). This, however, presents a challenge when defining bilingualism and bilingual individuals. Therefore, a broader definition is required that encompasses the different degrees of proficiency referred to in Figure 1.

According to Baker and Wright (2021), a more precise definition should encompass different degrees of proficiency, considering active skills such as speaking and writing in both languages, as well as passive skills, including understanding and reading without necessarily speaking or writing. This leads to recognition of receptive bilinguals and passive bilinguals. Added to this, Henning and Pentón (2016) point out the variability in bilingual fluency, from a high degree almost indistinguishable from the mother tongue (L1) to lower levels. As shown in Table 2, Wei (2000) even defines 27 types of bilinguals.

Table 2
Types of bilinguals

Types of bilingualism	Definition
Late bilingual	Someone who becomes bilingual after the period of childhood.
Additive Bilingual	Someone whose languages are combined in a complementary way.
Ambilingual/balanced bilingual/ symmetrical bilingual/equilingual	Someone whose command of the two languages is identical or nearly identical.
Ascendant bilingual	Someone whose ability to function in L2 is developing due to constant use of L2.
Early bilingual	Someone who has acquired both languages during early childhood.
Asymmetrical bilingual/ receptive bilingual /passive bilingual	Someone who understands an L2 orally or in writing; but cannot necessarily speak or write it.
Compound bilingual	Someone whose languages are learnt at the same time and regularly, in the same context.

Consecutive bilingual/ successive bilingual	Someone whose L2 was added at a later stage than the acquisition of L1.
Co-ordinated bilingual	Someone whose languages were learnt in different contexts
Covert bilingual	Someone who conceals or hides their knowledge of an L2 due to linguistic attitudes.
Diagonal bilingual	Someone who is bilingual in (1) a non-standardized language or variant and (2) a standardized language that is not closely related to the former.
Dominant bilingual	Someone who is more proficient in one of their languages and uses it much more than the other.
Dormant bilingual	Someone who has emigrated to another country (where a language other than their L1 is spoken) for a considerable period of time and has few opportunities to keep their L1 in use.
Functional bilingual	Someone who works in both languages — with or without fluency— for performing a task.
Horizontal bilingual	Someone who is bilingual in two different languages, but with equal or similar status (hegemonic, for example).
Incipient bilingual	Someone who is in the early stages of bilingualism, where one of the languages is not yet fully established.
Maximal bilingual	Someone who has near-native proficiency in the languages they speak.
Minimal bilingual	Someone with knowledge of only a few words or phrases in L2.
Natural bilingual/primary bilingual	Someone who has not taken training courses to —and is not in a position to do so— interpret or translate easily in both languages.
Productive bilingual	Someone who not only understands but also speaks and possibly writes in two or more languages.
Recessive bilingual	Someone who begins to experience some difficulty in either understanding or expressing themselves in one of their languages due to lack of use.
Secondary bilingual	Someone whose L2 has been learnt through formal instruction (language classes).
Semilingual	Someone with insufficient knowledge of either of their two languages.
Simultaneous bilingual	Someone whose languages have been present since the beginning of their speech (acquired both languages).
Subordinate bilingual	Someone who experiences interference from L1 on L2 during use; that is, they use L1 to learn L2.
Subtractive bilingual	Someone who learned an L2 at the expense or detriment of their L1.
Vertical bilingual	Someone who is bilingual in (a) a standardized language and (b) a language that is different but close to L1 or a variant of it.

Note: Adapted from Wei (2000). Own translation.

Baker and Wright (2021) argued that the binary classification of bilinguals and monolinguals, as well as the single categorization of bilinguals, is simplistic in the face of the broad spectrum of bilingualism, as presented in Table 2. Furthermore, they also emphasize the need to recognize different degrees of proficiency on a continuum rather than static classifications.

Addressing the issue of bilingualism in Baja California is complex due to the many aspects that the term alone implies; the bilingualism referred to in this article is one that Wei (2000) does not address: popular bilingualism —as opposed to elite bilingualism—. These types of bilingualism and their main characteristics can be seen in Table 3 below.

Table 3
Differences between Elite Bilinguism and Popular Bilinguism

Elite Bilinguism (privileged)	Popular Bilinguism (circumstantial)
Characteristic of the middle and upper classes.	Result of contact between different ethnic groups.
They are usually "educated" people.	Result of contact between an ethnic group and a majority language.
People choose to learn another language and which language(s) to learn.	It occurs involuntarily, and they must learn another language in order to survive and participate in society.
Students and professionals who travel regularly or who migrate to another country and learn the language.	Speakers of a minority language have no choice but to learn the majority language of the place where they live.
They do not lose their L1 but rather add an L2. L1 continues to be used.	L1 is a minority language and does not enjoy prestige*.
L1 is the majority language; L2 enjoys great prestige*.	They often learn L2 and stop using their L1 because it lacks prestige. *.
L2 brings social and economic benefits.	It occurs at a more collective level.
It is given at a more individualized level.	

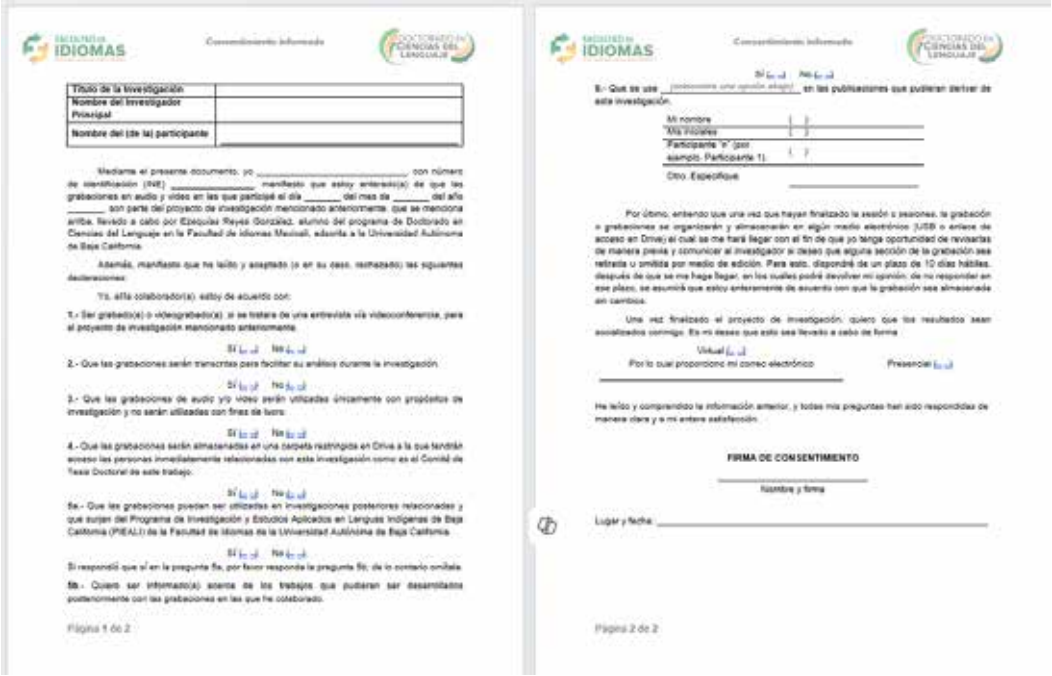
Note: Baker and Jones (1998), Baker and Wright (2021), Guerrero (2010), Paulston (1980)
L1 = Mother tongue or Language 1..
L2 = A language acquired or learned after the mother tongue—or simultaneously.
* = Prestige is assigned by society. It has to do with linguistic attitudes, not with aspects inherent to languages.

In any case, it is important to be aware that bilingualism will mean different things depending on who you ask: a foreign language teacher, a university student, a speaker of an indigenous language, or a politician, for example, will have different ideas and opinions on the subject (Cook, 2011).

METHODOLOGY

This article is derived from a doctoral thesis to analyze the meanings that teachers of an indigenous primary school and other members of the community of El Mayor, Mexicali, Baja California attribute to Intercultural and Bilingual Education. For this paper, in particular, the meanings regarding bilingualism have been addressed. Based on the literature review and the analysis of the interviews, the meanings attributed, more specifically, to the type of bilingualism of the participants were determined. The types of bilingualism of three of the eight participants in the study are presented: one participant who holds a supervisory position and two female teachers from the Alfonso Caso Andrade multigrade elementary school. The other five participants in the doctoral thesis work are students, graduates, and parents. As mentioned above, this article addressed the meanings of teaching and administrative staff.

In the informed consent form provided to the three participants, they authorized the use of their names for the research and derivate works, such as this article. On the contrary, for practical reasons, when the corresponding interview fragments are presented, the terminology Teacher 1, Teacher 2 and Educational Authority will be used. Figure 2 presents the consent form used.



Note. Own elaboration

Figure 2 . Informed consent form

For the analysis of the data, the Interpretive Phenomenological Analysis (AFI in Spanish) has been used; which involves a series of six stages that Howitt and Cramer (2011) propose, namely:

(a) Familiarization with the case and initial comments.
(b) Initial identification of issues.
(c) Identify connections in topics.
(d) Preparation of tables.
(e) Analysis of other cases.
(f) Writing the analysis.

In the AFI the interpretation es central (Smith et al., 2009; Smith & Nizza, 2022). This research had a particular focus on understanding participants' experiences and the meaning they assign to those experiences. In accordance with AFI guidelines, the analysis process also implies that the data

collected from each participant will be analyzed individually. Therefore, researchers have delved into each transcript by making exploratory notes, which are classified into three types: descriptive, linguistic, and conceptual (Smith & Nizza, 2022). We then proceeded to identify the meanings attributed to bilingualism, as shown in Table 4.

Table 4
Meanings attributed to Bilingualism

Category	Experiential statements
Bilingualism	A bilingual person is someone who speaks quickly.
	A bilingual person is someone who knows how to use isolated words and phrases
	Self-recognition as bilingual is not sufficient.
	It is important how the indigenous language is spoken and written.

Note. The term bilingual has been inserted to match the most common term in specialized literature. Participants referred to the term "speaker" as one who speaks the Cucapá language in addition to Spanish.

Once identifies, these meanings were placed into one of the types of bilingualism in Wei's (2000) typology. These meanings and the corresponding type (or types) of bilingualism are presented in Table 5.

RESULTS AND DISCUSSION

All participants are popular bilinguals since, according to what was presented in Table 3, the bilingualism of the three participants is the result of contact between different ethnic groups and contact between an ethnic group and a majority language. In addition, because it occurs involuntarily and they must learn another language and participate in society; in this case, Spanish.

On the other hand, according to the typology of Wei (2000), it is possible for a person to be at different stages of bilingualism. Considering that bilingualism is a continuum (Baker & Wright, 2021; Valdés, 2003), it would be incongruous to affirm that the type of bilingualism in which a person is located is static; on the contrary, it is dynamic. Thus, each participant falls into different types of bilingualism, as can be seen in Table 5.

Table 5
Types of bilingualism among participants

Types of participants	Type(s) of bilingualism
Educational authority	Early bilingual, functional bilingual, productive bilingual.
Teacher 1	Incipient bilingual, minimal bilingual, Asymmetric bilingual/receptive/passive.
Teacher 2	Incipient bilingual, Minimal bilingual, Recessive bilingual, Asymmetrical bilingual/receptive/passive, Consecutive bilingual/successive.

The following paragraphs present some excerpts from fragments with the participants to justify why they have been labeled in one or another type of bilingualism.

EDUCATIONAL AUTHORITY

The participant who has a supervisory position in school zone 711 stated that she learned both the Paipai language and Spanish at an early age. In fact, she only learned Spanish once she entered school. It is interesting that the participant states that she has been *pressured* to learn the Spanish language.

> Well, I learnt Spanish, but the teacher never taught me Spanish, but rather I learned it through peer pressure and all that. So, this is something very important, because you don't even realize when you learned [the language] (Educational authority).

Thus, the participant points out that the language she acquired first was Paipai, and then she acquired Spanish; so she is considered an early bilingual. It is also relevant that the participant makes a contrast when she says that the teacher did not teach her Spanish, but that she did not realize it when she learned it. In this matter, Krashen (1982) highlights the difference between *acquiring* and *learning*: those who acquire a language —L1— do not do so consciously, since they communicate in it and acquire it through use. On the other hand, learning a language is a conscious process, regularly, but not always, of an L2.

The participant is a functional and productive bilingual, as she indicates that she has taught the language before and used the Paipai language as a language of instruction. That is, she uses the indigenous language fluently to perform a task, in this case, to teach it. She is also a productive bilingual, as she indicates that the language written in Paipai played an important role in her classes.

> So, we were gradually working on the language until we got to the verbs. We did exercises such as how to arrive at a house, knock on the door, greet, say: "I came to this, I came to that", receive a phone call. In other words, making the dialogues; writing the dialogues and pronouncing them (Educational Authority).

The participant in question in this section can read and write in Paipai, which allows her not only use writing in the indigenous language, but also to adopt a critical but respectful attitude towards the use of the written language by other members of the Paipai community. This can be seen in the following excerpt.

> For example, sometimes I have seen colleagues who post on Facebook or something like that and, well, there are words that they don't finish spelling well. But, I say: "well, that is an improvement". I mean, I at least, have never criticized or observed. I'd better keep quiet (Educational authority).

TEACHERS

As for the teachers, both are incipient bilingual and minimal bilingual because they have knowledge of only a few words or phrases in L2. In a consultation with the Secretary of Education of Baja California, the educational authority indicated that the teachers have "incipient knowledge (Level I) of the language of their community, they know words such as numbers, fruits, colors, forms of greetings and farewells, imperative orders, chants and phrases" (Secretariat of Education, 2020, p. 3).

> Because it is assumed that, since we are from indigenous education [...], we have already mastered the language. When the educational system knows very well; the authorities know very well that it is not like that (Teacher 2).

On the other hand, it is relevant that teacher 1 attributes the knowledge of some words and phrases in Cucapá to a very limited lexicon of the language and not to her own bilingualism. This can be observed in the following excerpt.

> There is very little vocabulary [in Cucapá]. There are not as many words as in Spanish. Sometimes you have to take a dive, to think about what word can be substituted in Cucapá for the word that is. That is, there are not so many words [lexicon] (Teacher 1).

Now, it can be argued that being in the early stages of bilingualism could motivate them to take actions that will lead them to continue their development

as bilinguals. This is especially important since they are teachers in an indigenous school and are expected to teach the Cucapá language to their students. In fact, a fragment is presented in which teacher 1 points out that she only knows a few words in Cucapá. Interestingly, it is observed that the teacher has the idea that bilingualism is a continuum and is progressive.

> But, at least in my family, they never stopped us [...], if I said "jatpá", instead of "jatpa'a", that is "coyotes"; but I was missing two letters. No, on the contrary, they applauded me because I already knew one more word that, maybe, was not exactly the way they said it; but, well, I already knew [a new word] (Teacher 1).

In addition to the limited use of oral language by both teachers, and because Cucapá does not have a standard writing system (although there are proposals, there is no consensus), exposure and access to written materials in that language is limited. Thus, it can be argued that both teachers are also asymmetrical/receptive/passive bilingual since they understand an L2 orally or in writing but cannot necessarily speak or write it.

There is a different situation with teacher 2; who is also a speaker of Kumiai, another Yuman language. Thus, Cucapá is one of three languages that the teacher uses in certain contexts. Since the teacher points out that she learned Kumiai as a child, after she learned Spanish, this makes her a consecutive/successive bilingual. This is observed in the following excerpt.

> At the beginning it was more problematic because I had to start from scratch; practice, investigate [...]. So, I had to start from zero; from doing research with the people. Before there were more [Cucapá] speakers (Teacher 2).

Finally, teacher 2 presents a peculiar situation with the three languages she speaks. During the interview, the teacher indicated that she is more proficient in Kumiai than in Cucapá. However, this situation of speaking three languages presents certain challenges. On the one hand, the teacher points out that in the elementary school where she works she cannot practice the language belonging to her people, the Kumiai, and this is causing her to forget it. Thus, we speak of recessive bilingualism, i.e., that begins to experience some difficulty in either comprehension or expression in one of its languages due to lack of use.

> I am a Kumiai speaker. I am not 100 percent fluent. And, more so because I no longer practice it here; but I do speak the language, I do speak the Kumiai language. As I already speak the Cucapá language, which I also do not master 100 percent; neither one nor the other. But I do speak them, well, I can understand (Teacher 2).

On the other hand, being languages that belong to the same linguistic family, there are similarities. These similarities have caused confusion for this teacher. The following excerpt allows us to observe another instance that places her type of bilingualism as recessive.

> I already mix up what is Cucapá with Kumiai. And, I say: "well, in a certain way I have to dom...that...I have to practice both and I already confuse the two. I mean, I put words together; if I am going to write a text and I attach the Cucapá with the Kumiai. But, well, it is part of. I just go back to, to retake what I wrote and everything and I say: "Ah, no, yes, this is true, this is not right, this word does not go here. This is Kumiai and I am writing in Cucapá" (Teacher 2).

Thus, as discussed in this section considering the results from the analysis of the interview transcripts, the teachers and supervisor are bilingual from a broader and more holistic perspective (Baker & Wright, 2021; Valdés, 2003; Wei, 2000). This differs from what the Secretariat of Education of the state of Baja California reports. For this authority, both teachers participating in this study, as well as the rest of the teachers in other indigenous schools that serve indigenous communities of the Cochimí-Yumana family, have an incipient level of knowledge of the indigenous language.

Although, in this regard, the educational authority states that it works "in partnership with the teachers themselves, with language revitalization actions" (Secretariat of Education, 2020, p. 3), the teachers point out that the courses they receive are more focused on didactic and pedagogical strategies; not specifically on language or bilingualism.

> The General Directorate of Indigenous Education at the national level designs the courses and they are downloaded through the teachers' center. Well, courses have been offered through the teachers' center and are available. In fact, there have been very good courses; the only detail is how to implement those contents (Educational Authority).

This means that the bilingualism of teachers is not considered by the Secretary of Education of Baja California, probably because it is ignored that bilingualism is not dichotomous but a continuum (Valdés, 2003).

> And, well, courses, common and ordinary courses of what we have here in the teacher training centers, but the same for all (Teacher 1).

This is interesting because teachers seem to be aware of the state of bilingualism but have not designed the necessary language policies or courses to address the situation. It is preferred to focus on purely educational

aspects, leaving aside the linguistic aspect, which is equally important in an indigenous school.

> They just gave us an introduction to intercultural and bilingual education when we entered, because it is assumed that, as we are from indigenous education, teachers, professors, people from the community, we already mastered the language. But, when the educational system knows very well, the authorities know very well that it is not like that (Teacher 2).

In addition, the courses offered by the secretariat seem to be aimed at balanced bilinguals, functional bilinguals and, possibly, productive bilinguals; not incipient bilinguals as reported in Table 1. Along with the poor relationship between the type of bilingualism of the teachers and the language (and didactic-pedagogical) courses offered, there is also a lack of follow-up of these courses.

> But, being in the area, they have given us courses, they have given us workshops of indigenous language. Recently, last year, they gave us a course on preparation or elaboration of didactic material, but it did not have much impact because we were not even in the classrooms. Eh, there was no follow-up; we received a 2-hour on-line course (Teacher 2).

Thus, it is evident that the State Secretariat of Education pays little attention to the type of bilingualism of teachers, which leads to courses that focus more on pedagogical aspects of curricular content rather than linguistic content. Additionally, the language-related courses that are offered seem to be aimed more at bilinguals who are at another point on the continuum proposed by Valdés (2003). Hence, the importance of first identifying the type of bilingualism of the teachers and then designing and creating opportunities for them to continue advancing their bilingualism in order to have an impact in the classroom.

CONCLUSIONS

Concerning the meanings attributed to bilingualism and the types of bilingualism in which the three participants place themselves, the specialized literature recognizes that the definition of who is bilingual and who is not can vary even at the individual level. It is possible that this is due to the fact that the definition of bilingualism has gone through different changes and has been strengthened and broadened each time.

So, the definitions that emerge from the interviews go together with the popular definition of being bilingual. That means, the one that defines

a bilingual as balanced bilingual (ambilingual, symmetrical bilingual or equi lingual) whose command of both languages is identical or nearly identical. However, although Crystal (1997) notes that most of the World's population is bilingual or multilingual, the same author points out that balanced bilinguals are the exception, not the rule. For someone to aspire to this type of bilingualism, it is important that he or she be exposed to both languages from a very early age and that the opportunities to use both languages be abundant. Unfortunately, none of these situations occur among the members of the Cucapá people. Cucapá language is no longer the language used at home to communicate. Additionally, the spaces in which the language is used have been reduced in recent decades.

Moreover, considering balanced bilingualism as the reference standard can lead to unhelpful situations. It should also be remembered that the L1 of the students in El Mayor, Mexicali is Spanish. In this case, it would be advisable to offer a talk to teachers and educational authorities of the school zone in which bilingualism is approached from a non-dichotomous perspective. It is necessary to present bilingualism as a continuum. In this way, both teachers and educational authorities could have a more realistic perspective on bilingualism.

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Design of a Didactic Situation with Lateral Thinking to Favor the Learning of the Riemann Sum

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— Abstract—

A design proposal is presented for a teaching situation that incorporates inversion, a theoretical element of lateral thinking, and the visualization of dynamic graphics using GeoGebra. Methodologically, it is based on five moments that lead the student to construct arguments around the Riemann summation. This instrument successfully constructs a cognitive construction around the mathematical object, contrasting with the way it is presented in the books suggested by the analytical program for the Integral Calculus course in the Civil Engineering degree program at the Autonomous University of Chiapas.

Keywords:

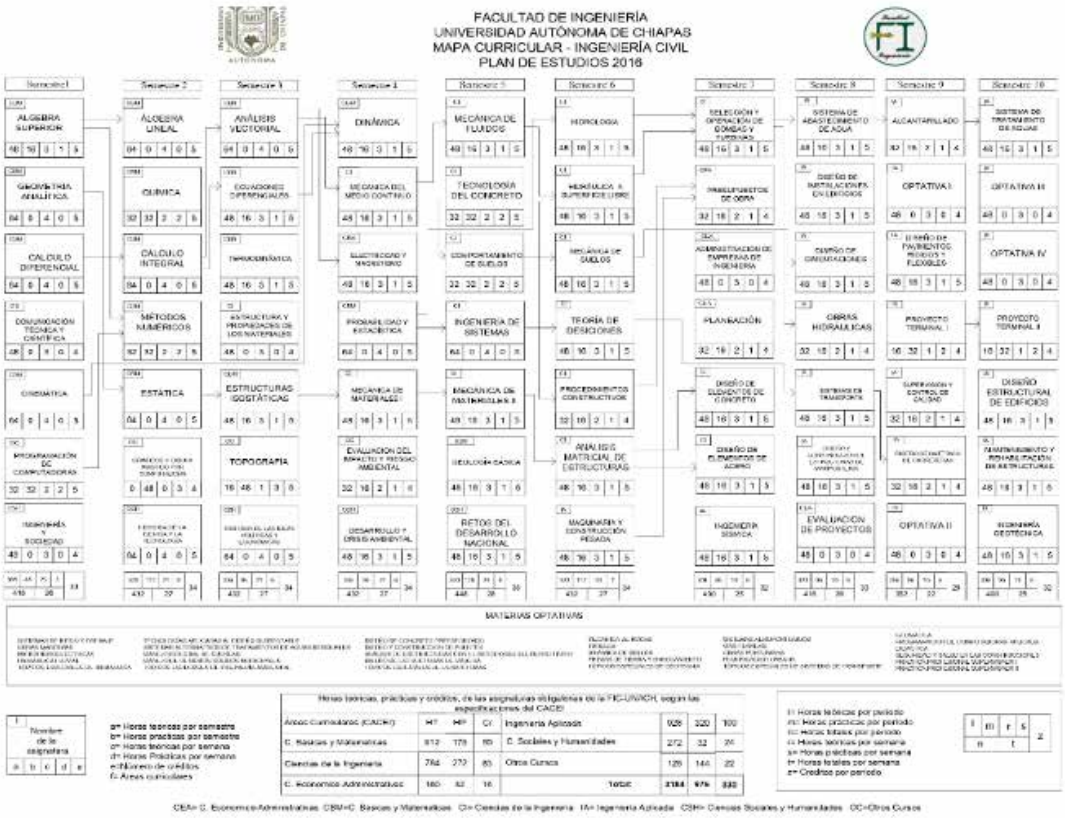
Lateral thinking, visualization in GeoGebra, summation.

The Faculty of Engineering (FE) at the Universidad Autónoma de Chiapas (UNACH) offers a Bachelor's Degree in Civil Engineering (CE), which in the first semesters teaches subjects with a mathematical content, as shown in Figure 1. The Curriculum (CURR) of the Bachelor's Degree in CE has a focus on competency-based education, which allows the student, upon graduation, to mobilize and integrate diverse knowledge and cognitive resources when faced with a new situation or problem in their workplace, so that they are able to face said situation, with constructed knowledge, propose an appropriate solution and make the most pertinent decision regarding possible courses of action, doing so effectively, and keeping in mind their ability to solve complex and open-ended problems, in different scenarios and moments.

The bachelor's degree in CE contributes to the training of professionals in Engineering through a 10-semester academic program. In order to achieve comprehensive training for the student community, competency units have been designed in various areas of training, such as life skills, basic training, and professional training.

In addition, there are optional units of competence that the student community can study in the FE, or in other educational programs of the University or at national and international Higher Education Institutions (HEI).

However, we will focus the design proposal on a mathematical content called Riemann Sum in the unit of competence called Integral Calculus (shown in the circle in Figure 1) corresponding to the second semester of the IC degree program.



Note. UNACH (2016a).

Figure 1. Curriculum map for the 2016 academic year

At UNACH, the analytical programs of each competence unit have been designed in such a way that they contribute to the development of competence attributes, which are linked to the graduate profile: knowledge, skills, attitudes and values. The curriculum and program of the bachelor's degree in CE responds to the needs and problems of today's society, as well as to other emerging issues in the field of CE application in various fields.

The current 2016 CURR includes the Integral Calculus competency unit, which aims to develop students' mathematical thinking based on modeling phenomena of variation in different contexts specific to CE, so that the student community can infer relationships and results of Calculus through a variety of real contexts. Along with analyzing and reasoning, using concepts and procedures specific to Calculus, adequately arguing decision-making and solution strategies when solving problems. Finally, to be able to effectively communicate the solutions they construct.

As part of the contents of Integral Calculus, there is the sub competence called *Definite Integral*, which is the first in the analytical program. In its content are the sequences and series, area and defined integral (properties

and their respective calculation). All this structure is focused on calculating areas under the graphs of continuous functions and on the "x" axis. The purpose of this content is to understand what a sequence is in order to then build series of expressions or figures and, based on these series, construct an area under a curve (to later incorporate into a function) and above a reference (to later call it the "x" axis in a reference system). The sub competence organizes the contents in a sequential manner to reach the defined integral, which uses the series to determine the area by evaluating the anti-derivative with the initial and final values of the interval.

PERFORMANCE CRITERIA (EXPECTED LEARNING OUTCOMES)	CONTENTS
• Calculate areas under graphs, areas between graphics, and find the definite integral of different functions by applying the Riemann Sum.	**DEFINITE INTEGRAL** Sequences and series. Area. Definite Integral. Properties of the definite integral. Calculation of definite integrals.

Note. UNACH (2016b, p.151).

Figure 2. Content of the sub competence (unit) of Integral Calculus

On the other hand, in the case of *Area* content, a mathematical object called the Riemann sum is incorporated, which a calculus book defines as shown in Figure 3.

Let f be defined on the closed interval $[a,b]$, and let Δ be a partition of $[a,b]$ given by

$$a = x_0 < x_1 < x_2 < \cdots < x_{n-1} < x_n = b$$

where Δx_i is the width of the i-th subinterval. If $c1$ is any point in the i-th subinterval. If c_1 is *any* point in the i-th subinterval $[x_{i-1},x_i]$ then the sum

$$\sum_{i=1}^{n} f(c_i)\,\Delta x_i, \qquad x_{i-1} \le c_i \le x_i$$

is named a Riemann sum of f for the partition

Note. Larson & Edwards (2010, p. 272).

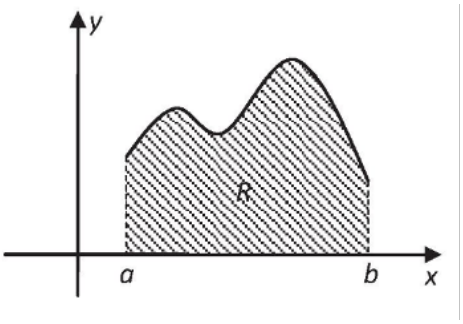
Figure 3. Excerpt from a Calculus book showing the definition of Riemann summation

The above definition implicitly involves calculating the area of a rectangle (which would be considered below the curve), where Δ_{xi} would be the base and the value $f(c_i)$ would be its height. According to a reference from the CURR 2016, Integral Calculus analytical program, Stewart (2010, pp. 343-344), the definition shown in Figure 3 is used in another for the process of

calculating the area under the curve. This other definition establishes the definite integral as a limit with a tendency to infinity for the Riemann sum.

$$\int_a^b f(x)dx = \lim_{n\to\infty} \sum_i^n f(x_i^*)\Delta x$$

In fact, Acosta (2012) mentions that in the texts used in teaching practice, and in the teaching of calculus, the predominant approach is to introduce the concept of definite integral of a function $y = f(x)$, which is continuous and non-negative in a closed interval $[a,b]$, in close relation to the problem of determining the area of the corresponding curvilinear trapezoid, as seen in Figure 4.



Note. Acosta (2012, p. 343)

Figure 4. The definite integral of the function y = f(x) , continuous and non-negative on [a,b], is numerically equal to the measure of the area of the region R

However, this entire approach obscures the relationship between mathematical thinking that can emerge in the modeling of variation phenomena in different contexts specific to CE. Where is the inference of relations and results from the Calculus through a variety of real contexts? The student goes so far as to state that everything he was taught in the sub/competency is nothing more than to justify the use of an algorithm for the definite integral. And that is enough to use the power of series expressions that correspond to certain functions, obtain the antiderivative and get the result of the value of the area under the curve when performing the evaluation. All this leads to commenting that UNACH's FE program prioritizes the application of an algorithmic procedure without contextualizing Riemann's Sum.

In this regard, Granera (2019) points out that "in mathematics, there is little visualization and contextualization of the properties of the concepts; as well as little cognitive linkage between their graphic-visual and analytical-algorithmic aspects "(p. 5).

Regarding the point made about prioritizing the teaching of Riemann sum in the use of an algorithm for definite integrals, it agrees with the following.

> Salinas and Alanís (2009) mention that the traditional teaching of Calculus encourages teachers to focus the evaluation on the ability of students to apply algorithms and algebraic processes in the resolution of exercises. (Granera, 2019, p. 4)

It should be noted that teaching must be a conscious and intentional act on the part of the teacher, who aims to achieve learning through a series of actions that encourage the student to build their knowledge from the modeling of variation phenomena in different contexts specific to CE. On this matter, the design proposal presented in this document incorporated an element of lateral thinking into the investment. Now that, instead of presenting the analytical expression, as Calculus books do, students are asked to construct an approximation of area in a regular figure, then in an irregular figure, to finally approximate an area in a curve obtained experimentally in a context related to CE, as it is in the mechanical resistance tests on concrete masonry units (CMUs).

It is considered that investment is incorporated since in all the interaction at no time is the student presented with an analytical structure to which he or she resorts to apply algorithms and algebraic processes. Everything is based on each individual's own area approximations when interacting with the design proposal. Each closing moment in the activities suggests at the end that an analytical expression is obtained from the interaction with the parties that make up the activity.

It was stated that the investment is also implicit in the activity involving construction and mechanical testing of CMUs. Since requesting the area under the experimental stress-strain curve without providing an analytical expression for the function will cause students to resort to approximation strategies for that region. This contextualized surface alludes to the energy absorption capacity of the sample before it collapses. (Beer et al., 2010, pp. 670/671).

On the other hand, incorporating the use of GeoGebra to construct approximations of areas allows students to establish a relationship between different representation records around Riemann sum.

> GeoGebra has some representation records, such as the algebraic view, the CAS symbolic calculation view, and two-and three-dimensional graphic views, among others. These representations optimize time and allow a variety of behaviors of the object under study which will be difficult to obtain through the graphic representation with pencil and paper. (Vergara,2022, p. 2)

It was also considered that implementing GeoGebra will have an impact on dynamic visualization in the approximation of the area under the curve,

since it is a software that has a degree of incidence in the teaching-learning of mathematical objects belonging to Integral Calculus. In this regard, according to Laderas et al (2023):

> The use of GeoGebra had a significant impact on the teaching and learning of Differential and Integral Calculus in higher education students. GeoGebra proved to be an effective tool both in general mathematics teaching and in specific Calculus teaching. (p. 374)

With this initial problem that was built for the Riemann sum, the aim was to develop representation records or models in GeoGebra, both geometric and analytical and numerical, in which an approximation of the area under the curve in an interval $[a,b]$ is guaranteed. As well as contextualization in CE applications, from the modeling of a stress-strain curve an approach is made to the area below the experimental curve from zero strain to the moment of rupture. The design proposal has not yet been applied to a group of students, and it is planned that this will occur in the season August-December 2025 at the FE of UNACH.

PURPOSE OF THE DESIGN PROPOSAL

The purpose of the design proposal as a *medium* was to promote learning about Riemann sums, using lateral thinking in a proposal that incorporates technology and problem-based learning. The medium is understood in the sense that Sadovsky (2005) interprets it:

> The concept of medium therefore includes both an initial mathematical problem that the subject faces, and a set of relationships, essentially mathematical as well, that change as the subject produces knowledge in the course of the situation, thereby transforming the reality with which they interact. (p. 20)

It was considered that students will develop the competences mentioned in the analytical program for the subject of Integral Calculus. The following competencies are highlighted:

- Use logical, formal mathematical, iconic, verbal and non-verbal languages to understand, interpret and express ideas and theories.
- Manage information and communication technologies as a tool for learning and collaborative work that allow their constructive participation in society.
- Use logical, critical, creative, and proactive thinking to analyze natural and social phenomena, enabling you to make relevant de-

cisions within your sphere of influence with social responsibility. (UNACH, 2016b, pp. 149-150)

Expected learning outcomes

Students will identify the composition of an area under the curve using geometric shapes such as rectangles. Said composition is an approximation of the area between the curve “f(x)” and the axis “x”.

Background knowledge

Areas of shapes (rectangles, squares, triangles, and circles), positioning, reference plane.

Who will we be working with?

For this intervention project, our subjects of study are young people between the ages of 18 and 20, from various locations in the state of Chiapas. In the second semester of the bachelor's degree in CE, it would be applied in the first sub-competency of the unit of competence called “Integral Calculus”, as marked by the analytical program for that subject.

Research question

From all the above, a research question emerged: How does a didactic sequence based on the incorporation of lateral thinking and visualization in GeoGebra favor the learning about Riemann sums in the second semester of the bachelor's degree in CE?

GENERAL OBJECTIVE

Design a teaching sequence that incorporates lateral thinking into learning about Riemann sums, incorporating GeoGebra and problem-based learning.

Specific objectives

- It is proposed to incorporate investment in the design of the didactic sequence, the approach that I have called regular-regular, which consists in that a regular area can be constituted approximately with infinite regular areas (rectangles).
- The investment in the design of the teaching sequence incorporates the approach known as irregular-regular, which consists of an

irregular area being made up of approximately infinite regular areas (triangles, rectangles, squares, circles, or others).
- Activities are proposed that incorporate the project-based learning methodology for the construction of hollow concrete blocks and the modeling of the unitary stress-strain curve.

CONCEPTUAL FRAMEWORK

The initial problem proposal or problem situation is considered to have two theoretical components: lateral thinking, on the one hand, and the visualization of graphics with the incorporation of technology in mathematics teaching, on the other.

Lateral thinking

One strategy for generating reasoning based on mathematics is lateral thinking. This concept is in contrast to the so-called vertical thinking, traditional cause-effect. Its foundations consist of taking an approach that “moves away from taking things for granted” and provocation. On the other hand, lateral thinking, "also called divergent thinking, considered by many authors as synonymous with creative thinking, which involves risk and adventure, seeks different solutions or goals in each individual, own and original" (López, 2010 in Muñoz, 2013, p. 269).

To apply it, there are different techniques (in the case of problems), among which one of them is called *Inversion*, which consists of inverting the meaning of the problem and trying to turn it into exactly the opposite. That is, an attempt is made to "rotate" it. The idea is to come up with something new that contributes to the solution of the original problem (De Luca, 2012).

We consider it relevant to invert the way the Riemann sum is displayed in a calculus course. Typically, the finished formula is presented as discussed in the introduction to this paper and applied to a standard example that develops the formula established by the textbook used by the teacher.

Incorporating technology

Using technology in the math classroom allows students to look for creative ways to solve problems, since they can focus the discussion on the meaning of mathematical ideas involved in procedures and results, because digital tools can perform mathematical calculations and procedures (Santos, 2015, p. 149).

This is where the role of the teacher comes in, given these premises, making use of lateral thinking with the incorporation of technology can help students look for creative ways to solve problems in class and not repetitive exercises. This coincides with Brousseau's proposal (1988, in Sadovsky, 2005):

> The teacher's job is therefore to present the student with a learning situation in which they can produce their knowledge as a personal response to a question and apply or modify it in response to the demands of the environment rather than the teacher's wishes. (p.28)

Since teachers can search for and find tools such as GeoGebra. That allows the design proposal for the Riemann sum a visualization of the effects that can occur between the different representation records of this mathematical object. And observe in real time the effects of the variation of the elements from one record to another.

For all these reasons, it was considered that the implementation of the technology, for the design proposal of the Riemann sum, is something feasible.

Display

It was considered that by incorporating the technology through the GeoGebra software, it allows the real-time manipulation of geometric objects, a factor that will favor the visualization and contextualization of the properties of the Riemann sum. In this regard, Granera (2019) pointed out the following:

> The findings of research show that conceptual and applied learning are scarce. Mainly in mathematics, there is little visualization and contextualization of the properties of the concepts; as well as little cognitive linkage of graphic-visual and analytical-algorithmic aspects of them. (p. 5)

On the other hand, the *Humans-with-Media* theory emphasized the role of technology in the reorganization of mathematical knowledge, considering it closely linked to *visualization*, a cognitive process that supports representation, generalization, transformation, documentation, reflection, and communication based on visual information (Hershkowitz et al., 1990; & Torregrosa, 2002, quoted in Díaz-Urdaneta & Prieto, 2016).

Diaz-Urdaneta and Prieto (2016) mentioned that in the simulation with GeoGebra, *visualization* is conceived as a cognitive process through which a selected phenomenon (natural or scientific) is represented, using mathematical ideas (in different registers) that are expanded or reorganized during the development of the activity.

We conclude this section by pointing out that we consider that these theoretical components, lateral thinking and visualization with the incorporation of technology, complement each other in an appropriate way in the design of our problem situation.

RESULTS

The result is a tool that facilitates learning about Riemann sums, which proposes a construction of the mathematical object, incorporating inversion, a theoretical approach to lateral thinking, and the visualization of dynamic graphs with GeoGebra.

METHODOLOGY OF THE PROBLEM SITUATION

The proposal is a sequence of instructions (*medium*) for students, which is designed in five stages in a start-development-end format, as proposed by Díaz (2013).

Initially, the proposal is to work with an inscribed rectangle, a circumscribed rectangle, or a combination of both characteristics, using a dynamic program for teaching and learning mathematics such as GeoGebra. In a second stage, the aim is to continue using the technology (software) and emphasis is placed on determining the appropriate number of rectangles to calculate a proposed area. In a third stage, a project is used that reflects the transition from an irregular to a regular figure. In a fourth stage, which concludes stages one, two, and three, which responds to a paradigm known as the modern conception of calculus, Moreno and Ríos (2006) noted the following about this model:

> This concept refers to learning as the construction of meaning, whereby students build knowledge based on their cultural background and guidance from the teacher. The teacher is no longer seen as a transmitter of knowledge, but as another participant in the learning process who, together with the student, constructs knowledge. This means that the teacher's activity is aimed at promoting the organization, interpretation, and understanding of the information so that the student decides what and how to learn.
>
> From this perspective, mathematical knowledge is not considered something finite, but rather knowledge in the process of creation, supported by pedagogical practices such as those promoted in the modern conception, which places conceptual structures that expand and strengthen throughout life above the storage of concepts. Thus, lectures are not sufficient; rather, scenarios must be created in which students participate in the development of their own learning. (pp. 33-34)

In a fifth moment, the entire intervention would be completed by incorporating project-based learning, which could lead to the teacher becoming another participant in the learning process and working together with the student to build mathematical knowledge.

Moments 1 and 2 consider the construction of a regular figure, which is a semicircle, using regular figures such as rectangles. Moment 3 considers the construction of an irregular figure, such as Romanesco's fern leaf; with regular geometric figures such as triangles, rectangles, squares, or circles. Moment 4 considers closing these two forms of construct. Moment 5 would conclude the entire intervention with the students. It should be noted that the teaching sequence obtained was the result of validation by a group of five teacher-researchers, who were presented with the Moment-based methodology and the proposed teaching sequence. They provided their comments, and what is shown in the results section is the final version.

Moment 1

Discussion on the implementation of the shape of a rectangle that can be used to determine another area (that of the tunnel), under the assumption that we did not know that the tunnel is the outline of a circle. Lateral thinking was used by reversing the way of looking at the Riemann sum as textbooks do when presenting the constructed figure. They were provided with a GeoGebra file where, with the help of sliders, they could manipulate the number of rectangles appearing under the tunnel, as well as the intersection point of the top of the rectangle with the unknown $f(x)$.

Moment 2

After discussing the position of the rectangle in relation to the curve to be used in Moment 1, in this Moment 2 and in a second file in GeoGebra (the file will only contain the semicircle), students were able to come up with proposals regarding the number of rectangles that best suited the circular tunnel proposed in Moment 1. The following query was posed to them.

Triggering question to the student for Moment 2.

Of the shapes presented in Moment 1, what would be the best position for the rectangle to set up the tunnel area? How many rectangles would you suggest to get close to the tunnel area?

Use the second file provided in GeoGebra and use the Polygon command to draw  the rectangles inscribed in the tunnel.

Moment 3

The aim was for students to use a regular figure to characterize an irregular figure. An irregular figure such as a fern leaf or Romanesco broccoli was

presented to the students, as shown in Figure 5. The proposal was taken up again from Lima (2020), since a fractal is characterized by being a geometric object with an irregular structure that repeats itself at different scales. This property, known as self-similarity, according to this author, implies that each part of the fractal, when enlarged, shows the same shape as the entire object.

Note. Istockphoto (2025).

Figure 5. Image of Romanesco broccoli

Triggering question to the student for Moment 3.

As presented at the beginning of the session, use the  Polygon command to draw the triangles inscribed or circumscribed around the cauliflower. How many triangles would you suggest to approximate the area of the Romanesco?

Moment 4

The conclusion of moments one, two and three raises two triggering questions, which are as follows.

If the number of geometric shapes (triangles, rectangles, etc.) were very large, greater than one million geometric shapes, how close would the sum of these areas be to the area of the tunnel or the Romanesco (depending on the stage of the teaching sequence)? Explain your answer.

_____

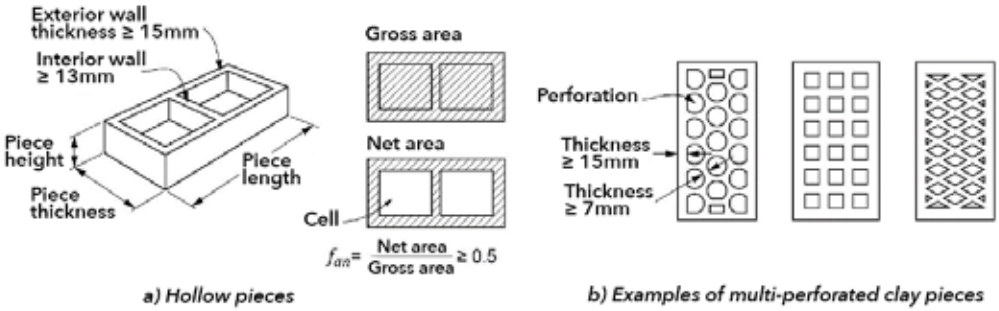
_____.

What expression would you use to calculate the area of the enclosed figure using the areas of the figure or figures you proposed?

Moment 5

They proposed the construction of Hollow Concrete Block (HCB) teams, which were subjected to loading in the FE materials laboratory. The objective of this stage was to construct an HCB that must have a certain area of material that can withstand the load. As stated in the Mexican Standards ([NTC], Gavilán, 2018), hollow blocks, in their most unfavorable cross section, is a net area of at least 75 percent of the gross area; in addition, the thickness of their exterior walls is no less than 15 mm, as shown in Figure 6.

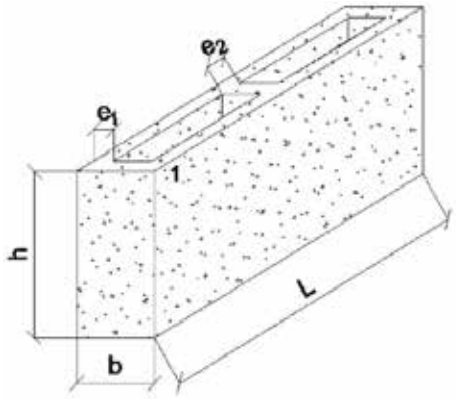
According to NTC-2018 specifications, HCB pieces with two to four cells must have a minimum interior wall thickness of 13 mm. For multi-perforated HCB pieces, whose perforations are of the same dimensions and evenly distributed, the interior walls must have a minimum thickness of 7 mm. Multi-perforated parts are understood to be those with more than seven perforations or alveoli.



Note. Gavilán (2018, p.17).

Figure 6. Specifications for hollow blocks and multi-perforated blocks

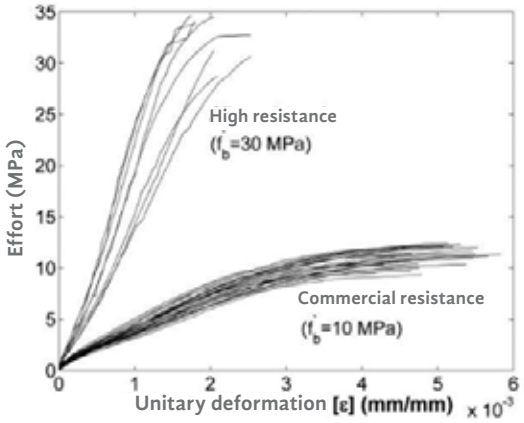
To construct a hollow concrete block (HCB), geometric characteristics are required, as indicated by Ruiz ands Godínez (2022): e1 is the thickness of the walls in the longitudinal direction; e2 is the thickness of the walls in the transverse direction, length (L), height (h), and width (b). As shown in Figure 7.



Note. Ruiz & Godínez, (2022, p. 68).

Figure 7. Relevant geometric characteristics of an HCB

Therefore, to relate the object of Riemann sum to mechanical analysis in HCB's, a continuous analysis could be performed on the mechanical tests of the students' HCBs so that they can obtain experimental stress-strain graphs of the HCBs. In García et al. (2013), concrete block samples were subjected to loads at a rate of 1 kN/s until failure. From the load versus axial deformation history of each sample, the stress-strain curves for each of the blocks tested were obtained, as shown in Figure 8.



Note. García et al. (2013, p. 79).

Figure 8. Stress-strain curves of the blocks tested at different strengths

Based on these curves, students can be asked to calculate the area under the stress-strain curve, which is interpreted as the **tenacity** of the material (Yépez, 2014). According to García et al. (2013), the experimental stress-strain curves exhibited two behaviors: Part of the curves behaved linearly (up to approximately 30% of their maximum resistance), while the next part behaved non-linearly (up to diagonal shear failure). Therefore, incor-

porating Riemann sum to find the area under the curve would be applicable to both the linear and nonlinear parts. Considering that the curve's function is not known analytically (unlike in Calculus textbooks, which do provide the analytical expression for the function), because it comes from an experimental process.

This Moment 5 is based on Project-based learning, in which FE students have the project of designing their HCB, with a specific number of alveoli and controlled aggregates. Following the guidelines of standard NMX-C-036-ONNCCE-2013 (2013), they will obtain the experimental stress-strain curve by measuring the displacement caused by the universal machine using an Arduino and displacement transducers (LVDTs). From this curve, it is possible to obtain the **tenacity** by approximating the area under the stress-strain curve.

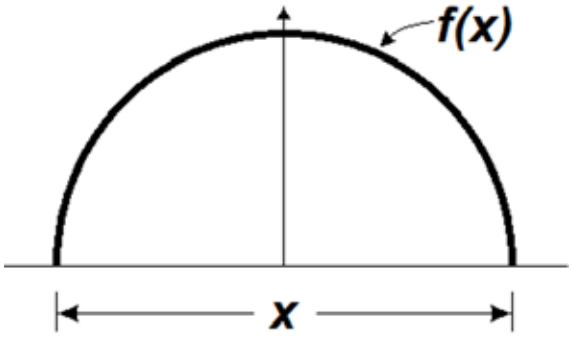
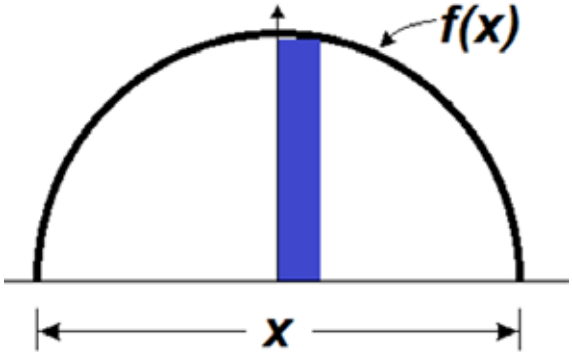
A set of tasks based on solving questions or problems (challenges) is established through a process of research or creation by the student community, which works relatively autonomously and with a high level of involvement and cooperation. At the end, the process culminates in a final product presented to the others (dissemination).

Session 1

Learning objective: Students are expected to identify an ideal way to configure a rectangular area to understand another area that corresponds to a regular figure. They are provided with a file in GeoGebra so that they can propose regular figures below an f(x) without an analytical expression.

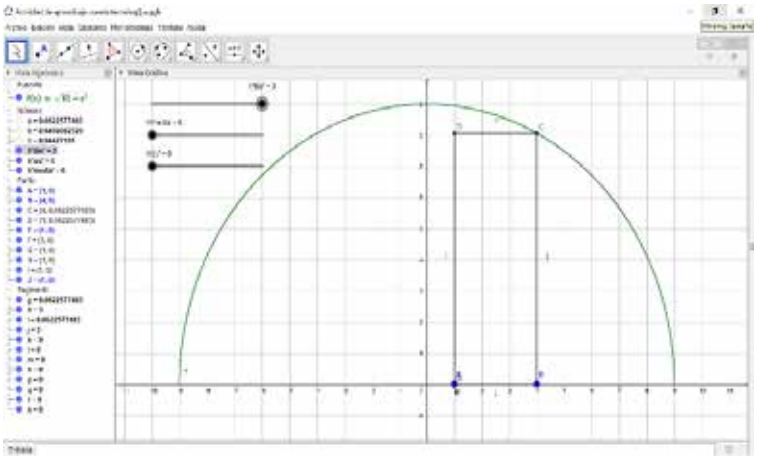
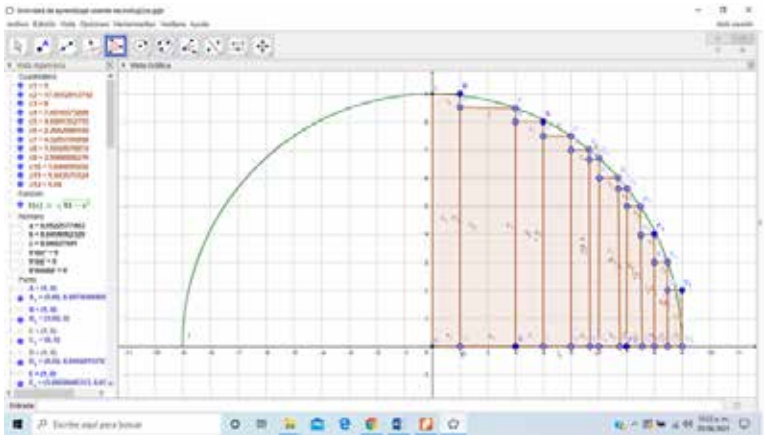
In the initial stage, students are presented with a problem in which they are required to establish an area under a curve f(x), a function that lacks an analytical representation. The teaching objective is to generate a brainstorm session with students' comments by proposing a blue rectangular figure below the semicircle and how the area of the semicircle could be covered with that rectangle or several rectangles.

Table 1

Stage	Activity	Time
Begi-nning	The problem of determining the area of a tunnel using rectangular areas is presented. With an indeterminate number of rectangles (regular shape) inside a tunnel (regular shape). **Introduction to the problem** The area of a tunnel (a semicircle) must be determined by approximation. To do this, we propose constructing rectangular figures inside it, as shown in the following image.   How could the area of the semicircle be covered with that rectangle?	10 min.

In the development stage of Session 1, the educational objective is for students to construct a series of inscribed or circumscribed rectangles with bases of equal size in the file provided by the teacher. Rectangles with different bases can also be proposed. Students are expected to grasp the idea of dynamism in the construction of rectangles and that, as their number increases, they can approximate the area under the proposed curve.

Table 2

Stage	Activity	Time
Development	Form teams of three people to work on the problem situation in **Moments 1** and **2** presented in the methodology section of this document **Moment 1** Students are provided with a file previously created in GeoGebra and instructed to: Manipulate the sliders shown on the screen one at a time. Discuss what you observe with your classmates:  **Momento2** What would be the best position for the rectangle to configure the area under the tunnel you just manipulated (referring to the first GeoGebra file provided)? How many rectangles would you suggest to approximate the area of the tunnel? Use the second GeoGebra file provided and use the Polygon  command to draw the rectangles inscribed or circumscribed around the tunnel.  You will select a team representative who will present the work done on the problem situation to the class.	80 min.

At the end of Session 1, the educational objective is to obtain feedback from students' answers. They should observe that by increasing the number of rectangles, they can better approximate the area of the semicircle. They are expected to construct an analytical expression for the geometric series they have proposed.

Table 3

Stage	Activity	Time
Closure	Agree on the best option that answers the question in Methodological **Moment 4**. According to your rectangular area proposal, how close is it to the tunnel area? Compare your answer with that of your classmates. If the number of rectangular shapes were very large, greater than one million rectangles, how close would the sum of these areas be to the area of the tunnel? Explain your answer. What expression would you use to calculate the area of the requested curve in a given interval using the rectangles you constructed?	25 min.

Session 2

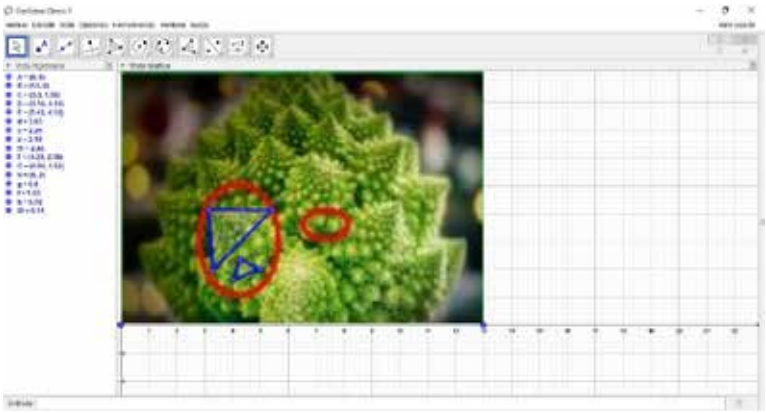
Learning Objective: Students are expected to apply a specific number of triangular areas or any other area that can be visualized in the transition from an irregular area to a regular area. In the initial stage, the educational objective is for the students to identify the self-similarity that exists in the fractal (Lima, 2020) and comment that the part enclosed in the red circle resembles the entire cauliflower. The aim is to generate a brainstorming session with the students' comments by proposing a triangular shape for the part enclosed in the circle and how the entire cauliflower area could be covered with that triangle or several triangles according to the suggestions.

Table 4

Stage	Activity	Time
Beginning	Present an irregular figure such as a fern leaf or Romanesco broccoli to the students (**Moment 3** of the methodology) Look at the circled part in the following image of a Romanesco cauliflower Does the circled red part look like the whole cauliflower?  The area of the entire cauliflower shown in the image must be determined by approximation. To do this, it is proposed to construct a triangle for the part enclosed in the circle. How could the area of the cauliflower be covered with that triangle?	15 min.

In the development stage of Session 2, the educational objective is for the students to apply a specific number of triangular areas in the transition from an irregular area to a regular one. In the initial stage, students are presented with an irregular shape and asked to determine whether a smaller area resembles the complete irregular shape. The aim is to generate a brainstorming session with students' comments when proposing a smaller area composition.

Table 5

Stage	Activity	Time
Development	Returning the work done in the initial stage. Use the file provided to help you. Use the image of the Romanesco in GeoGebra and use the Polygon command to draw the triangles inscribed or circumscribed around the cauliflower. Does it draw a single triangle that covers the entire surface of the cauliflower? Do you consider that the area of this single triangle is equal to the requested surface area? Try drawing more triangles to approximate the area. How many triangles would you suggest to approximate the area of the cauliflower? 	80 min.

At the end of Session 2, feedback from the students' responses is expected. They should observe that by increasing the number of triangles, they can better approximate the total area of the cauliflower. They are expected to construct an analytical expression for the geometric series they have proposed.

Table 6

Stage	Activity	Time
Closure	Socialization of your proposals (**Moment 4** of the methodology). According to the triangular area proposal, how close is it to the surface of the cauliflower? Compare your answer with that of your classmates. If the number of triangular shapes were very large, greater than one million triangles, how close would the sum of these areas be to the surface area of the cauliflower? Explain your answer. What expression would you use to calculate the area of the surface requested in a given number of triangles that you constructed?	25 min.

Session 3

In the case of project-based learning (Moment 5), a series of activities are considered for the construction of the HCB and the modeling of the stress-strain curve.

Start of session 3

Research on how to develop an HCB and the standards it must meet. Research on how to develop a BHC and the standards it must meet. As well as the dissemination of the research findings. This coincides with the proposal by Vázquez (2021), who points out that conducting research allows students to discover new ideas, explain their opinions in a reasoned manner, apply acquired theories to practical problems, and discover new and more effective paths for their own educational process.

Development of session 3

Construction of HCB prototypes and testing in the materials mechanics laboratory to determine the experimental stress-strain curve. At this stage, students are asked to plan and organize the information obtained at the beginning of Session 3. After planning and organizing the information, they must synthesize the information that will be useful in the construction and design of the HCBs. They are also expected to identify the information that is missing for the HCB trials. This stage is based on what Aragay and Martínez (2020) mentioned about searching for and synthesizing information, as well as developing the final product.

> Information search and synthesis: In this phase, students gradually become aware of what they know and what they still need to learn. New knowledge is synthesized and linked to the needs of the project.
>
> Preparation of the final product: At this point, with the newly acquired knowledge, students are ready to respond to the challenge: the development of their final product. (p.16)

The challenge is to determine the tenacity of student-built HCBs.

Closure of session 3

Presentation of the HCB to the student community together with the results of the mechanical tests. It is considered that at this stage students will be able to pour all their experience into carrying out the BHC development project and it represents for them a much more relevant way of learning than presenting knowledge that has already been completed.

> The work that students do is much more meaningful when it is not aimed at the exam or the grade awarded by the teacher. The experiences that have developed this way of working show that when students present their work

> to a real audience, they are much more concerned about its quality. (Aragay & Martínez, 2020, p.16)

This last activity concludes Moment 5 designed in the Project-Based learning methodology.

CONCLUSIONS

The process of considering the elements that constitute a design proposal is something that has been reflected throughout the document. It is considered relevant to mention the intentions behind each part of the activities, since in many studies the sequences are presented as if they were created from scratch. A beginning, a development and a conclusion are incorporated for each of the activities. The proposal is to apply the design proposal before presenting the mathematical object, as is done in calculus textbooks.

The proposal seeks a deeper, more meaningful and contextualized learning of Riemann summation, using inversion and dynamic visualization to actively engage students in knowledge construction. It aims to break with traditional and abstract presentation, promoting understanding and mathematical reasoning in second-semester CE students at the FE of UNACH.

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A C A D E M I C S
P A P E R S

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Fear among people of sexual diversity for expressing their sexual and gender orientation in Jalisco

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— Abstract—

The objective of this research note is to show the fear why people of sexual diversity hide their sexual or gender orientation in the state of Jalisco, in spaces such as the family and public where coexistence occurs, or also in the networks. social, this due to the fear of being discriminated against or having some type of violence exerted on them.

The note is made up of a brief account of the emergence of the LGBTTTQ + movement, in Mexico and in the state of Jalisco to become visible and fight for their rights, which has brought them negative reactions due to their sexual and gender orientation, such as mockery, discrimination, accusations, violence, etc., the argument why people of sexual diversity reserve their sexual or gender orientation is complemented by a survey by the pollster Kaliopeo, based on its study Jalisco LGBT+ 2023.

Keywords:

Sexual diversity; fear of its expression; concealment of gender identity and undignified acts.

FEAR OF EXPRESSING SEXUAL ORIENTATION AND GENDER IDENTITY AMONG SEXUALLY DIVERSE INDIVIDUALS IN JALISCO

Sexual and gender diversity is defined as «all the possibilities that people have to assume, express and live their sexuality, as well as to assume sexual expressions, preferences or sexual orientations and identities. It is based on the recognition that all bodies, all sensations and all desires have the right to exist and manifest, with no limits other than respect for the rights of other people» (National Human Rights Commission [CNDH], n.d.).

The fight for the rights of people of sexual diversity in our country arose on October 2, 1978, in the framework of the commemoration of the tenth anniversary of the massacre of students in Tlatelolco. That day, Nancy Cárdenas, leader of the Homosexual Liberation Movement, paraded among the contingents, hence new movements emerged, and its members began to give talks on the subject in high schools and faculties, which brought mockery, rejection and resistance in society (Monsiváis, 2005, p.46).

Writer Carlos Monsiváis reported on the outrageous expressions of contempt directed at LGBTTTQ+ people in Mexico City at that time, and from then on, constant rejection, discrimination, and violence arose in response to the visibility of sexual orientations and gender identities, as seen in Jalisco, and which undoubtedly occurs throughout Mexico.

Now, in Jalisco, in the sexual diversity movement, one of the first groups to become visible was the Homosexual Liberation Pride Group (GOHL) in 1983, but which already operated since 1981 under the name of Lamba de Guadalajara, which was led by Pedro Preciado and began to have visibility in the state capital through demonstrations in the streets (Carrillo, 2022). This leader endured beatings and contempt at a time when homosexuality was still punishable by law (Islas, 2023).

In this context, it was identified that being part of the diversity community has been a constant risk in violation of their integrity for expressing their gender identity, making themselves visible and demanding respect for their rights. It should be noted that gender identity refers to:

> Concept and feelings one has about oneself as a sexual being. Each person defines it according to their lifestyle, sexual practices and desires, gender identity, sexual preference, attitudes, and behavioral manifestations (Ministry of the Interior [SEGOB], 2018).

Nowadays, in Jalisco we find a critical panorama on the subject, since people still do not go out to live and freely express their sexual or gender orientation, according to the above, a recent report by the pollster Kaliopeo (2023),

showed the difficulty that people of sexual diversity have expressing themselves freely as part of the community and they do not tell anyone about it because of the risk (of negative reactions) that it may represent. In this context, 67.8% of the people surveyed mentioned that they told a friend, followed by a schoolmate and their mother 7.3%, and 7.0% to their siblings. It was identified that most of them have told a friend because of the trust that this represents. Similarly, they were asked if they felt safe telling, and 71.4% responded affirmatively, while 28.6% said they did not (Ibid).

However, the use of social networks is also part of people, since through it they share feelings, public and family coexistence. In this regard, another question asked of sexually diverse individuals was whether they made their sexual identity or orientation visible on social media. In this matter, 38.2% of the respondents answered yes, while 32.4% said yes, but they hide certain posts from some people. On the other hand, 14% mentioned they do not socialize it (Ibid. p. 20).

Another fear that exists among people of sexual diversity for expressing their sexual or gender identity is to be subjected to conversion therapies or the Efforts for the Correction of Sexual Orientation and Gender Identity (ECOSIG), with the aim of involuntarily "correcting" them. A representative case of this occurred in April 2022, a few days after the law prohibiting these conversion therapies was passed. That month, a 19-year-old woman from the municipality of Atotonilco el Alto was the victim of this type of practice, a situation that was reported by the organization Atoto Diverso (Orozco, 2022). Besides another important aspect to consider is that people subjected to this type of center who promise to "correct" their sexual or gender orientation may be victims of other abuses, such as the case reported in 2021 by the Unión Diversa Jalisco association, in which a young woman said that she was raped in one of these places, under the pretext that this abuse was what she needed to "correct" her sexual orientation (Ruíz, 2024).

Regarding the central axis of our topic, the Directorate of Sexual Diversity of Jalisco pointed out in a 2019 statement that 9 out of 10 adolescents in the state have been afraid to express their sexual or gender identity for fear of being discriminated against, and that 93.3% have witnessed expressions of hatred, physical aggression and harassment due to their gender identity (Government of Jalisco, 2019). These data showed that the majority of the sexually diverse population in Jalisco has suffered some type of violence or discrimination.

Likewise, Jalisco in 2022 was one of the three entities that presented the highest number of incidents against the sexual diversity community in the country, only after Guanajuato and the State of Mexico, where together there were around a thousand actions against the sexual diversity community (Ramírez, 2023). Likewise, Jalisco in 2022 was one of the three entities

that presented the highest number of incidents against the sexual diversity community in the country, only after Guanajuato and the State of Mexico, where together there were around a thousand actions against the sexual diversity community (Ramírez, 2023).

The expression of people of sexual diversity according to their gender identity, as observed, has brought unfortunate events that have affected their dignity and integrity. In this regard, sexually diverse individuals change their way of being, as stated by 71.9% of the people surveyed, the reason was that there is fear of suffering a negative reaction from other people; while only 28.1% do not hide to express themselves as they are (p.18). In this sense, it is striking that 50.9% of the people surveyed had attended a march, and 49.1% mentioned that they had not (p. 22). In accordance with the above, it was identified that there may be several reasons why they do not express their gender identity. As has been observed, their closest circle, such as their family, does not provide them with the necessary support for their sexual orientation, and they stop being who they are for fear of a negative reaction from others.

Similarly, among the main forms of aggression experienced by sexually diverse people have been verbal harassment, insults, and mockery, which represent 56.4% of cases, followed by discrimination in public places with 15.0% (Kaliopeo, p. 32), with public places, such as squares, parks and streets, being the main ones where they have suffered such aggression, as mentioned by 40.0%, with the main perpetrators of the aggression being unknown (Kaliopeo, p. 33).

According to a note from the digital newspaper *El Occidental*, the reporter Isaura López (2022) wrote that sexually divers individuals open the door and face discriminatory acts that violate their integrity and dignity, thereby preventing their freedom, development and the guarantee of their human rights. Moreover, she also mentioned that younger generations today experience greater homophobia and violence than ever before, including harassment, violence, kidnappings, disappearances, and murders.

With respect to the previous panorama, pride marches are a space where sexually diverse individuals can express themselves freely without fear of being judged, repressed, violated or discriminated against. They are a special day to show diversity, come out of anonymity and walk the streets manifesting themselves as they are, something they cannot be during each day in their lives, both privately and publicly. Also, when asking to 59% of the people who said they had attended a march about their main reasons, the answers were: 39.1% to celebrate diversity and pride; 30.7% so that sexually diverse individuals have more rights; and 24.3% to assert their identity or make themselves visible (Kaliopeo, p. 23).

The average that the people surveyed gave to the government of Jalisco in the level of respect for the human rights of the sexually diverse population was 6.29 while at the municipal level it was 6.18%. In addition, 48% of respondents said that the state government has done little to address issues that benefit people of sexual diversity. This feeling is the same in the municipalities, since 46% stated that they are not very concerned with this issue (Kaliopeo, pp. 48-49).

In this context, Jalisco is one of the 9 states of Mexico where more than 50% of the sexually diverse population is concentrated, with the State of Mexico, Mexico City, Veracruz, Nuevo León, Puebla, Guanajuato, Chiapas and Oaxaca leading the list (National Institute of Statistics and Geography [INEGI], 2021). However, Jalisco is a state where the sexual diversity community still experiences fear of expressing their gender identity.

Therefore, it is important that the federal, state and municipal governments undertake actions of respect towards people of sexual diversity, since they are a vulnerable sector of society, where they cannot live freely according to their sexual or gender orientation, so it is necessary that actions are taken that stop violating said population and live in a context of peace, freedom, fullness and respect.

CONCLUSION

This informative note made it possible to know that the visibility of people of sexual diversity continues to be a reason for mockery, fear, and finger-pointing, which is why they are afraid to express their gender identity. In this regard, as could be observed, they continue to hide their sexuality and change their way of being for fear of suffering a negative reaction in the spaces where they interact. Furthermore, they continue to suffer verbal harassment, mockery, insults from society as in 1978 when some organizations talked about these issues and at the same time there was mockery, rejection, and resistance in society. Today, it continues to be replicated despite the existence of laws prohibiting discrimination, such as the *Ley Federal para Prevenir y Eliminar la Discriminación* [Federal Law to Prevent and Eliminate Discrimination] (2003) and the *Ley Estatal para Promover la Igualdad, Prevenir y Eliminar la Discriminación en el Estado de Jalisco* [State Law to Promote Equality, Prevent and Eliminate Discrimination in the State of Jalisco] (2015). Currently in Jalisco there exists a fear of being diverse; there is no guarantee that people can express their sexual orientation or gender identity and live freely.

Actions should be undertaken in the streets to make sexual diversity visible, one of them has been the crosswalks, others can be images in the

streets, in public transportation, galleries, cultural events and, at the same time, that there should be those who guarantee the right.

Much remains to be done, and this is shown by the survey data reviewed. Hopefully in the not-too-distant future in Jalisco there will be a free manifestation of sexual diversity and there will be no more mockery, harassment and violence towards this population, so it will be between society and government that progress will be made towards a new society of respect for plurality and that, with actions in favor of it, it can be achieved. In Jalisco today, people of sexual diversity do not freely express their sexual and gender orientation for fear of negative reactions; this problem must be addressed, and the context must change.

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Case Study of the Academic Body "Health Promotion and Education" of the Autonomous University of Chiapas

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— Abstract—

The duties of an academic at the Dr. Manuel Velasco Suárez School of Medicine, Campus II, of the Universidad Autónoma de Chiapas (Autonomous University of Chiapas, UNACH), should focus on teaching, research, and community outreach, in addition to academic management (Luna-Ortega & Gárate, 2013).

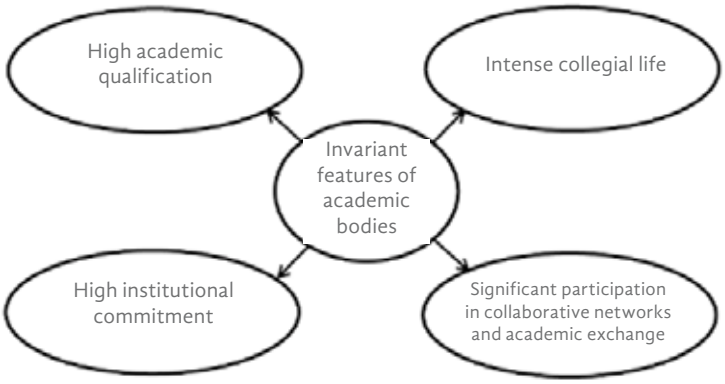
The generation and dissemination of knowledge is where the research paradigm has its foundations. It is essential for teachers to be organized into Academic Bodies, classified as Academic Bodies in Formation and consolidated Academic Bodies, in accordance with guidelines established by the Secretaría de Educación Pública (Ministry of Public Education, SEP) through the Teacher Improvement Program (Programa de Mejoramiento del Profesorado) (Luna-Ortega & Gárate, 2013). Thus, in order to achieve goals in any of the fundamental activities, coordinated and timely efforts must be made to achieve synergy among the members of the Academic Bodies. Based on the above, the characteristics of the Academic Body UNACH-CA-42 "Health Promotion and Education" tend to promote its status and continuous improvement, a situation that is considered key to the development and projection of the Dr. Manuel Velasco Suárez School of Medicine, Campus II of UNACH (FMH C-II, n.d.), this is achieved through collegial work, that supports the creation, dissemination, and social outreach of scientific knowledge in the field of health.

The Secretaría de Educación Pública (SEP) promotes, as part of its functions, the improvement of faculty members' academic qualifications and professional skills (Luna-Ortega & Gárate, 2013) within Public Higher Education Institutions (Instituciones Públicas de Educación Superior, IES) through the Teacher Professional Development Program (PRODEP), which encourages, as one of its strategic lines, the production, dissemination, and publication of scientific work, both individually and collectively, through bodies known as Academic Bodies (CA) (FMH C-II, n.d.).

Witin the public university subsystem, an Academic Body is defined as a group of full-time faculty members who work toward by objectives, in order to promote the creation or re-creation of knowledge, the development, transfer, or enhancement of technology, thereby impacting any sphere or ac-

tivity within society. These works are organized into Knowledge Generation and Application Lines (LGAC) (Secretaría de Educación Pública, 2013a).

In addition, the SEP (Luna-Ortega & Gárate, 2013) indicates that CA should be formed within the framework of institutional policies and that teachers who comprise them are grouped according to a genuine interest in the development of their LGACs. Within each institution, these groups have their own characteristics, but in all of them there are always at least four elements that have been called invariant features of academic bodies, schematically represented in Figure 1.



Note. Secretaría de Educación Pública, 2006 (Luna-Ortega y Gárate, 2013).

Figure 1. Invariant features of academic bodies

The Academic Bodies (CA) from each IES has a PRODEP classification, according to their production and collegial work within research, each level awarded demonstrates compliance with certain indicators established within the framework of the operating rules (Luna-Ortega & Gárate, 2013). There are three categories, which are:

- Academic Body in Formation (CAEF).
- Academic Body in Consolidation (CAEC).
- Consolidated Academic Body (CAC) (Secretaría de Educación Pública, 2013a).

The Academic Bodies of the Dr. Manuel Velasco Suárez School of Medicine, Campus II at the UNACH, have made progress in human resources development, particularly in the area of research, as among the four Academic Bodies registered and recognized by PRODEP is currently consolidated.

Currently, two CA are in the consolidation process: one has achieved consolidated status; while the other has lost its registration. The results are largely due to the efforts made by the CA, focusing on the training of

undergraduate students and academic management (Luna-Ortega & Gárate, 2013). It is worth noting that one aspect that had not been taken into account is the mobility of members, which requires future planning for the constant renewal of human resources.

This paper presents the analysis and strategies that the UNACH-CA-42 Academic Body "Health Promotion and Education" is implementing to advance from an Academic Body in Consolidation to a Consolidated Academic Body.

MISION AND VISION OF THE DR. MANUEL VELASCO SUÁREZ SCHOOL OF MEDICINE, CAMPUS II

Mission

The Dr. Manuel Velasco Suárez School of Medicine is a public institution dedicated to training leading professionals in the health sciences through updated, competency-based programs that promote self-regulated learning and meet standards of excellence, with an emphasis on ethical conduct and respect for the culture of individuals, aimed at preserving and improving the health of the population of Chiapas and society in general (FMH C-II, n.d.).

Vision

By 2025, the Dr. Manuel Velasco Suárez School of Medicine is a leader in the education of high-quality health professionals through innovative education and creative, applied research with a high impact on the well-being of the population of the state of Chiapas and the country (FMH C-II, n.d.).

MISSION AND VISION OF UNACH-CA-42 "HEALTH PROMOTION AND EDUCATION"

Mission

CA UNACH-CA-42 "Health and Promotion and Education" is responsible for the generation, dissemination, and application of knowledge in the field of skills development for education, promotion, and prevention in the field of health, through projects and programs adhering to the principles of Bioethics, which contribute to the training of teachers and students at the Dr. Manuel Velasco Suarez School of Medicine, Campus II. Moreover, it maintains close relationships with national and international academic networks that share the same goals.

Vision

CA 2027 UNACH-CA-42 “Health Promotion and Education” is recognized as a Consolidated CA. It is made up of teachers with doctoral degrees and recognition of the Desirable Profile. The members form highly competitive human resources at the undergraduate and graduate levels in programs recognized for their quality. They publish and disseminate their results collectively, and their output is a benchmark at national and international levels, which contributes to placing the Health Area in a plane of academic excellence. They are part of national and international academic networks and contribute to social and human development with relevance and social responsibility.

Objective

Design, manage and operate programs and projects that offer comprehensive inter- and transdisciplinary training, with a vision to identify problems that affect individual or collective health, both nationally and internationally. Additionally, it prepares leading researchers and specialists in this field who disseminate their results through traditional and electronic media.

Code of ethics

The purpose of this code is to provide guidance for the development of academic activities, contribute to improving the quality of collective and collegial work, and increase the satisfaction of the communities with which we collaborate. In this manner, the members of the CA join the effort to strengthen the core activities of the Dr. Manuel Velasco Suárez School of Medicine at the Autonomous University of Chiapas, Campus II (Luna-Ortega & Gárate, 2013), with the aim of consciously ensuring compliance with the regulatory framework governing the core functions of the academic body.

As members of the CA we are committed to apply the methodologies, scientific and academic processes, whose purpose is to generate and disseminate the results of the work carried out within the CA. Thus, the members are ethically committed to:

1. Participate in a collegiate manner in the activities of the CA (face-to-face or remotely) invariably respecting the official rules, as well as the programs, protocols and procedures established in the institution.
2. Maintain friendly and respectful treatment between colleagues and the community, establishing links of effective and affective

communication, as well as dignified and considerate treatment with respect to the socio-cultural condition and preferences of people.
3. Propose projects for teaching, research, and extension of services within the regulatory framework of UNACH.
4. Have an integral and productive performance from the efficient use of working time, as well as the rational use of the resources that are available for the performance of substantive duties.
5. Register projects and activities with the corresponding faculty and university authorities, in accordance with the established procedures, while also ensuring their appropriate dissemination in the existing academic spaces (Rivera, 2019).
6. Acknowledge and provide, in presentations or publications of any type and medium, the corresponding credits to academic and technical collaborators who have contributed to the research with some degree of authorship or co-authorship (including research assistants, photographers, among others), as well as the financial or institutional support received (Rivera, 2019).
7. Acknowledge and extend appropriate thanks to the non-academic collaborators of the project (such as secretaries, librarians, archivists, among others) (Rivera, 2019).
8. Thank, recognize or, as appropriate, give credit for the legitimate contributions of formal academic authorities, even when such contributions derive strictly from the fulfillment of the duties associated with their office or position, they hold (Rivera, 2019).
9. Correctly cite data, ideas, documents, interpretations, arguments, or complete texts from other researchers. Sources must be cited with complete accuracy to avoid plagiarism (Rivera, 2019).
10. Disseminate the results of the CA's projects in a collegial manner.
11. Comply with the principles of bioethics at all times.

BACKGROUND OF CA-42

This section presents the background of CA-42 in order to situate its role within the institutional dynamics of the School of Medicine (FMH-CII) (Luna-Ortega & Gárate, 2013).

CA-42 was established in 2002, and its founding leader was Dr. Laura Elena Trujillo Olivera, who invited four full-time faculty members affiliated with the School of Medicine, Campus II at that time, as shown in Table 1.

Table 1
Creation of the Academic Body in Formation in 2002

Year of entry	Associate	Academic Profile
2002	M.Sc. Laura Elena Trujillo Olivera (Líder)	Surgeon and Master's Degree in Health Sciences Education.
2002	M.Sc. Ángel René Estrada Arévalo	Doctor and Master's Degree in Health Sciences Education.
2002	M.Sc. Denny Domínguez Domínguez	Doctor and Master's Degree in Health Sciences Education.
2002	M.Sc. Teresa Dávila Esquivel	Bachelor's Degree in Pharmaceutical Biology (QFB) and Master's Degree in Health Sciences Education.
2002	M.Sc. Octavio Orantes Ruiz	Pediatrician and Master's Degree in Health Sciences Education.

Note. Based on the CA-42 historical archive.

Over the following years, CA-42 was classified as an Academic Body in Formation (CAEF), a status that enabled the strengthening of its members' professional profiles through postgraduate studies. For other members, this period also involved holding senior administrative positions, such as the Rectorship of UNACH and even the Secretariat of Health of the State of Chiapas, as was the case of Dr. Ángel René Estrada Arévalo.

In 2005, Dr. Laura Elena Trujillo Olivera was admitted to the Doctor of Science (PhD) program in Ecology and Sustainable Development, which at the time was listed in the National Register of Quality Postgraduate Programs (PNPC) of CONACYT. The program was offered by the Department of Health and Population at El Colegio de la Frontera Sur (ECOSUR), San Cristóbal de las Casas Unit, Chiapas (ECOSUR, n.d.).

In 2007, Dr. Néstor Rodolfo García Chong joined the CA as a member, coordinating the development and implementation of a new work program. This initiative resulted in several scholarly outputs, including a book, book chapters, and manuscripts published in various national and international peer-reviewed, double-blind indexed journals. The evaluated productivity led to the CA being granted the status of an Academic Body in Consolidation (CAEC). Subsequently, in 2009, the CA underwent a new evaluation and achieved the status of a Consolidated Academic Body (CAC). The Knowledge Generation and Application Lines (LGAC) was defined by consensus, based on the academic profiles and research interests of its members as shown in Table 2, and was established as Health, Disease, Care.

Table 2
Academic Body in Consolidation, 2010

Year of entry	Associate	Academic profile
2005-2010	M.Sc. Laura Elena Trujillo Olivera	Surgeon and Master's Degree in Health Sciences Education.
2005-2010	M.Sc. Néstor Rodolfo García Chong	Surgeon and Master's Degree in Health Sciences Education.
2005-2010	M.Sc. María de los Ángeles Cuesy Ramírez	Medical Specialist in Audiology and Phoniatrics and Master's Degree in Health Sciences Education.
2005-2010	M.Sc. Marlene Zúñiga Cabrera	Surgeon and Master's Degree in Health Sciences Education.

Note. Based on the CA's historical archive.

The CA-42 work program was planned with the aim of achieving consolidation, which was accomplished by adjusting to a single LGAC, as well as obtaining a doctoral degree for more than 50% of its members; however, as shown in Table 3, only 3 members were successfully integrated.

Starting in 2012, the CA-42 joined a Thematic Network with other CAs from Universidad Autónoma de Tamaulipas, Benemérita Universidad Autónoma de Puebla, Universidad Autónoma de Baja California, Universidad de Quindio, Colombia and Universidad Autónoma de Chiapas. Collaborative work within this network facilitated the production of various manuscripts and books published during those years.

Table 3
Consolidated Academic Body in 2010

Year of entry	Associate	Academic profile
2010-2017	Dr. Néstor Rodolfo García Chong (Lider)	Surgeon, Master's Degree in Health Sciences Education and Doctor of Science.
2010-2017	Dr. Laura Elena Trujillo Olivera	Surgeon, Master's Degree in Health Sciences Education and Doctor of Science.
2010-2017	M.Sc. María de los Ángeles Cuesy Ramírez	Medical Specialist in Audiology and Phoniatrics and Master's Degree in Health Sciences Education.

Note. Based on the CA historical archive.

In 2017, Dr. Laura Elena Trujillo Olivera (founder of CA) completed her retirement process. In 2018, Dr. Hilda María Jiménez Acevedo joined, followed by Dr. Miguel Ángel Rodríguez Feliciano in 2019. Together with these members, various manuscripts, books, and book chapters were produced, along with significant contributions to the training of human resources. At the end of 2018 and beginning of 2019, Dr. María de los Ángeles Cuesy

Ramírez retired. Unfortunately, due to Dr. Trujillo's retirement in 2018, all the production from previous years was not considered in the corresponding evaluation of CA-42, a situation that led to a decline in status, returning to CAEC, as illustrated in Table 4.

Table 4
Academic Body in Consolidation

Period	Associate	Academic profile
2019-2025	Dr. Néstor Rodolfo García Chong (Lider)	Surgeon, Master's Degree in Health Sciences Education and Doctor of Science.
2019-2025	Dr. Miguel Ángel Rodríguez Feliciano	Bio-Pharmaceutical Chemist, Master of Science and PhD in Educational Research.
2019-2025	Dra. Hilda María Jiménez Acevedo	Bachelor's Degree in Political Science and Public Administration, Master's, Degree in Social Management and Social Policy, and Doctor in Social Development.

Note. Based on the historical archive of the CA

DEVELOPMENT STRATEGIES FOR CA-42

This section presents the methodology of the analysis conducted within the CA-42 to establish strategies that culminate in the promotion of the level and developing a work plan with short, medium, and long-term goals. With the aim of identifying and developing key strategies for the advancement of CA-42, the Strengths, Weaknesses, Opportunities, and Threats (SWOT) matrix methodology was employed (Luna-Ortega & Gárate, 2013).

The specific objective of the SWOT analysis is to identify factors that positively or negatively affect CA-42 and establish comparisons that enable the generation of feasible alternative strategies, which will subsequently be selected and prioritized to finally identify CA-42's core objectives (Zabala, 2006).

It is therefore essential that the SWOT analysis warns the potentialities, challenges, risks, and limitations of CA-42 with respect to its institutional policy from an intercultural perspective to propose its strategic objectives (Ansión & Villacorta, 2004).

The analysis begins with strengths and weaknesses. Strengths are the set of factors that enable development, while weaknesses are the set of factors that hinder, limit, or create barriers to institutional development (Luna-Ortega & Gárate, 2013). According to Zabala (2006), opportunities are external factors that can enable or promote an institution's development, while threats represent the set of external barriers that may hinder its de-

velopment. A model proposed by Venegas (2006) is presented to display the SWOT analysis by categories. These categories were selected by CA-42 in accordance with the current PRODEP operational guidelines, as illustrated in Table 5 (Luna-Ortega & Gárate, 2013).

Table 5
SWOT analysis conducted in 2023

Analysis category	Strength	Opportunity	Weakness	Threat
I. Academic production	• Most CA members committed to collegiate research. • Existence of individual and collective production. • Completed research projects by CA members. • Bachelor's and master's thesis supervised by CA members. • Possible publications in high-impact journals. • The products obtained feedback into the academic program.	• Extraordinary federal support for publication expenses. • Existence of alternative sources of financing. • Inclusion in academic collaboration networks.	• Low overall production. • Limited production in educational research. • Emerging scientific output in Journal Citation Report (JCR)-indexed journals. • Intensive academic management prevents a strong focus on publications • CA members must demonstrate substantial collegial activity in their production.	• External processes for evaluating teacher productivity
II. Teacher profile	• The 4 members with a doctor's degree. • 5 of the 6 collaborators hold doctoral degrees.		• Only 2 of the members have a desirable profile.	
III. Teaching career	• All CA members with postgraduate studies. • All CA members with wide teaching careers. • All CA members have publication in indexed and peer-reviewed journals.		• Scarce thesis supervision at undergraduate and graduate levels. • Incipient participation of CA members in the SEI or SNI.	
IV. LGAC	• All CA members advise on competency units related to the LGAC. • They include undergraduate students to develop projects in the LAGCs that the CA cultivates.			

V. Redes de investigación	• CA members collaborate with members of other CAs, both national and international; some of them are consolidated. • CA members leverage established contacts to involve more than one member in the research conducted.	• Limited collaboration with other CAs within the FMH.

From the developed SWOT matrix, strategic lines of action were generated within each established category. Often, this type of analysis remains at the organizational diagnosis phase, as analyzing the competencies and observable behavior of the various functional roles reveals that significant changes are required. Changes to be implemented within the CA regarding its structure and distribution of members were identified, which are summarized below (Luna-Ortega & Gárate, 2013).

Restructuring

In the self-assessment conducted, it was observed that CA-42 met most of the requirements for a CAEC, except for participation in the SNI and SEI. The current distribution of members is illustrated in Table 6 (Luna-Ortega & Gárate, 2013). Additionally, there are five collaborators holding doctoral degrees and one with a master's degree: one expert in the clinical area, two experts in the development and evaluation of medical clinical competencies, and three experts in the field of gerontology.

Table 6
Current conformation of the CA-42 (2025)

Associate	Academic profile	Knowledge generation and application area	Status	Educative program
Néstor Rodolfo García Chong	Surgeon, Master's Degree in Health Sciences Education and Doctor of Science.	• Children's health. • Epidemiology and Public Health.	Member (Lider of CA).	Surgeon.
Miguel Ángel Rodríguez Feliciano	Pharmaceutical Biochemist, Master's Degree in Science and Doctor in Educational Research.	• Microbiology and Medical Biochemistry. • Educational Research.	Member.	Surgeon.

Margarita Yvon Valdez Morales	Surgeon, Master's Degree in Educational and Social Gerontology, Master's Degree in Health Science Education and Doctor in Education.	• Gerontology. • Healthy aging.	Member.	Gerontology.
Dra. Hilda María Jiménez Acevedo	Bachelor's Degree in Political Science and Public Administration, Master's Degree in Social Management and Social Policy, and Doctor in Social Development.	• Poverty and health.	Member.	Doctorate in regional studies.
María del Socorro de la Cruz Estrada	Surgeon with a specialty in Health Services Administration and Master's in MDG Management.	• Public Health. • Health system. • Gerontology and Public Health.	Collaborator.	Surgeon and Gerontology.
Nelyda Hernández Badillo	Sociologist, Master's in Demography and Doctor in Social and Political Sciences.	• Demographic Statistics (natality, mortality, and migration). • Qualitative and Quantitative Research Methodologies.	Collaborator.	Gerontology.
Angélica Jassey de León Sancho	Surgeon, Master's Degree in Competency-Based Education and Doctorate in Educational Technology.	• Medical simulation. • Evaluation of exit competencies in General Medicine.	Collaborator.	Surgeon.
Rogelio Ernesto Marcial Zavala	Bachelor's Degree in Pedagogy, Master's Degree in Cultural Studies, Doctorate in Regional Studies, and P.G. Diploma in Gerontology.	• Gerontology. • Studies on LGBTIQ+ aging and old age. • Quality of life and well-being in older adults. • Biopsychosocial Approaches in Gerontology. • Research Methodology in Sciences.	Collaborator.	Gerontology.
Elizabeth Robledo Argüello	Surgeon, Master's Degree in Competency-Based Education and Doctorate in Educational Technology.	• Medical Simulation. • Assessment of graduate competencies in General Medicine.	Collaborator.	Surgeon.

Carlos Patricio Salazar Gómez	Surgeon with a specialty in Clinical Genetics, Master in Higher Education and Doctorate in Educational Technology.	• Epidemiological Surveillance of Hereditary Diseases. • Study and Monitoring of Chronic Degenerative Diseases. • Assessment of graduate competencies in General Medicine.	Collaborator.	Surgeon.

The Knowledge Generation and Application Lines

As one of the reflections arising from the CA's self-assessment, the LGACs were updated to align with each member's academic profile and experience, as well as undergraduate and graduate programs existing at FMH C-II, and the content of the competency units overseen by each faculty member.

Line 1. Salutogenesis

The prevailing concept of *health* and the predominant approach, from which daily life is developed, serve as the general population's reference for the perception of health and the socially and culturally constructed values linked to it.

This concept had been isolated from life promotion, but following the Alma-Ata Declaration (PAHO/WHO, 1978), a new vision was established, initiating what is now known as "Health Promotion", as outlined in the Ottawa Charter postulates (WHO, 1986) and the new *health* designation from the World Health Organization (Ramos, 2000).

This new paradigm emerges as a key element for well-being and good health, supported from an ontological perspective: corporeality, emotionality, spirituality-in harmony with the environment (Rivera,2019), which projects lifestyle modification as strategy through health promotion and education.

Likewise, this new paradigm is not disconnected from Public Health, where healthy policies are generated in urban, community, and individual settings (Rivera, 2019), to improve quality of life, including environmental conservation.

Currently, *Salutogenesis* holds significant importance in Public Health, as it enables individuals, communities and populations at large to enhance their capacity to improve health and well-being through lifestyle habits that prioritize health lifestyles as a determining factor in the quality of health (Rivera, 2019) of people, communities, and the environment.

Line 2. Communication and education

This research line proposes a threefold exploration of the relationship between the educational field and the communicative field, through the discussion and investigation of the logics of production, social circulation, appropriation and consumption of knowledge in contemporary societies.

The current educational reality is characterized by a growing role of information media and technologies in discursive production and circulation, an explosion of practices, devices and modalities for the generation, transmission and assimilation of knowledge, in addition to an accelerated hybridization of cultures and diversification of cultural consumption. This scenario poses multiple challenges to education, especially with the increasing predominance of Artificial Intelligence today (CUCSH, n. d.).

CONCLUSIONS

Through the collaborative work of the members of the Academic Body and their individual contributions of experience, it was possible to concretize the SWOT analysis, which enabled the rethinking of the internal work lines within the CA.

Thus, the development of the SWOT analysis of CA-42: "Health Promotion and Education", with specific categories aligned to the evaluation criteria of PRODEP, has enabled the identification of improvement opportunities and the proposal of strategic actions to restructure the CA's work (Luna-Ortega & Gárate, 2013).

As the result of the situational analysis, areas of opportunity were identified to guide the Academic Body's future work. Achieving the new objectives and goals will require the active commitment of each member.

This work is dedicated in memory of Dr. Carlos Patricio Salazar Gómez, an esteemed teacher, and dear friend.

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