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To disseminate multidisciplinary scientific unpublished articles, elaborated under the parameters of the research methodology, written with academic rigor and based on the teaching practice.

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The topics covered are the theoretical bases of the Education Sciences in its different specialties and levels of the educational system. Priority will be given to papers describing pedagogical experiences, didactics used, innovation processes, and their relationship with new educational technologies.

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From its origins, the Revista Céetdra was published in printed format. It is currently published in electronic format, using virtual environments to align to the needs of the revista s users and editors.

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Cátedra Journal, of the Universidad Central del Ecuador, Faculty of Philosophy, Letters and Educational Sciences, publishes scientific articles on various areas of knowledge related to Educational Sciences, based on the methodology of educational research and community service.

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To be promoters in the publication of high quality scientific articles that, guided by research and from different areas of knowledge, become the most prestigious reference in the understanding and improvement of the educational process.

FOCUS AND SCOPE: Revista Cátedra has as its theoretical basis the Educational Sciences in its different specialties and levels of the educational system. Priority will

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It disseminates scientific-academic articles constructed under the parameters of research methodology. It is open to national and international writers interested in contributing significantly to the solution of current educational problems.

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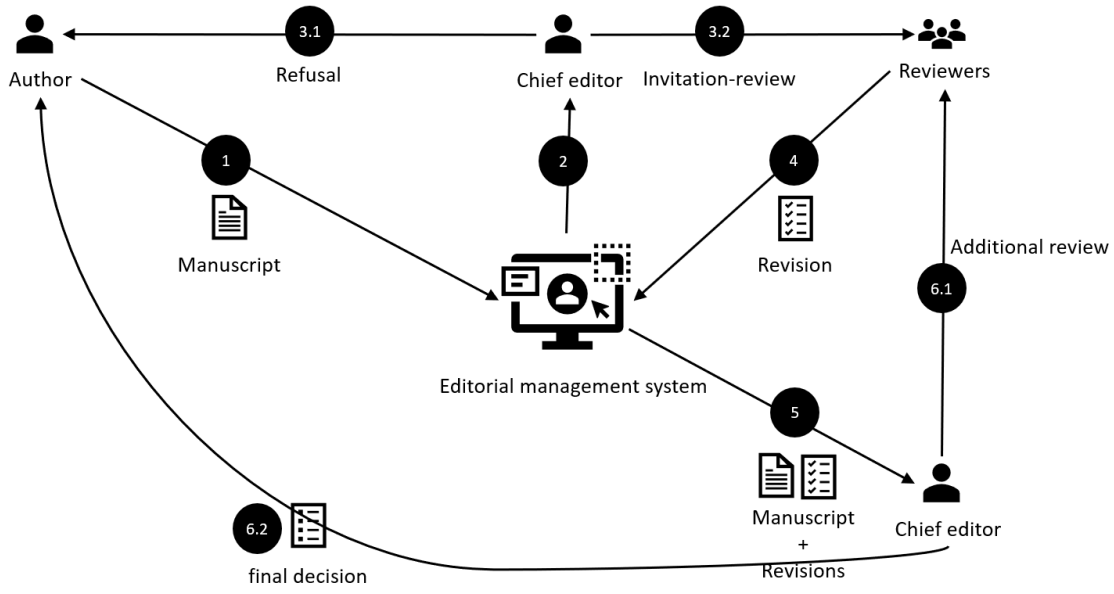

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- **Time for publication:** The periodicity of the journal is quarterly; therefore, editors are the guarantors of the fulfillment of time limits for revisions and publication of accepted works.

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EDITORIAL

For the editorial team of the Cátedra magazine, it is satisfying to present in each of its issues valuable research in the socio-educational context. On this occasion we show to the academic community the results of eight scientific articles with high methodological rigor, whose refereeing and publication process corresponds mainly to interdisciplinary dissertations on local and national didactic problems.

The first article, with an emphasis on literary pedagogy, corresponds to the authors Glenda Viñamagua Quezada and Paúl Puma Torres; it is entitled " Alterity, introspection, self-knowledge in the works Bruna Soroche y los Tíos and La pasión según G.H.". Framed in the hermeneutic, critical, and interpretative analysis, this research is based on the methodology proposed by the thematic and the imagotypes, to approach the religious symbology in the imposition of identity and ethnicity as a social construct product of the look of the center and the periphery. The contribution of this research was to determine in the writing of Alicia Yánez Cossío and Clarice Lispector how, from fiction, self-recognition is manifested through introspection in the construction of identity. As a second article, we present " The vocational identity of the initial and terminal level in the teaching careers of the Faculty of Philosophy, Central University of Ecuador", belongs to the researchers Wilman Ordóñez Pizarro, Juan Castejón Costa, Byron Chasi Solórzano and Willam Aguilar Veintimilla. The results of this study of ontological-pedagogical nature allow proposing academic strategies to prevent students' desertion while consolidating their personality as future teachers, in accordance with the challenges they will have to assume in today's education. The authorship of the third article concerns Alfredo Figueroa Oquendo, who reflects on " Intrinsic motivation and its impact on the academic performance of university students in Ecuador". The importance of the results of this work lies in the application of gamification as an autonomous, dynamic, and participative cognitive strategy in positive relation to the academic performance of university students. The fourth article is entitled " Use of Information and Communication Technology for Quality Management in the Classroom", authored by Paulina Pauta Ruales. At a time when digital literacy is related to educational quality, the study delves into the management of the baccalaureate classroom, to point out that information technology is not being adequately managed with respect to the stages of planning, organization, leadership, and evaluation of knowledge. It is undoubtedly a wake-up call that opens the debate on the role that information and communication technologies should play in the new paradigms and challenges of the educational scenario.

The articles from the fifth to the eighth have the particularity of being circumscribed to the teaching-learning process in the field of Biology and Chemistry. In this sense, Fernanda Faicán Juca and Renato Manzano Vela, present their " Open research in laboratory practice to learn Chemistry in high school students". The study points out

that students of this discipline are not directly involved in the construction of their own knowledge due to the excessive attachment to the laboratory guide at this educational level. The authors' proposal is oriented to the application of an open, constructivist methodology that allows students to strengthen their research process in the chemistry laboratory. The sixth article " Obtaining vegetable dyes as a didactic resource in Biology laboratories", authored by Raúl Pozo Zapata, Adriana Barahona Ibarra, Jonathan Tigasig Urcuango and Marxuri Vivar Toapanta, is also praiseworthy; it proposes that a natural vegetable dye can be obtained from the Jamaica flower using vinegar as a solvent; the intention is to use this procedure as a didactic resource that allows improving the experimentation in the Biology laboratory. The penultimate article, entitled " In bioethical criteria in demonstrative and experimental practices with animals in the Career of Pedagogy in Chemistry and Biology", under the authorship of Marjorie Murillo Cumbal, Anabel Velasco Chaluisa and Elizabeth Pérez Alarcón, exposes the need to use, in the laboratories of these scientific disciplines, bioethical norms in the study of animals to avoid their unnecessary sacrifice. To conclude, authors Lizeth Simbaña Farinango, Helen Figueroa Cepeda and Mónica Caizatoa Flores, close our current issue with their article " Incidence of procrastination on the academic performance of the subject of Chemistry". These researchers demonstrated that procrastination in homework due to the use of social networks and technological devices negatively affected the academic performance of chemistry students. This is research that invites us to reflect on the teaching role when it comes to behaviorally influence the performance of our students, to help them manage anxiety, improve their self-esteem in the face of evaluative pressure, anxiety and fear of failure.

From the Editorial Board of the Cátedra magazine, we hope that the socio-educational issues raised in this issue contribute to the academic debate, as a support tool in the generation of didactic strategies relevant to the requirements of our readership.

MSc. Luis Cuéllar
Managing Editor

REVISTA CÁTEDRA

Alterity, introspection, self-knowledge in the works Bruna Soroche y los Tíos and La pasión según G.H.

Alteridad, introspección, autorreconocimiento en las obras Bruna soroche y los tíos y la pasión según G.H.

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Abstract

In this research work, a critical and interpretative analysis of the works Bruna, soroche y los tíos by Alicia Yánez Cossío and La pasión según GH by Clarice Lispector was carried out, taking as a point of convergence the theme of the image as a space where the gaze of the other is determinant in the construction of identity. For the development of this research, the methodology proposed by the theatology and the imagotypes was used. Concerning the theoretical support, the postulates of Córdova 2016, Boadas 2016 and Sánchez 2005, who is based on Moura's theoretical proposal on the three aspects of the image, were used as a starting point. In this way, the religious conception in the imposition of identity and

ethnicity as a social construct product of the gaze of center and periphery were determined as thematic axes. This analysis, which is based on the hermeneutic tradition, aims to analyze the construction of identity from the gaze of the other and how this idea is perpetuated and conceived as true from the transcendence of the image and religious symbology, as occurs in the novel Bruna Soroche and the uncles. While in the work La pasión según GH, the image is assumed as a trigger for self-recognition through the introspection provoked by the subaltern gaze. The contribution of this research lies in determining how fiction creates narrative spaces where there is a relationship between the gaze and the image in the construction of identity.

Keywords

Alterity, social construct, imagootype, image, thematics.

Resumen

En este trabajo de investigación se realizó un análisis crítico e interpretativo de las obras *Bruna, soroche y los tíos* de Alicia Yánez Cossío y *La pasión según GH* de Clarice Lispector, se tomó como punto de convergencia el tema de la imagen como un espacio donde la mirada del *otro* es determinante en la construcción de la identidad. Para el desarrollo de esta investigación se tomó la metodología propuesta por la tematología y los imagotipos. En el concerniente al sustento teórico se partió de los postulados de Córdova 2016, Boadas 2016 y Sánchez 2005, quien se basa en la propuesta teórica de Moura sobre los tres aspectos de la imagen. De esta manera se determinó como ejes temáticos la concepción religiosa en la impostación de la identidad y la etnia como un constructo social producto de la mirada de centro y periferia. Este análisis, que se sustenta en la tradición hermenéutica, tiene por objetivo analizar la construcción de la identidad a partir de la mirada del otro y como esta idea se perpetúa y se concibe como verdadera a partir de la trascendencia de la imagen y de la simbología religiosa, como ocurre en la novela *Bruna Soroche y los tíos*. Mientras que en la obra *La pasión según GH*, la imagen se asume como un detonante del autorreconocimiento a través de la introspección que provoca la mirada *subalterna*. El aporte de esta investigación radica en determinar cómo desde la ficción se crean espacios narrativos donde existe una relación entre la mirada y la imagen en la construcción de la identidad.

Palabras clave

Alteridad, constructo social, imagotipo, imagen, tematología.

1. Introduction

In this research work, an analysis of the literary works Bruna, soroche y los tíos by the Ecuadorian writer Alicia Yánez Cossío and La pasión según G.H. by the Ukrainian-Brazilian writer Clarice Lispector is carried out. In order to deepen the study of these novels, two elements that are considered key to this approach will be taken. The first will address the theatology to deal with the theme of otherness as a common factor in both works. Meanwhile, the second aspect of this study will focus on three aspects of the image, according to the postulates of Moura, who according to Sánchez (2005):

> First, he proposes to approach the term image as an image of the (or of the) foreign or foreigner. Second, he suggests investigating the image as a product of a nation, culture or society (the social imaginary). Finally, he

> suggests delving into an image as a product created by a particular author (p. 13).

The question to be answered in this analysis is how is otherness constructed from fiction based on introspection and social revelation, actions that characterize the characters GH in the work The Passion according to GH by Clarice Lispector and María Illacatu in the work Bruna Soroche and the uncles by Alicia Yánez Cossío? For this purpose, the theory of the theatology and imagology developed in Moura's proposal will be taken as a basis, according to Manuel Sánchez 2015.

Regarding otherness, it will be based on the postulates and the vision of Córdova, who conducts his studies on otherness from the perspective of transmodernity. In this sense, the definition proposed by Eduardo Sousa (as cited in Córdova, 2016) will be used as a starting point.

> The "other", being defined by Eduardo Sousa as the philosophical principle of alternating or exchanging one's own perspective for that of the other, considering and taking into account the point of view, the conception of the world, the interests, the ideology of the other, and not assuming that "one's" is the only possible one (p. 1003).

In the literary works analyzed in this study, otherness is portrayed in the female characters mentioned above, who from their internal dialogues reflect on the dimension of life from introspection and from the questions that arise from their relationship with society. In this sense, the stereotypes that model behaviors, assign roles and annul human beings in their deepest feelings gain strength. In some cases, this leads to the revelation of the female characters, who undertake the search for their own selves through the motif of the journey. Either from the space of introspection as in the case of the character GH or from focusing the gaze outward as in the case of Bruna.

The importance of this study lies in reflecting on otherness as the space that allows us to explore the internal and external world of the characters in order to know the different ways of seeing, understanding, feeling or living them. And literature shows this possibility that remains hidden in the course of everyday experiences. In this sense, literature is revealed as a space of sensitivity, analysis and reflection that shows a different reality characterized by questioning the status quo of a homogenized society, imposed from the West, which mutilates the being to assign value from its objectification and thus make it functional.

It is considered that this study is pertinent and addresses a topical issue, since from art and specifically from literature, aspects are opened through fiction where it is possible to reflect on facts that concern humanity in general and that are manifested through individual experiences.

> When the character is the narrator himself and tells us the story from his point of view, he does not usually give us descriptions of himself, physical descriptions, but he does communicate his vision of the world, his moral and aesthetic categories, in a very powerful way, we end up having an image of him, knowing him (Puértolas, 1993, p. 148).

In the novels under study, the conflicts of the female characters are the product of the struggle between social impositions and the construction of their own destiny that opposes the norm. The narrative voice in both works shows beings who, upon recognizing themselves, question the roles that society has assigned to them, thus producing a struggle where memory, religion, and social conventions trigger internal conflicts in the characters. In a passage of Bruna, Soroche and the uncles, Bruna gives her friends bathing suits that fall apart when the young women dive into the water. This moment of relaxation culminates in a tragedy, due to a society that appropriates the female body; where sexuality becomes a value to which life itself is sacrificed:

> They preferred to resist the cold of the water rather than go out and expose their nakedness: The girls were compared to Maria Goretti and declared from the pulpits of the churches: martyrs of purity -These heroic girls preferred death rather than commit a sin of impurity (Yánez, 2010, p. 306).

The female body has been relegated to the space of taboo and social property promoted by religious power. It is a world where women do not decide, but rather they accept what society determines and even more, they feel guilt for not complying with what society demands of them. When the woman submits herself to the norm that leads her to assimilate her body under the concepts of taboo, shame or shamefulness, she is forced to sacrifice her thoughts and identity in favor of a religious reward that makes her a saint, then, religion endorses the social subject as the owner of the female body.

The conflict in The Passion according to GH also has a religious background, society takes over the decisions about women's bodies. At this point, in addition to moral motives, as in the case of Bruna, there are also aspects such as the preservation of status, economic, social or intellectual notoriety, which are superimposed on the value of life.

> Mother: I killed a life, and there are no arms to embrace me and in the hour of our desert, amen. Mother, everything now became solid gold. I interrupted an organized thing, mother, and that is worse than killing, that makes me enter through a breach that showed me, worse than death, that showed me rude and neutral life yellowing. The cockroach is alive, and the eye of it is fertilizer, I'm afraid of getting loutish, mother (Lispector, 1964, p. 55).

When these conflicts that concern a patriarchal vision of society are manifested through literature, these stories become unique and revealing. The exercise of recreating these themes in depth through the actions of the characters allows us to internalize diverse feelings, thoughts or sensations. Then, those who get involved in the plot through reading have the ability to question the system that takes over individuals, their affections and desires.

This characteristic of fiction creates in the reader a catharsis by recognizing in the reality of these characters personal or social sequences. From this emotional and intellectual shake-up, reflection and critical thinking are enhanced and, at the same time, it contributes to the construction of a symbolic reparation.

Regarding the structure of the article, section 2 contextualizes the works that constitute the corpus of this analysis. Section 3 presents the methodology applied for the development of

this research. Section 4 presents the results of the research, applying the selected analysis criteria. Section 5 deals with the discussion. Section 6 records the conclusions according to the results obtained.

2. Contextualization of both novels

In order to continue with this study, it is necessary to approach both novels through the most outstanding features that lead them to converge in the same subject of analysis.

2.1 Bruna soroche and uncles

Bruna, the protagonist of this novel, is the youngest member of a Quito family whose prejudices lead them to hide their indigenous ancestors, masking them with a change of surname, religious fanaticism, naivety or madness. These characteristics become symbols in the behavior of Bruna's uncles, who also come to represent a society in decline that is ending along with them and that gives way to new generations with new conflicts. These new generations seek a space and an identity by emulating the behaviors and customs of foreigners. The death of each of Bruna's uncles is understood as a metaphor for the death of thoughts marked by the shame of miscegenation, characteristic of a society in decline that gives way to a new generation in a constant search to find a place and an identity.

2.2 Passion according to GH

G. H. are the initials of the protagonist of Lispector's novel. She belongs to an influential economic and social sector of Rio de Janeiro, where she is well known for her closeness to the arts, an activity that has allowed her to achieve status within her social circle. In her inner life, however, the protagonist experiences an emotional uprooting caused by an abortion and her failure in love.

These conflicts that GH experiences generate emptiness and anguish, emotions that she tries to purge when she eats a cockroach in the room of her ex-employee, whom she has just fired. In addition to these feelings that the protagonist experiences, as a result of the introspection generated by being alone in her apartment, there is also the questioning that she feels when she can't remember the name of her employee, Janair. The indifference she has shown to Janair leads the protagonist to question her lack of empathy towards others. Janair, through her gaze, invites GH to self-knowledge. The trigger in this process of introspection is an image: a mural that Janair is presumed to have drawn in the room she occupied before being fired.

3. Methodology

The methodology followed in this research is based on the methodology of theatology and imagotypes. As a branch of comparative literature, tematology studies the abstract dimension of literature and its relationship with multiculturalism. It allows an approach to works coming from different cultures, where similar themes are addressed. This discipline is fundamental to understand the connections between literary works from different cultures and their communicative force, as is the case in this study. The application of this method, approached from the analytical documentary approach, allows focusing the analysis on the elements that determine the themes, motifs and characters such as stereotypes in the context of literary representation.

Regarding imagology, Moura's theoretical proposal is followed, as a branch of literature that focuses on the study of images and their relationship with identity and culture. In the case of this study, religion was determined as a guide for analysis in the imposition of identity

and ethnicity as a social construct product of the look of center and periphery. In this aspect there will be an approach regarding the individual or collective self over the other individual and collective self, within the concept of otherness. The thematic inquiry followed in this research is linked to hermeneutics, since this interpretation explores the historical, social and cultural motives that configure the characters as the triggers of the works object of this study.

4. Results

4.1 The theme of otherness in the construction of the characters María Illacatu and G.H.

Otherness is presented as a concept where there is what is valid and what departs from this conception or differs from it. From this concept, the other emerges as a space of conflict that questions the fact of being classified as different. With respect to this concept that has its place of enunciation from a place of power. Ruiz (n.d) indicates that:

> in this approach, the other (the foreigner, the madman, the marginal, the homosexual, the woman, etc.) is the one who distinguishes himself from the limit of the world and questions it. It appears fortuitously in the horizon of understanding that sustains us and shakes the system that sustains this horizon (p. 99)).

The other, then, within a system built from imposition, becomes the marginalized, a being that must be hidden or is forced to hide, to deny himself. Within this context, otherness emerges as a way of establishing difference and acceptance, recognition without making comparisons with a center conceived from a vision of center and periphery. Córdova (2015) is supported by Enrique Dussel's studies to affirm that:

> otherness is knowing how to think the world from the alterative exteriority of the other, which has as a consequence the recognition of the other as different from the self, through the face-to-face encounter with the other, the oppressed, the poor; that is, someone who escapes the power of the subject and who responds rather to an experience and a temporality that do not belong to the self (p. 1003).

According to Aguirre, the Spanish invasion of America brought with it various types of violence that led to the annulment of a civilization that had been built based on logics different from those of Western thought. This other way of thinking the world had as one of its axes an integral and harmonious thinking, since both the environment and the human being were conjugated in spaces that contributed to the conservation of what could be understood as human dignity in consonance with the environment: "within the indigenous cosmovision [...] the earth is conceived as a mother, it is the mother that gives, compact with men, who are considered important within the community" (Aguirre, 1986, p. 18).

This principle of integrality that follows a form of horizontal relationship clashes with the vision and lacerating action that the Spaniards brought with them. This culture that was imposed with the use of violence marked the behavior of the original inhabitants, leading them to hide their way of relating to the world. This concealment of identity becomes a form of symbolic violence whose traces are manifested in the character María Illacatu, an indigenous woman from whom Bruna descends. María Illacatu was robbed of her culture,

her identity, and they tried to implant a new way of life that tried to legitimize itself through the permanence of the image:

> Maria Illacatu had succumbed long before her portrait was made. She did not resist the tragic process of her transplantation and her adaptation to the white world. Her customs, inherited from centuries and anchored to the land with a lordship of race, had to be erased overnight as if they were stigmata.
> -The Indian has to be put in a corset to pose.
> -And are you going to spend so much money to paint her...?
> -So that my grandchildren won't say that...
> -Oh, yes, I understand! (Yáñez, 2010, p. 83)

María Illacatu was disguised to erase her indigenous identity when she was portrayed. Thus, the portrait assumes an impostured identity. The indigenous past is hidden behind an image that denies the other, who is marginalized from a society that is built on shame. The meaning of the image is located as the truth that endures, survives and is accepted, because it is the only one that testifies in a tangible way an artificial and imposed truth. That truth that appeals to appearance and that complies with the stereotype of beauty that is demanded of women from the imposition of the West:

> as individual images, photographs of natives and "traders" posing in awkward forms and exotically attired were judged by the same canons of beauty, convention and physiognomy used to evaluate bourgeois portraits (Poole, 2000, p. 164).

The character G.H., on the other hand, recognizes that the life she has (until the moment she sees the cockroach, an animal she describes as ancestral) and which is reflected in a photograph in which she smiles, is a reflection of what others have constructed about her, the image of the Western woman who triumphs in the modern social scene.

> Sometimes, looking at a photo taken on the beach or at a party, I would distinguish with slight ironic apprehension what that smiling, darkened face revealed to me: a silence. A silence and a destiny that escaped me: me, a hieroglyphic fragment of a dead or living empire. When I looked at the portrait, I saw the mystery (Lispector, 1964, p.14).

The photograph in the novel La pasión según G.h., or the portrait in the novel Bruna, soroche y los tíos, are associated with the idea of the stranger or foreigner where the gaze of the other is used to impose an identity, in addition to what Sánchez (2005) indicates as a second aspect of the study of the image "as a product of a nation, culture or society leads us to the theme of otherness" (p. 59). This affirmation that Sanchez takes from the studies carried out by Moura with respect to the imagotypes directs towards the image of the other with respect to the society in which he lives. These constructs turn the being into a stranger in front of his own reality and his image or what the individual assimilates as his image is not his true "I", but an artifice that society makes of the subject, with the purpose of achieving that he fulfills roles and that he adjusts and perpetuates an imposed system.

With respect to image and representation, Pool (2006) mentions "seeing and representing as material acts insofar as they constitute means of intervening in the world" (p. 15). The

image becomes tangible through the act of the gaze, and this in turn becomes an act of domination and control, a situation experienced by María Illacatu and G.H., women with polarized social conditions one from the other, a particularity that makes even more tangible the symbolic violence that subjects two women who do not follow the route that society has historically marked for them.

However, in both characters there is a trigger that allows them to look inward. Either through contact with nature, which becomes an accomplice in moments of uneasiness, as in the case of María Illacatu, in the context of her near maternity:

> Maria Illacatu told the secret of her motherhood to the road and the road took pity on her by suddenly cutting off and stopping in the ejidos of a town that opened its windows to see an arriving caravan. No one noticed how the land ran into the ravines and the mountains retreated. The road contracted: ten trees went inside one. The birds fell down dead of old age and the eggs just laid became wings (Yánez, 2010, p. 86).

A similar situation occurs in the case of G.H., when two key situations present themselves to her: the first, the contemplation of the drawing in her ex-employee's room. This image, which shows a naked couple with their dog, represents for the character G.H. a sort of mold in which she fits genuinely and more comfortably than in the photographs of her trips and parties, where she smiles. We would thus be in front of what Pérez (2016) nominates as "the image of the other is the mirror of one's own" (p. 19). These cave images open a door for G.H. to observe her inner self, that ancestral being that emerges through an exercise of introspection that allows her to undress her inner self. G.H. approaches her inner self, the one that society taught her to hide, since her role was to fulfill the stereotype of the educated, artistic, refined and well-to-do woman.

> On the whitewashed wall next to the door - and that is why I had not yet seen it - there was almost a life-size silhouette, drawn in charcoal, of a naked man, a naked woman and a dog that was more naked than a dog. In the bodies was not drawn what nudity reveals, the nudity came only from the absence of everything that covers: they were the silhouettes of an empty nudity. The line was coarse, made with the broken tip of the charcoal. In some pieces the line was duplicated as if one stroke was the tremor of another. A dry tremor of dry charcoal (Lispector, 1964, p.25).

Before seeing the insect in Janair's room, G.H. does not recognize herself, she does not find her true self, she is only aware that what she has experienced up to that moment is the product of an image constructed by agents external to her. Her true inner self was known to her employee, the woman whom G.H. fired, and that is why she painted this image for her. In this regard, Levinas (2001) mentions that:

> the Desire of the Other [Autrui] is born in a being that lacks nothing or, more precisely, is born beyond what can lack or satisfy it. This Desire of the Other [Autrui], which is our very sociality, is not a simple relation to the being in which, according to the formulas from which we started, the Other becomes the Self (p. 57).

The second situation that G.H. experiences is the symbolism of the cockroach, because in the moments of his introspection this insect ceases to mean a pest-animal and becomes the symbol of the return to the origin and the integrality of the human being by merging with it. This form of acceptance of two realities in the same being is possible when he observes it carefully and turns it into his food in order to mimic the essence of the animal that represents the hidden side and thus recognize his true identity, the one he wishes to hide.

> That morning, before I entered the room, what was I? I was what others had always seen me to be, and that's how I knew myself. I couldn't say what I was. But, at least, I want to remember: what was I doing (Lispector, 1964, p.14).).

This reflection precedes the turn that G.H.'s life will experience after entering the room of Janair, his former employee. And that then leads to a recognition of his true self, which at times he is afraid to face. When he observes this image, G.H. senses that this encounter will allow him to find himself again in a new space and tries to return to his origin, which he achieves at the end of the work, when he merges with an original insect by devouring it. In that instant GH dies as an image formed by the other and lives from herself by recovering her inner self. In this regard, Pérez (2016) indicates:

> Nowadays, scholars are increasingly emphasizing that this discipline (imagology) not only helps to understand the idea of the Other from its representation but also to become aware of an "I" with respect to that Other (p. 12).

The character of María Illacatu recovers her origin through the murder of the person who took it away from her, and returns to it through her suicide. Thus, it is possible to establish an analogy between three actions that occur in these stories: the murder of the Spaniard, Maria Illacatu's husband; the death of the cockroach and the reunion that the authors of these murders experience with themselves, Maria Illacatu with her suicide and G.H. by eating the cockroach.

Through death, both women free themselves from the image that society constructed of them and recognize themselves in a new space where they are reunited, where they are no longer strangers to each other or to themselves. In this regard, Ruiz (n.d.) states that "the problem of otherness finds its origin in the assumption of a center. Accordingly, we acquire an identity whose foundation is to provide us with a location and a meaning that articulates the way we relate to the world" (p. 99). In the female characters indicated, that center wavers because they feel emptied within a space that does not recognize them, but has molded them to fulfill a role through the annulment of their self. To which they recover with their death, either physical as in the case of María Illacatu or the death of an image constructed by society in which GH does not recognize herself.

With respect to the identity that is constructed of the self through the vision of the other, it can be noted that the characters María Illacatu and Janair remain invisible, the space they occupy is that of the shadow and they come to light while they are productive for those who make use of them. Maria Illacatu is given another life and her welcome letter is the baptism she receives "I baptize you, Yahuma with the name of Mary. In the name of the Father, the Son and the... And she was called María from that moment when they poured water over her bent head and washed with it the ideas of father Sol" (Yánez, 2010, p. 78). From the moment

of baptism, María Illacatu becomes visible to a society that has marginalized her. Religion is then understood as a form of repression that annuls the human being and makes him/her visible as long as he/she adjusts to what the Western vision determines as the center. In this regard, Ruiz (n.d.) affirms:

> The clearest criticism of the attempt to know the other is formulated on the basis of practical historical experience. It has been sought to know the other in order to dominate and subjugate him, never to establish a permanent and daily dialogue in which the possibility of the other's participatory existence is granted (p. 99).

Within her cultural context, Maria Illacatu was the daughter of a cacique and would be a wife of the sun. But when she was taken by force by a Spaniard, these privileges were taken away from her and she was visible as much as the gold she possessed, an element that nullified her and from which she detached herself with her suicide: "all the truths of our present are the surviving beliefs of the past. Beliefs that were imposed on others and come to us as truths in use. The history of the center is not wrong, until the other appears and shakes that order that excludes it" (Ruiz, n.d., p.99).

Concerning Janair, there is a singularity, she is invisible while she is useful to G.H., and her strength is present in her absence, her being takes shape while G.H. remembers her through the traces she left in the back room that was destined for servitude, a space that G.H. had never been to, although it was within the same place where she lived as the owner of the apartment. When she entered that white room, she recognized herself and realized that the image that society had made of her was nothing more than a staging that she had represented up to that moment

> That woman, G. H. in the leather of the suitcases, was me; is it me, still? No. From now on I foresee that the hardest thing my vanity will have to face will be the judgment of myself: I will have all the appearance of one who failed, and I alone will know if bankruptcy was necessary (Lispector, 1964, p. 20).

This questioning that arises from her loneliness and that in an internal dialogue allows her to recognize that she does not feel identified with the life she has and that is represented by the initials of her name. This identity that has been built from the gaze of her environment, also opens a door to the uncertainty of knowing if the identity in which she recognizes herself, which is distant from the other and which comes only from her, will be enough to move away from the one she was. These reflections come to her and come to the surface when she remembers Janair:

> I looked at the mural where I must have been represented... Me, the Man. And as for the puppy, was this the epithet she gave me? For years I had been judged only by my peers and by my own environment, which were made, in short, of myself and for myself. Janair was the first truly alien person whose gaze I became aware of (Lispector, 1964, p. 26).

The gaze of the other gives way to the construction of an identity. In the case of G.H., the gaze of an invisible person offered her the possibility of recognizing and reconstructing

herself, far from the gazes that had constructed an identity that she felt alien to, and that turned her into a hollowed-out being.

> It was then that I unexpectedly managed to remember his face; of course, how could I have forgotten it? I saw again the black and calm face, I saw again the entirely opaque skin that seemed more like one of her ways of keeping quiet, the well-drawn eyebrows, I saw again the fine and delicate features that were barely distinguishable in the dull blackness of the skin (Lispector, 1964, p. 26).

Janair, in this case is a door to introspection and to the construction of identity based on self-knowledge and acceptance. "We are the other with respect to a history of thought that ignores us. And it is the otherness and its possibility what sustains us and the aspiration to a realization that in this time we ignore what we expect" (Ruiz, n.d., p.100). When G.H. recognizes Janair's physical features, she also recognizes herself, she banishes from herself the image she has created of her identity and now longs to rediscover the truth and the origin, elements symbolized in an ancestral insect.

4.2 Imagotipo: three aspects of Moura's proposal in Bruna Soroche and the uncles and The Passion according to GH.

Before carrying out the imagological analysis, we quote what Boadas (2015) mentions regarding the factors that need to be taken into account when carrying out a work of this nature: "to stop and reason about which cultures are looked at, how they are looked at, from where they do it and if from that look attitudes linked to judgments, questioning, dreams, fantasies about the Other emerge" (p. 143). The aspects mentioned by Boadas coincide with the three axes from which Moura starts: "the image of the foreign or foreigner, the image as a product of a nation, culture or society, and the image as a product created by a specific author" (Sánchez, 2005, p. 13).

Within the works analyzed in this study, the elements that are found in function of the parameters indicated are presented in the following tables:

Works under study	**Traces leading to otherness**
Bruna soroche and uncles	Presence of religion Image configuration Imposition of identity Image, identity and meaning
Passion according to G.H .	Alterity Social role as a construct Recognition of the inner self Encounter between the real self and the self as social construct

Table 1. Traces of otherness in the plays Bruna Soroche and the uncles and The Passion according to GH.

Bruna, soroche and the uncles	Passion according to GH
The apostles in Aunt Catalina's bed	Rupestrian images in the utility room Images of a man, a woman a dog painted in the utility room. service room.
images of pool, mermaid, manneken pis	The image of the unclean and the occult represented in a Cockroach.

Table 2. Imagotypes in the plays Bruna Soroche and the uncles and The Passion according to GH

4.3 Bruna, soroche and the uncles: the apostles in aunt Catalina's bed

The character of Aunt Catalina shows a woman who takes refuge in her particular way of understanding faith, a faith that instead of evoking peace in those close to her, provokes fear and rejection. This character conceives faith from the point of view of repression, flagellation, sacrifice, etc. And he demands the same behaviors from those around him. In this regard, Sánchez (2015) indicates that "the imagotype consists of several elements, including images, stereotypes or prejudices" (p. 24). Catalina's stereotype is that of a woman who shuns affection and the spaces of pleasure that life generates and hides in religion conceived from repression.

This way of living her faith led her to ask a carpenter to build her a bed whose pillars were the four Evangelists, and which is described in the novel as follows:

> The four evangelists: St. Mark, St. Luke, St. John and St. Matthew had been lowered from heaven itself to contemplate the murky dream of the aunt. They were covered with gold leaf on which the painting had been applied... (Yánez, 2010, p. 265).

The significant thing about this image of the bed is its exterior, as it is described as an unreachable space, it transmits fear and marks distance. It can be noted, according to the description, that there are inconsistencies in the proportions of the evangelists, a detail that is narrated with a certain sarcasm. In view of this particularity, Aunt Catalina, a woman marked by religion, does not feel comfortable, but accepts it. Another detail of this resting place is that, just as its exterior is majestic, despite the errors pointed out, the mattress, the inner part of the bed, is rather modest and neglected. In this passage of the novel, the latent conflict between the inner self and the outer self is addressed.

> It was a papal bed, imposing, superb, on which any mortal other than the aunt would have had qualms of conscience when lying on it. But the mattress was miserable, made of moor straw, stiff and cold, full of icy edges that penetrated through the skin, until they touched the bones (Yánez, 2010, p. 266).

An analogy can be drawn between the inner and outer parts of the bed with the image of Catalina, whose stereotype is that of a sanctimonious woman who shows a reserved

exterior, intent on following the norm, but with an intimidating lack of feelings. However, her inner self is cold, worn, stiff, just like the mattress. According to Sanchez (2005) "the imagotype consists of several elements, among them images, stereotypes or prejudices" (p. 24) In the character of Aunt Catalina we can see portrayed the stereotype of a repressed woman who takes refuge in religion as a way to face the outside world that hurts her, because her inner self, like the straw of the mattress of the papal bed, is dry.

4.4 The images of the pool: mermaid, fish, manneken pis

These three images have water as a common factor, symbol of the flow of time and of the generations that are renewed in Bruna's family. The little mermaid would be linked to the uninhibited, spontaneity, femininity that characterized the house, while Camelia the weeping one led it. This image of novelty represents the new world that Camelia discovered on her journey and the sensuality that characterizes this female character.

When Aunt Catalina was in charge of the house, she replaced the little mermaid with a stone fish. She attributed this change to the fact that the fish was the first symbol of Christianity, and since religion, in the way she understood and practiced it, was her main reference, she decided to make this change. Religion from a traditional conception constituted the axis that guided Catalina's life, which was reflected in the image of the fish in the pool. This symbol located in a strategic place in the family home constituted a refuge from what Catherine considered an impure world.

With the manneken pis, which came to replace the fish, the novelty of getting to know new worlds through migratory displacements returns and now comes from the hand of Bruna's brother, when he travels to Europe. The manneken pis, as well as the little mermaid, are uncovered images, that do not wear clothes and that to a certain extent represent freedom and abolition of ties, as well as the disinhibition that shows the inner being. These three elements that with the appearance of each family generation are replaced in the decoration of the pool of Bruna's house, are related by the flow of liquid, the mermaid and the fish inhabit the water, while the manneken pis emanates liquid in the form of waste. This last symbol is understood, then, as a prelude to the dissolution of Bruna's family.

> It was only a few days before grandma's house was to be demolished. They were going to tear down the walls that sheltered so many lives of orphaned children and so many generations. They were going to tear out the doors and windows as they had torn out the children of María Illacatu (Yánez, 2010, p. 207).

These images, which represent the identity of a family that tries to hide its origin, change as different stages pass and new generations inhabit it. Both the family and social spheres are linked in a space crossed by the religious and the mundane and are questioned within the novel because none of these spheres offers the possibility of freedom for its characters. On the contrary, these spaces of submission are confirmed or endorsed, which perpetuates the idea of the center-periphery and its influence within the family sphere. Faced with this behavior of abandonment that arises from the power groups, the other is marginalized, the one who does not fit within the parameters of social imposition inherited from the West. In this sense, Ballesteros (2016) indicates that:

> The oppressed, offended and humiliated, the vilified of history who become aware of their situation, are the only protagonists capable of

> breaking the silence that has denied their voice and presence for centuries (p. 176).

In the works analyzed in this study, the characters María Illacatu and Janair break the imposed silence and reveal themselves through the decision to appropriate their lives. In the case of María Illacatu, her presence is revealed through her suicide, while Janair, G.H.'s employee, acts as a mirror of the protagonist mediated by the image she painted in his room. This image plays the role of triggering processes of introspection that lead G.H. to question how he had led his life up to that point.

4. 5 Passion according to G.H.: image in the utility room

Among the most significant images found in this work is the painting that GH finds in the maid's room, which he presumes could have been made by Janair. What stands out about this image within the construction of the story is the freedom from conventionalisms that it presents, an aspect that is reflected in the nudity of the painting:

> On the whitewashed wall next to the door - and that is why I had not yet seen it - there was almost a life-size silhouette, drawn in charcoal, of a naked man, a naked woman and a dog that was more naked than a dog. In the bodies was not drawn what nudity reveals, the nudity came only from the absence of everything that covers: they were the silhouettes of an empty nudity. The line was coarse, made with the broken tip of the charcoal. In some pieces the line was duplicated as if one stroke was the tremor of another. A dry tremor of dry charcoal (Lispector, 1964, p.25).

This image is described as a sort of cave painting, whose objective is to leave testimony of a way of life or, in Moura's words, the second point is presented with more precision, where the study of the image as a nation, culture or society is approached. A society that, according to the narrative voice, built the image of the protagonist and she only lived it. From this construction, G.H. only recognizes the initials of her name, but when she observes the painting in Janair's bedroom, she feels that she has the possibility of constructing her own story and locating it in a physical space, since from the window of the maid's room she can see the peaceful landscape of the city, a place that calms her and where she aspires to be.

> I looked at the mural where I was supposed to be represented... Me, the Man. And as for the puppy, was this the epithet she gave me? For years I had been judged only by my peers and by my own environment, which were made, in short, of myself and for myself. Janair was the first truly alien person whose gaze I became aware of (Lispector, 1964, p. 26).

The quote reads that in the gaze of Janair, a woman who, because of her work and her skin color, is marginalized from society, G.H. can recognize her identity. The image presumably painted by Janair plays a mediating role between G.H.'s identity and Janair's gaze and allows the protagonist to rediscover herself, her origin or her inner self, a concept that is very recurrent throughout the novel.

4.6 The image of the cockroach as a symbol of origin, transcendence and ancestry.

The relationship that is built between the character G.H. and the cockroach as a product of the protagonist's introspection has as a common thread the search. This search that leads

to understand the origin or to reach a sense of belonging to society, which occurs as a process of personal construction that arises from the subject himself and not from his environment. When the environment intervenes in the construction of identity, it gives way to stereotypes that lead to the fulfillment of roles. Throughout the work, we reflect on the annulment of the self when a role is fulfilled, which leads to a permanent search for oneself. With regard to stereotypes, Sánchez (2005) states that:

> However, the question arises as to whether stereotypes and prejudices contain some elements of reality or whether they are exclusively the product of our fantasy. It seems that there are stereotypes and prejudices that lack any basis in reality, but we can assume that both real and unreal elements are united in them. Thus, conflicting interests between peoples are commonplace, but these are self-servingly exaggerated on the part of one or even both sides (p. 23).

From the point of view of imagery, the image of the cockroach in the novel represents the place of encounter with the ancestral or the point of origin. It can also be related to the infinite circle that has been present since the beginning of the world and that in its form encloses the mystery of the origin of life. In the novel we read:

> to know that they were already living on Earth, and the same as today, even before the first dinosaurs had appeared, to know that the first man had already found them proliferating and crawling, to know that they had been witnesses of the formation of the great oil and coal deposits of the world, and there they were during the great advance and then during the great retreat of the glaciers, the peaceful resistance. I knew that cockroaches resisted for more than a month without food or water (Lispector, 1964, p.3 0).

The description of this ancestral being, witness of the past and the formation of the world and also adapted to the dynamics of life, puts the protagonist in conflict, as she experiences a process of searching for her identity that occurs in two moments. The first occurs during this exercise of introspection, when the protagonist recreates Janair in her mind, when she is no longer there, because when she worked with her, she did not see her, she was an invisible being. The second and decisive step is the approach to this ancestral insect: "I learned that the unclean animal of the Bible is forbidden because the unclean is the origin, since there are created things that have never changed and have remained the same as when they were created" (Lispector, 1964, p. 46). The image of the cockroach represents the opposite side of her life and at the same time points the way to approach the origin of her life, that space that remains hidden in every human being because it is constantly changing.

The process of introspection that G.H. undergoes ends with the longing to appropriate the mysterious being that lives on the opposite side of what his life was, to interiorize in that new space and recognize himself:

> Oh, God, I felt baptized by the world. I had in my mouth the matter of a cockroach, and at last I had performed the smallest act. Not the ultimate act, as I had thought before, not heroism and sanctity. But at last the smallest act that I had always lacked. I had always been incapable of the smallest act. And like the smallest act, I had been deheroized. I, who had

> lived in the middle of the road, had finally taken the first step of its beginning (Lispector, 1964, p. 113).

The contact with the ancestral being allows G.H. to explore within herself, to recognize herself and understand her true identity, where the imposition that is built from the assignment of roles no longer influences her behavior. Regarding the image and the way of assuming it, Zambrano (2002) affirms: "the image of what we are offered, the vision of what we should be, does not appear confronting what we are, but developing in a movement that irresistibly tends to be followed" (p. 97). However, after the process of self-recognition that G.H. undergoes, the character turns this conception of identity upside down and confronts what he should be with what he is. He has tasted, through the viscosity of the cockroach, all the dimensions that make up the human being and in this process of renewal, a new way of starting to build himself arises, based on self-knowledge.

5. Discussion

By analyzing the works of this study under the criteria of religion, identity, otherness, as well as the incidence of the image when assuming behaviors and roles as one's own, the preponderant influence exerted by society in the construction of identity is determined. This process, which is presented as an imposition, modifies self-perception as an act that is generated from self-knowledge. The subject loses autonomy over himself and gives way to alienation as a personal state that then overflows to the cultural plane and endures in the social memory through the image as a product imposed and perpetuated from the imposition that is generated from the concept of race.

In the configuration of the character María Illacatu, the annulment of identity is presented as an act of violence that is generated from the complex that is enunciated from miscegenation. The desire of whitening that her environment exerts on the indigenous woman, to show her as the root of a new generation is given in a process of impostor image. The portrait shows a woman who has been masked; her indigenous features have been annulled, and the image emerges as a perpetuator of the idea of the white woman as the matriarch of a new generation. To this is added the gradual transformation of her surname, then the reconstruction of the name, that is to say, the language as a form of personal and cultural identity joins the force of the image to derive in a social construct that annuls and invisibilizes until it leads to the suicide of the character.

The force of the image as an imposition is also incorporated from the religious plane. The character Catalina, moves between cruelty and dogma, which is experienced as suffering or purge. The body is conceived as a space of sin, of guilt, so the character martyrs it, with actions that move from the emotional to the physical, which is manifested in the discomfort she feels by the noise of the children or by the exposure of the sensuality of the female body. It is also evident in the mortification she inflicts on her own body. The religious images that make up the character's bed are described as deformed, it is then represented in a sperpentic image, similar to the way in which the character lives religion.

In Passion according to G.H., the main character questions the role she has assumed, her stereotype conforms to that of a woman who develops in spaces where art is conceived as a place for the elite. The gaze of Janair, the woman who works for her and of Afro descent, becomes an upheaval that leads her to question the extent to which life is subject to a construction of its own, the product of self-knowledge, or is clearly due to the assignment of a role that is enunciated from a social imposition, based on the concept of race.

Janair leads the protagonist towards a return to her inner self, in this process, the symbolism of the cockroach as the ancestral being witnessing the events of time, opens the way for the main character towards her self-knowledge. The image of the insect is accompanied by the portrait that remains in Janair's room as a reinforcer of the ancestral being that shows his nakedness and his return to the original being supported by the image of the dog that protects the memory of the original state that survives in the character's consciousness. The absence of identity of the protagonist is also manifested in the social construction that provides identification such as the name. G.H. are the letters that identify her, and reinforce the confusion that the character experiences at that moment, she is torn between anonymity and the saturation of symbolism that leads to multiple interpretations. The character's feelings are exacerbated to the point of questioning the life he has led up to that moment, he thinks he has worn a mask imposed by society that has annulled his humanity and only when he has swallowed the cockroach has he become aware of it.

6. Conclusion

After carrying out a comparative analysis of these works by two Latin American writers, it was determined that the female characters present processes of annulment in the construction of their own identity. This type of social violence leads the female characters to find themselves in a constant search for a space that allows them to recognize themselves. The character G.H. explores the inner world to link the image that is constructed from the gaze of the other and that condemns her to fulfill a role assigned by society, but that annuls her as a thinking and feeling subject. GH's face, which is reflected in a photograph, in one of the passages of the work, is shown with a smile, this gesture clashes with the identity that remains hidden in the intimate and interior space of the character. The body is limited by a social construction that, by appealing to the exterior, prevents the emergence of one's own identity, which struggles to become visible.

The identity of the protagonist manages to emerge when the protagonist discovers in Janair's room a cave painting with a naked couple accompanied by a dog. The symbol of nudity in the image, far from showing a human being vulnerable due to the absence of a shell that protects him from the social gaze, presents a human being identified with his ancestral self. The message conveyed by this image becomes a destabilizing one that comes to shake what G.H. lived until that moment as his identity space.

From this process of inner search that detonated with Janair's dismissal, the gaze of the other emerges in the construction of identity. This gaze acquires the function of a mirror that deconstructs the imposed image. During this deconstruction, the character G.H. goes through phases that allow him to explore his inner self. At first she feels the need to clean the house, starting with Janair's room; this thought of the protagonist externalizes the concept of stereotype linked to prejudice. G.H. is surprised when she finds Janair's room clean. From this finding, the protagonist's beliefs are shaken. She feels that she lives in a farce that society has created for her. She accepts that a model of life has been imposed on her that she has limited herself to follow up to that moment. She then finds that one way to reclaim her inner self is to eat the cockroach that was in Janair's room and integrate her ancestral self into it. This mechanism of integration leads her to consider the construction of an authentic way of life that arises from herself.

Whereas, in Bruna's novel, Soroche and the Uncles, this search does not focus on the inner self that needs to recognize itself, but on the self that seeks a space in society. This being longs for his place in the world after a process of cultural destruction, where the identity of

the subject has been annulled through the imposition of customs, religion and concealment of origin. These elements are based on the vision of superior and inferior race, as a product of the homogenizing vision of the West. This is the case of María Illacatu, an indigenous woman who lived a process of personal and cultural annulment through a forced marriage, where she gradually lost her identity, which is reflected in the image that remains of her as the initiator of the family until the metamorphosis that her surname undergoes. Finally, María Illacatu decides to take her life as a way of resisting her destiny.

> The members of oppressed cultures are dehumanized and treated as objects, with whom mechanical and utilitarian relations of exclusive use and abuse are maintained. They themselves are functional instruments that annihilate not only the energy of their body, but also the breath of their spirit (Ballesteros, 2016, p. 173).

The female characters of Bruna, Soroche and the uncles hide their thoughts, their being and their feelings. In some cases, as in the case of Tía Catalina, this imposition becomes imperceptible, since the character complies with the assigned role. In her we can understand the stereotype of the beata who denies the sexuality of her body, of the spaces that generate joy or pleasure, such as the games or the children's commotion, for example. In her is embodied the construction of a woman who confirms with her actions an arbitrary construction of the principles of Catholicism. Thus, a double mask is condensed in her: the one imposed on women by confining them to the space of purity in order to be socially accepted, and the second one linked to the religious space, which preaches the need for suffering in earthly life. Both facets are combined in a mixture that annuls the corporal part of the feminine being, to polarize it by placing it in sin or in sanctity. The curious thing about Aunt Catalina's character is to notice how this imposition is naturalized in her. She does not question those who have constructed her character and willingly assumes her role as executioner.

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REVISTA CÁTEDRA

The vocational identity of the initial and terminal level in the teaching careers of the Faculty of Philosophy, Central University of Ecuador

La identidad vocacional del nivel inicial y terminal en las carreras de docencia de la Facultad de Filosofía, Universidad Central del Ecuador

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Abstract

The Faculty of Philosophy, Letters and Educational Sciences faces the challenge of ensuring that students choose a career in which their vocational identity enables their successful completion, so it has the need to have information to assist the decision making of institutional managers. The objective was to characterize the vocational identity of the initial and terminal level of the students of the seven careers of the Faculty of Philosophy of the Universidad Central del Ecuador, period 2022. A conceptual review of vocational identity was carried out and methodologically the research was based on positivism, quantitative approach, ex post facto, cross-sectional, comparative type. The population consisted of 941 students from seven careers of the Faculty. The Vocational Identity scale was used as a research instrument. It was found that there are statistically significant differences in vocational identity between the initial and terminal levels, likewise for the sex variable, men have greater vocational identity than women, the career Pedagogy of Experimental Sciences of Mathematics and Physics, and the career of History and Social Sciences had the highest levels of vocational identity, while the lowest scores of vocational identity were found in the career of Psychopedagogy. It was concluded that vocational identity is affirmed as the levels of study advance. The results will support the establishment of academic strategies to avoid desertions and improve the exit profile of future teachers.

Keywords

Psychological characteristics, initial teacher training, vocational identity, graduate profile, entry profile, entry profile.

Resumen

La Facultad de Filosofía, Letras y Ciencias de la Educación se enfrenta al reto de lograr que los estudiantes escojan una carrera en la que su identidad vocacional posibilite su culminación exitosa, por lo que tiene la necesidad de disponer información que coadyuve a la toma de decisiones de los directivos institucionales. El objetivo fue caracterizar la identidad vocacional del nivel inicial y terminal de los estudiantes de las siete carreras de la Facultad de Filosofía, de la Universidad Central del Ecuador, periodo 2022. Se realizó una revisión conceptual de la identidad vocacional y metodológicamente la investigación se basó en el positivismo, enfoque cuantitativo, ex post facto de tipo transversal, comparativo. La población estuvo compuesta por 941 estudiantes de siete carreras de la Facultad. Como instrumento de investigación se empleó la escala de Identidad Vocacional. Se encontró que hay diferencias estadísticamente significativas en la identidad vocacional entre el nivel inicial y terminal, así mismo por la variable sexo, los hombres tienen mayor identidad vocacional que las mujeres, la carrera Pedagogía de las Ciencias Experimentales de la Matemática y Física, y, la carrera de Historia y Ciencias Sociales tuvieron los mayores niveles de identidad vocacional, mientras que los puntajes más bajos de identidad vocacional se encontraron en la carrera de Psicopedagogía. Se concluyó que la identidad vocacional se afirma en la medida que avanzan los niveles de estudio. Los resultados apoyarán a establecer estrategias académicas para evitar deserciones, y mejorar el perfil de salida del futuro docente.

Palabras clave

Características psicológicas, formación inicial docente, identidad vocacional, perfil egreso, perfil ingreso.

1. Introduction

The mission of the Faculty of Philosophy, Letters and Educational Sciences is to train teachers of basic education and high school in various specialties, with scientific, axiological, and academic foundations according to the demand of Ecuadorian society, this requires of its applicants certain characteristics that allow them to fulfill the functions and tasks that demand the exercise of the teaching profession. Its implications are of enormous transcendence when considering that its work is directed to the integral formation of children and young people according to the policies of the Ministry of Education of Ecuador.

The nature of the problem is associated with the decision to select a professional career based on: 1) aptitudes, 2) interests, 3) vocational identity, 4) opportunities, and 5) the family and social context that contribute to an adaptation that allows overcoming the levels of demand of the teaching career. The difficulties in the training of future teachers are represented in the lack of vocational identity, low perseverance, and their dedication to the academic achievements of training. In addition, a fundamental obstacle is that the School does not have a systematized process associated with vocational identity, since the admission profiles are based on external processes managed by the Secretariat of Higher Education, Science, Technology and Innovation (SENESCYT), and the access profile for teaching careers is not specified, so the challenge of this research is to generate useful information to guide decision-making on curricular development and to strengthen vocational identity, attitudes and aptitudes required by the teaching profession.

The main contribution of this study lies in the analysis of the factors that determine vocational identity. In addition, the results are intended to guide the decisions of the faculty authorities and the performance of teachers in the classroom. The manuscript describes by means of a valid and reliable instrument the level of vocational identity. The study answers the following questions: what is the level of vocational identity of the students of the initial and terminal levels of the careers of the Faculty of Philosophy, Letters and Educational Sciences; what are the differences between sexes of the initial and terminal levels of the studied variable, in the seven careers of the Faculty of Philosophy, Letters and Educational Sciences, period 2022; and what are the differences between sexes of the initial and terminal levels of the studied variable, in the seven careers of the Faculty of Philosophy, Letters and Educational Sciences, period 2022?

In order to answer these questions, it should be considered that vocational identity as a psychological characteristic is important in the choice of a university career, so this article aims to disseminate the results of the study of characterization of vocational identity,

Consequently, this research formulated the following objectives and hypotheses:

1.1 Objectives

- To characterize the initial and terminal level vocational identity of the students of the Faculty of Philosophy, Letters and Educational Sciences of the Universidad Central del Ecuador in the period 2022.
- To establish if there are differences between sexes and initial and terminal cycles of the students of the Faculty of Philosophy, Letters and Education Sciences of the Universidad Central del Ecuador in the period 2022.

- To identify the levels of development of the vocational identity of 1st and 8th cycle students of the Faculty of Philosophy, Letters and Educational Sciences of the Universidad Central del Ecuador in the period 2022.
- - To group the levels of vocational identity according to the careers of the Faculty of Philosophy, Letters and Educational Sciences of the Universidad Central del Ecuador in the period 2022.

1.2 Hypothesis

- H1. There are statistically significant differences between sexes in the vocational identity of students of the Faculty of Philosophy, Letters and Educational Sciences of the Universidad Central del Ecuador in the period 2022.
- H2. There is a higher level of terminal vocational identity than the initial one in the students of the Faculty of Philosophy, Letters and Educational Sciences of the Universidad Central del Ecuador in the period 2022.

From the social point of view, it is considered that this research will have a positive impact, since it involves all the elements that intervene in the educational process, especially the professionals responsible for professional orientation and selection. It will guide the development of curricular planning and teaching-learning processes that are taught in the classrooms by the teachers of the education careers of the Faculty of Philosophy, Letters, and Education Sciences of the Universidad Central del Ecuador.

This research contains the following structure: introduction, objectives, hypothesis, theoretical reference, methods and instrument, participants, instruments, design and data analysis, results, discussion, conclusions, thanks and authors and researchers.

2. Theoretical reference

Vocational identity refers to a person's understanding and development in relation to his or her vocation or career. The identification of this involves the exploration and understanding of one's skills, interests, values, and personal goals in order to make informed decisions about choosing a profession or job that is satisfying and meaningful. In addition, it involves self-awareness and reflection on one's strengths, weaknesses, passions, and purpose. Also, it involves research, and acquiring information about different career fields, employment options, and career paths. As a person develops his or her vocational identity, he or she becomes more familiar with the options available and feels more confident in choosing a path that aligns with his or her interests and goals.

In this regard, it is stated that:

> Vocational identity includes the motives and interests that help a person decide what he or she wants to do in life. Theoretically, a well-formed vocational identity will help decide the job that brings the most satisfaction to a person, and at the same time these coherent and satisfying vocational decisions for the person could possibly increase his or her psychological well-being (Gutierrez, 2021, p.7).

It is important to note that vocational identity is not static but can evolve and change throughout life as individuals acquire new experiences, skills, and perspectives. Also, there may be times of uncertainty or reassessment of vocational identity, especially during major transitions, such as entering the workforce or changing careers.

According to Bohoslavsky (2007), he noted that "the chooser is not just choosing a career. He is choosing what to work with, he is defining what to work for, he is thinking about a meaning for his life, he is choosing a how, delimiting a when and where, that is, he is deciding his personal fulfillment" (p.14). When choosing a professional career, decisions are made that imply the integral development as a person and as a professional in search of self-realization.

According to Santana and Vigueras, effective vocational identity should be sectorized based on the context of complexity, recognizing that it is not pertinent to apply standardized and unified solutions, but rather to generate an approach that respects and recognizes the individual differences of students. This procedure is carried out through the search and analysis of data on educational and work opportunities in a welcoming environment that allows decision making about a responsible future and gives people full autonomy to initiate and carry out personal and professional development projects, from the contextual insertion of personal, socio-cultural nature and the context in which they perform (Santana and Vigueras, 2023, p.7).

The identity vocation includes two concepts with a deep psychological meaning: identity and vocation. The first is defined as a subjective conception of the self and a determinant of personality according to psychoanalytic theory. On the contrary, in Gestalt it is considered as a set of characteristics that determine the behavior of a person with a sense of belonging to a social or cultural group. Therefore, in this research it was considered that identity is a personality characteristic modifiable with time and space according to the experiences of a person, that is to say, it is dynamic and subjective. The second concept is vocation, which is determined by the interest, aptitudes, and pleasure of carrying out an activity that as a result the person achieves satisfaction in doing it. It was also considered as "the particular disposition of each individual to choose the profession or trade he/she wishes to study and practice, according to his/her aptitudes, psychological and physical characteristics, motivations and socioeconomic and cultural frames of reference" (D'egremy, 1982). (D'egremy,1982, p. 20).

The vocational provides a solid basis for the academic and professional orientation of students. It helps them select areas of study and careers that align with their interests and goals. This helps to avoid choosing careers that are not right for them, which could lead to dissatisfaction and lack of motivation in the future. According to Matthews et al., (2019).

> Professional identity requires a well-defined training, since there are variables that will be present within a complex process, in which students acquire skills, knowledge and attitudes necessary to be part of a group or discipline (p. 4).

A well-developed vocation aligned with an individual's interests and values contributes to their job satisfaction and overall well-being. Students who choose a career that they are passionate about and allows them to use their strengths and skills tend to be happier and more satisfied in their professional lives. Vocational identity education helps avoid impulsive choices or outside influences, which can lead to unsatisfactory careers. Vocational education promotes the holistic development of students by helping them to better understand themselves, make decisions aligned with their interests and values, and develop the skills necessary for a satisfying and rewarding professional life.

2.1 Vocational identity at university

Vocational identity in the university is an important aspect for the personal and professional development of students. It implies the consolidation of a vocational option consistent with their interests, abilities, and values, as well as the commitment to their academic training and future projection. Vocational identity in college can be influenced by various psychosocial factors, such as family support, institutional climate, job opportunities, social expectations, among others.

In this sense, Gálvez (2018) states that:

> Vocational identity in the university is an important aspect for the personal and professional development of students. It implies the consolidation of a vocational option consistent with their interests, abilities and values, as well as the commitment to their academic training and future projection. Vocational identity in college can be influenced by various psychosocial factors, such as family support, institutional climate, job opportunities, social expectations, among others.

Some studies have analyzed the process of formation and evolution of vocational identity in the transition from school to university and in the first years of university life, finding that there are different levels of vocational maturation according to the degree of exploration and commitment to a vocational option.

González et al. (2023) pointed out that the "process of choosing studies, among other reasons, is due to the existing gaps in the information to which they have access, as well as the guidance received from their families" (p. 254).

2.2 Importance of vocational identity

Vocational identity is important because it contributes to finding a purpose in life and feeling fulfilled in our work. When a person has a clear vocational identity, he or she feels motivated and committed to his or her work, which translates into better performance and greater personal satisfaction.

Gonzalez et al. (2020) state that:

> The importance of vocational identity in the choice of career in the pre-university student begins with the knowledge of why? and for what? he/she wishes to study, in addition to the need to know the particularities of the career that express: his/her future work location, the subjects to be studied by study plan and years, how it is evaluated, who will be some of the professors, among others (p. 4).

In addition, vocational identity also contributes to making important life decisions, such as choosing a career or a job. When you have a clear vocational identity, you affirm that you are prepared to choose a career or job that matches your skills and values, which increases your chances of success and self-fulfillment.

2.3 Vocational identity in teacher training

According to Ortega and Fuentealba, vocational identity is an important issue in teacher training since teachers need to have a clear vocation for teaching and feel committed to their social function in order to be able to perform their work effectively. The teacher in training begins to discover his or her professional work from the different experiences in school

classrooms: observation, analysis of classes and educational institutions, generation and application of teaching and learning sequences, classroom management, course leadership, among others (Ortega and Fuentealba, 2019, p. 118).

Teacher training seeks to foster the vocational identity of future teachers through reflection on their role as educators and on the values and principles that should guide their teaching practice. It also seeks to develop skills and competencies that will enable them to perform effectively in the classroom and in the educational community.

According to Day (2006), he states that:

> the development of one's professional teaching identity is seen as an ongoing process of clarifying what one believes about teaching-learning and, particularly, about oneself as a teacher, in order to establish one's roles and purposes, consistent with professional ethics (p. 330).

In this sense, Gómez et al. (2022) point out that:

> today, the role of teachers is not only limited to that of instructors and subject specialists, but they must also act as educators and problem solvers, be able to maintain fluid and constructive communication with families and mediate in conflict situations (p. 396).

Vocational identity allows them to find a purpose in life and feel fulfilled in their work, which translates into better performance and greater personal satisfaction. The world of work is dynamic and constantly evolving due to technological, economic, social and cultural changes. Some important aspects of the world of work include:

- **The labor market** is the space where supply and demand for employment meet. It comprises the availability of jobs and job seekers. Factors such as supply and demand, competition, economic trends and labor policies affect the labor market.
- **The labor world** involves the planning and development of careers and career paths. People seek opportunities for growth, promotion, and professional development. The International Labor Organization (2023) states that "increasing productivity is a key part of any strategy to promote formal work, through actions in key areas such as education, innovation, business climate and urban planning" (p.92). The demands of professionals are focused on the performance of efficiency for the fulfillment of their functions within the organization, based on innovation and management.

Decision making is a process that involves selecting among different options or alternatives available. It is a crucial skill in all aspects of life, including the professional arena. Start by clearly identifying the problem or decision you need to address. Understand the situation, the objectives you want to achieve, and the key factors involved. Gather all relevant and necessary information to make an informed decision. Do your research, ask questions, look for data and consider different perspectives. The more information you have, the more informed your decision will be.

Rubio and Gonzalez (2018) state that:

> Vocational decision making is a process that most adolescents go through at the end of secondary education. It is a moment of vital transition that implies, as subjective work, reviewing one's own school and personal path in order to be able to build some alternatives for the future. In some

> cases, these alternatives may be quite clear, since academic, personal and social backgrounds support, for example, the continuation of university studies or higher education (p. 2).

Decision making involves a certain degree of uncertainty and risk. Not every decision will result in the expected outcome, but every decision is an opportunity to learn and grow. Also, trust your intuition and your ability to make informed decisions based on your knowledge and experience. Making a career decision is a personal and unique process. Take the time you need, be patient with yourself and seek support if you need it. As you gain more information and clarity, you will be closer to finding a career that aligns with your interests.

Choosing a career based on vocation does not guarantee that you will not face challenges or difficulties, but it can provide you with a greater satisfaction and sense of purpose in your work. Take the time to explore your interests and evaluate your options before making an informed decision.

Currently there are several situations that students must take into account when entering college, if you add to this the doubts typical of youth, the pressure and the different difficulties that occur for entry into higher education, then there is no doubt that the choice of career is another of the most relevant and decisive and unique, taking into account that such a choice can mean dissatisfaction between job responsibilities and lack of commitment to it (Andrade et al., 2018, p. 374).

If you have a defined vocational path, that's great. Having a clear direction gives you a solid foundation to advance your career. Vocation to teaching is a topic that has been the subject of debate in society and in the educational community. Teaching can be viewed as both a vocation and a profession. Some argue that vocation is necessary to be a good teacher, while others argue that technical-pedagogical training is more important.

Teaching vocation has been defined as a natural inclination to engage in the professional activity of teaching with enthusiasm, commitment, and confidence in the power of education. According to López-de-Herrera et.al., (2020) "teaching as a profession emerged as a consequence of experiences in previous professions and as a late vocation. It was associated with greater emphasis to the idea of service, help and commitment, than, to a technical-professional concept." (p.49).

Emphasizing that vocation is a task, which demands from each person a constant effort of realization, a firm will that guides the steps and illuminates that inspiration that leads to one's own construction in and from the relationship with others (Romero, 2020, p.40). Self-evaluation and reflection on one's own teaching practice can help teachers develop their vocation and improve their teaching. Teaching can be a challenging and stressful profession, but it can also be very rewarding and have a positive impact on students' lives.

3. Methods and instruments

For the development of this research the "positivist paradigm" was selected (Hernández and Mendoza,2018, p. 673) the same examined the reality from the objectivity of the analysis of the initial and terminal vocational identity of the students of the Faculty of Philosophy of the Central University of Ecuador, starting from the basic description to determine a correlation between the two moments of the variables investigated, through the quantitative measurement of the presence of the variables and conclude on the hypotheses raised.

The scientific method was adopted, which guarantees the reliability of the results, and it also established a logical process from the statement of the problem, review of the existing literature, collection of information and procedures for the analysis of the information to issue scientific conclusions on the variables investigated.

The research had a correlational scope (Hernández and Mendoza, 2018. p. 700), which facilitated testing the hypotheses raised, using inferential statistics of the data collected through a test of exploration of the vocational identity.

3.1 Participants

The research population consisted of 941 students from the 7 courses of study, from the first semester and eighth semester, who have received the entire initial training process prior to graduation as professionals in the Education Sciences courses. The students of the seven courses of study were considered. Students in intermediate semesters were excluded from the study. The sample used was intentional, considering the inclusion and exclusion criteria mentioned above.

3.2 Instruments

The vocational identity scale is a tool used to measure the degree of clarity and stability of a person's vocational identity. It is composed of 20 items and is developed throughout life and is influenced by personal, social, and cultural factors.

It is composed of several interrelated elements, such as interests, values, skills, personality and experience. The scale responds to career goals, satisfaction with current job and stability of career choice. The results of this scale can help individuals to better understand their vocational identity and to make more informed decisions about their career and professional life.

3.3 Procedure

The data collection procedure follows the following steps:

- On-site verification of information sources.
- Contact with the academic managers of the center and the university.
- Obtaining informed consent from the students selected for the study. Prior to the application of the instruments to the samples selected for the study, the process of socialization of the research and the purposes it pursues will be carried out with the students involved in such a way that, in knowledge of the work to be done, they by their own rights and will can give the researcher the Consent for its realization through a signed document so as not to violate any right or susceptibility of the students. In this process the endorsement, support and participation of the Ethics Committee of the Central University of Ecuador will be requested, as well as the directors of the career for the application of the instrument that was done online.
- Application of the evaluation instruments outside class hours in the places established in the same Faculty. For the application of the instruments that will allow the collection of the empirical information needed in the research, a calendar was drawn up according to the availability of the students during working hours, with the previous authorization of the professors of the class to be held at that time. The calendar was made known to the directors of the faculty and of each of the careers for their corresponding authorization, cooperation and support.
- Distribution of the application of the instruments in an average time of 20 minutes.

3.4 Design and data analysis

In the development of this research an ex post facto research design of cross-sectional and comparative type is used, which allowed us to collect data at a single point in time, and to compare students according to sex-gender, at the beginning and at the end of their university studies, and according to the type of career.

The data were analyzed through descriptive statistical techniques that allowed the construction of statistical tables by variable and its dimensions, the calculation of the arithmetic mean and standard deviation for quantitative variables, while for categorical variables they were calculated as percentages.

Likewise, inferential statistical techniques made it possible to contrast the differences in vocational identity according to the sex/gender of the students and the comparison of the students of the first and eighth semesters, by means of Student's t-test, as well as the comparison of the careers through the analysis of variance, ANOVA, of one factor.

4. Results

The results are presented in accordance with the objectives of the study: first the differences between sexes are examined, then between first and last semester students, and finally the differences between careers, taking in all cases vocational identity as a study variable.

	Male Students	**Femenine students**	**Contrast test of means**	
Variable	*M (DS)*	*M (DS)*	*t*(939)	*P*
Vocational Identity	36.16 (4.39)	35.06 (5.28)	-3.32	.001

Table 1. results of the t-test for mean difference between male and female students in Vocational Identity.

Note. N students = 376, N female students = 565; M = Mean; SD = Standard deviation, in parentheses.

As can be seen in Table 1 the male students score slightly higher than the female students; although this difference is small it becomes statistically significant (t= 3.32, p= .001).

Table 2 presents the results of the t-test for difference of means between first (1) and last (8) semester students.

First semester students score lower (35.10) in vocational identity than last semester students (35.96). These differences are very small, although they become statistically significant (t= -2.64, p= .008).

Variable	**Cicle 1** ***M (DS)***	**Cicle 8** ***M (DS)***	**Contrast test of means** ***t*(939)**	***P***
Vocational Identity	35.10 (5.12)	35.96 (4.76)	-2.64	.008

Table 2 Results of the t-test for the difference of means between levels of beginning and end of studies in Vocational Identity.

Note. N semester 1 = 501, N semester 8 = 440; M = Mean; SD = Standard deviation, in parentheses.

Tables 3 and 4 provide the results related to the vocational identity of the students of the different careers of the Faculty of Philosophy and Educational Sciences of the UCE.

Table 3 presents the descriptive statistics, mean and standard deviation, for each of the seven careers.

Career	*Media*	*Standard deviation*	*N*
Pedagogy of Chemistry and Biology	35.20	4.94	184
Computer Science Pedagogy	35.86	4.59	124
Mathematics and Physics Pedagogy	36.59	4.09	113
Language and Literature Pedagogy	35.00	5.39	116
Pedagogy of Languages	35.43	5.18	105
Pedagogy of History and Social Sciences	36.38	4.69	144
Psychopedagogy	34.37	5.41	155
Total IV	35.50	4.97	941

Table 3. Descriptive statistics, means and standard deviations, for each of the careers on the total score of the Vocational Identity questionnaire.

As can be seen, there are slight differences between the mean scores obtained by the students in the different careers. Thus, the highest score is obtained by the Pedagogy of Experimental Sciences in Mathematics and Physics, followed by the Pedagogy of History and Social Sciences, while the students of the Psychopedagogy program are those who obtain a lower score in vocational identity. The Language and Literature and Languages careers occupy an intermediate position.

Table 4 summarizes the results of the analysis of variance, ANOVA, of one factor carried out to establish whether there are differences between the means of the different careers.

As can be seen, there are significant differences between the means (F= 3.46, p= .002, p= .002).

Variable	**Source**	***SC***	***gl***	***MC***	***F***	***p***	***Sense of differences***
Sense of differences	Between Inside	506.77 22758.46	6 934	84.46 24.36	3.46	.002	3>7,1,4; 6>1,4,7; 2>7,1; 5>1; 3=6=2; 1=2=4=7;

Table 4. Results of the one-factor ANOVA to establish differences among the seven Faculty Careers in vocational identity.

Note: Careers: 1= Pedagogy of Chemistry and Biology; 2= Pedagogy of Computer Science; 3=Pedagogy of Mathematics and Physics; 4= Pedagogy of Language and Literature; 5=Pedagogy of Foreign Languages; 6=Pedagogy of Social Sciences; 7=Psychopedagogy; 8=Pedagogy of Social Sciences; 9=Pedagogy of Social Sciences; 10=Pedagogy of Social Sciences; 11=Pedagogy of Social Sciences; 12=Pedagogy of Social Sciences; 13=Pedagogy of Social Sciences.

An a posteriori analysis of the differences between group/career means indicates the direction of these differences; students in the Mathematics and Physics Pedagogy career (3) obtain significantly higher scores in vocational identity than students in the Psychopedagogy career (7), Chemistry and Biology Pedagogy (1), and Language and Literature Pedagogy (4).

Students in group 6 (Pedagogy of History and Social Sciences) have higher scores in vocational identity than students in careers 1 (Pedagogy of Experimental Chemistry and Biology), 4 (Pedagogy of Language and Literature) and 7 (Psychopedagogy).

The students of career 2 (Pedagogy of Computer Science) obtain significantly higher scores than those of career 7 (Psychopedagogy) and 1 (Pedagogy of Chemistry and Biology).

The students of the careers 3 (Pedagogy of Mathematics and Physics), 6 (Pedagogy of History and Social Sciences) and 2 (Pedagogy of Computer Science) are the ones who obtain higher scores, with no significant differences among them.

On the contrary, the students of careers 7 (Psychopedagogy), 4 (Pedagogy of Language and Literature) and 1 (Pedagogy of Chemistry and Biology) have the lowest scores, with no statistically significant differences among the three groups.

5. Discussion

When we consider Vocational Identity as a formation process integrating the motivations, interests and needs that are manifested and to which special interest must be devoted in the professional orientation process, it is considered that the processes exert similar effects on all the persons subject to their influence, establishing a unity within the diversity of persons or students who opt for a teaching career. However, the results of the research establish a significant difference due to the sex of the students, showing that the level of intensity of the Vocational Identity of men is significantly higher than the level of intensity of female students.

This result allows us to conclude that male students have more focused and directed their interests and inclinations towards what they intend to be in the future, giving greater security and confidence to the choice of the professional career and with very high probabilities of achieving success in their professional training. The vocational identity in the University faces great challenges, the teacher and even more the student is responsible for obtaining day by day deeper knowledge that assures a greater specialization in the disciplinary field, since semester by semester the integration of knowledge and experiences required by the teacher for the future professional practice becomes more complex.

The results found in the research confirm the basic theoretical approaches. That is to say, vocational identity is affirmed as the levels of study of the career progress. Students in the first semester obtain a lower score in vocational identity than those in the last semester. This result allows us to establish that the levels of vocational identity are consolidated as the novices of professional training advance, that is to say, it goes from less to more identifying with the future professional career.

Therefore, the development of professional teaching identity is considered a continuous process of clarification of what one believes about teaching-learning and, particularly, about oneself as a teacher, to establish one's roles and purposes, in coherence with professional ethics. Vocational identity in teacher education is important because teachers need to have a clear vocation for teaching and feel committed to their social role to be able to perform effectively in their work.

The findings of the research show that the students of the different teaching careers do not have the same levels of vocational identity, establishing basically three groups due to the level of vocational identity. The first group with the highest levels of vocational identity is made up of Mathematics and Physics Pedagogy, History and Social Sciences Pedagogy and Computer Science Pedagogy, which, although there are differences among them, these are

not statistically significant. The second group with medium levels of vocational identity is formed by the Languages Pedagogy career. The third group, with the lowest levels of vocational identity, are the Chemistry and Biology Pedagogy, Language and Literature Pedagogy, and Psychopedagogy careers.

Hypothesis 1 was verified in which it was proven that there are statistically significant differences by sex in the vocational identity of the students of the careers of the Faculty of Philosophy, Letters and Educational Sciences of the Universidad Central del Ecuador in the period 2022. Hypothesis 2 was tested in which it was shown that there is a higher level of terminal vocational identity than the initial one in the population investigated.

It should be noted that the careers with the highest level of vocational identity are Pedagogy of Mathematics and Physics and Pedagogy of History and Social Sciences, while the career with the lowest levels of vocational identity is Psychopedagogy.

6. Conclusions

At the end of the research, it can be concluded that:

- Vocational identity is affirmed as the levels of study of the career progress, i.e., low levels at the beginning and higher levels at the end of the career. Although the differences are minimal in the scores, it was observed that there are significant statistical differences between students at the initial and terminal levels.
- The sex of the students is a determining factor in the variation of the levels of vocational identity, with higher levels found in men than in women. The levels of vocational identity of the students of the various teaching careers differ; this may increase according to the academic formation of the specialty of the careers.
- The highest level of vocational identity was found in the students of Pedagogy of Experimental Sciences of Mathematics and Physics, as well as in History and Social Sciences, while the lowest scores of vocational identities were found in the career of Psychopedagogy.

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REVISTA CÁTEDRA

Intrinsic motivation and its impact on the academic performance of university students in Ecuador

La motivación intrínseca y su incidencia en el rendimiento académico de los estudiantes universitarios de Ecuador

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Abstract

Education is currently immersed in a changing world, which supports the importance of implementing different strategies that prioritize the interests and encourage intrinsic motivation of students to achieve educational goals through the use of innovative techniques and strategies such as gamification, with the purpose of acquiring knowledge in a more active, participatory, autonomous and dynamic way. In this way, the development of skills and abilities that contribute significantly to the improvement of academic performance will be enhanced. In order to go deeper into this topic, the research was proposed with the objective of developing intrinsic motivation through gamification strategies, evidencing its incidence on the academic performance of students in the second semester of the Pedagogy Career of a university in Ecuador. The study was developed under a quantitative approach, with a quasi-experimental method of correlational type, approaching a sample of 129 students, divided into two groups, a control group with 65 members and an experimental group with 64. The information was collected through the application of a pretest and a posttest that led to the design of a proposal implemented to the experimental group. The main results showed that intrinsic motivation developed with

gamification activities is positively related to academic performance, since it is a fundamental contribution to the integral preparation of university students.

Keywords

Academic performance, strategies, gamification, intrinsic motivation, university education.

Resumen

La educación actualmente se encuentra inmersa en un mundo cambiante, lo que sustenta la importancia de implementar diferentes estrategias que prioricen los intereses y fomenten la motivación intrínseca de los estudiantes para alcanzar las metas educativas mediante el uso de técnicas, y estrategias innovadoras como la gamificación, con el propósito de que el conocimiento sea adquirido de manera más activa, participativa, autónoma y dinámica. De esta manera, se potenciará el desarrollo de capacidades y habilidades que aporten de forma significativa a la mejora del rendimiento académico. Para profundizar en este tema se planteó la investigación con el objetivo de desarrollar la motivación intrínseca a través de estrategias de gamificación, evidenciando su incidencia en el rendimiento académico de los estudiantes del segundo semestre de la Carrera de Pedagogía de una universidad del Ecuador. El estudio se desarrolló bajo un enfoque cuantitativo, con el método cuasiexperimental del tipo correlacional, abordando una muestra de 129 estudiantes, divididos en dos grupos, uno de control con 65 integrantes y otro experimental con 64. La información se recolectó a través de la aplicación de un pretest y un postest que propició el diseño de una propuesta implementada al grupo experimental. Los principales resultados mostraron que la motivación intrínseca desarrollada con actividades de gamificación se relaciona positivamente con el rendimiento académico, pues es un aporte fundamental a la preparación integral de los estudiantes universitarios.

Palabras clave

Motivación intrínseca, estrategias, gamificación, rendimiento académico, educación universitaria.

1. Introduction

Motivation is "an important element to be considered in the teaching-learning process, focused on encouraging the realization of creative activities, through a fully conscious action" (Alemán et al., 2018, p. 1257). Therefore, Castro et al. point out that educational practice should be oriented towards the development of interest as an elementary factor for the acquisition of knowledge, a fundamental aspect in training, since it has been estimated as one of the most effective processes in the achievement of knowledge, empowerment of skills and abilities, the formation and strengthening of persistence, and permanence for the graduation of students as future professionals (Castro et al., 2020, p. 31).

In general terms, motivation can arise through two processes: intrinsic or extrinsic. In this specific case, intrinsic motivation is addressed, considered as one of the most important factors that drives a person to take on certain actions and persevere in their achievements, continuing to perform them until previously established goals and objectives are reached. According to Fischer et al. (2019) it is the factor that presents an "inherent tendency in the search for novelty and challenge, to develop and exercise one's abilities, to explore and learn, which leads to the achievement of purposes in accordance with one's own desire" (p.

2). That is, this type of motivation is the one that allows performing an activity for the satisfaction of achieving it, without obligation or external reward.

What according to Virtanen et al. (2018) is what focuses a person with a strong intrinsic motivation to be "more willing to implement different cognitive strategies to implement the actions required in the advancement of the learning process, leading to the achievement of high levels of commitment and self-regulation" (p. 985). That is to say, through intrinsic motivation one seeks to achieve a purpose, in this case aimed at completing a university degree, demonstrating personality in the achievement of goals, aspirations and academic objectives. In itself, intrinsic motivation affects the desire to learn, evolve, improve and increase learning and knowledge, against which one must assume one's own initiative when giving assertive answers in the resolution of problems and every situation that arises.

Therefore, developing intrinsic motivation in students promotes creativity, curiosity, effort, and continuous participation, and fosters the consolidation of knowledge, satisfaction for the achievement of objectives and the success obtained. It is important to generate a link between internal motivation and academic performance, that is to say, that its function is elemental for the achievement of the effort to enhance the students' interest in their professional training and personal development.

However, considering that it is a fact that motivation influences the achievement of learning, it is vital to understand that the lack of intrinsic motivation is determinant for the achievement of educational success or failure of students, to the point that one of the objectives of teachers is to achieve motivation, since it is evident that the lack of it is one of the main causes to be assessed in the face of student failure, specifically when it is based on the gap that is established between the actors of the educational event. However, according to Alemán et al. in the university environment, the relationship between teachers and students is usually distant and impersonal, the approach within this educational system does not allow focusing on the subject who learns, but rather university training tends to emphasize the importance of learning, and the interaction between the teacher and the curricular contents (Alemán et al., 2018, p. 1261). This model is currently developing in a society whose purpose is immersed in a globalizing process, which faces interests of a quantitative nature and the technical management of information, which leaves aside the system of construction and transmission of knowledge in a way that recognizes and values the learner, who is provided with a more humanized experience.

In other words, the dynamics of the school context are of utmost importance for the academic and personal success of students. The quality of the relationships established within this environment will influence motivation, commitment and performance in the learning process. Therefore, it is essential that teachers establish close ties with their students, based on mutual respect, empathy and trust in order to offer them the necessary support and foster their integral development.

In this way, a positive and enriching learning environment will be promoted for the students. Intrinsic motivation is definitely influenced by the interaction of several factors that maintain a specific function and where this type of interactions and punctual relationships can generate unpredictable results. Therefore, through intrinsic motivation, students can be driven to try harder, to actively seek knowledge, and to persevere through challenges. This supports the importance of cultivating this type of motivation in the classroom to promote successful learning.

In this sense, paraphrasing Abreu and De la Cruz, it is important to know the level of intrinsic motivation of students, since it is possible to promote the implementation of effective interventions to strengthen ethical and moral values that encourage and promote their intellectual and emotional development. What is assumed as an essential determinant in the integral formation of students towards a successful graduation from the different university careers as future professionals (Abreu and De la Cruz, 2018, p. 478). That said, according to Lorente, it can be observed that the development of intrinsic motivation is easier to achieve when it is associated with personal interest. For this, it is necessary that they are aware of why they learn, what is the need to learn and how they can apply the knowledge in a practical way, not only as future professionals, but beyond this, in the daily life and the context in which they develop (Lorente, 2019, p. 11).

Bernate and Guativa point out that in the area of pedagogical training, where this work focuses, it is essential to develop intrinsic motivation in students, so that they can be formed within theory and practice, adopt, set high goals, acquire scientific knowledge, promote and contribute to the improvement of the quality of life in a particular way, community, and before society in general, within the process of university training (Bernate and Guativa, 2020, p. 151). In addition to this, especially in higher education, "technology is increasingly merging with pedagogy by incorporating the use of digital resources, adopting student-centered training models" (Yigzaw et al., 2019, p. 2). On this, more tools, techniques, and strategies have been used with the purpose of contributing to the improvement of the formative and educational process at this level, leaving behind practices typical of traditional systems, developing processes where the student is the real protagonist, all implemented under updated, innovative, dynamic, creative and interactive methods.

Thus, Revelo mentions that the educational processes carried out in the different university training careers should lead and be an example of development, and progress of future education professionals, showing them the ways in which they can integrate new methods, resources and teaching strategies to the educational processes (Revelo, 2018, p. 9). For his part, Carrión mentions that this is why it is expected that the activities designed under the gamification approach manage to provide the student with tools and strategies that allow them to be considered as innovative proposals, as a real and practical teaching alternative, in order to encourage and promote the intrinsic motivation of this student population in improving academic performance (Carrión, 2018, p. 13).

Gamification as a didactic resource proposes the purpose of guiding participants to the achievement of an objective through the modification of behaviors, propitiating the acquisition of new knowledge, as well as improving skills and abilities, helping them to responsibly assume the performance of the proposed activities (Smiderle et al., 2019; Trejo, 2019). To achieve these purposes, participants will complete the previously established challenges, following the rules indicated at the beginning of the game, which awakens motivation and interest, and promotes the achievement of the expected results.

It is relevant to indicate that, within the framework of gamification, feedback is provided, which reinforces learning, and thus productivity and academic performance (Heredia et al., 2020; Reyes and Quiñonez, 2020). It is therefore undeniable, as Oliva states in his research, that the effect of this strategy on the involvement and active performance of students is highly significant, since it allows them to feel emotionally motivated to participate in the development of the activities planned through these resources and the results of the processes leading to the acquisition of more meaningful, practical, effective and sustainable learning (Oliva ,2018).

Consequently, from these approaches a series of research questions arise: how does the development of intrinsic motivation through gamification activities impact on the improvement of academic performance of university students, how does a gamification activities guide stimulate the development of intrinsic motivation in the improvement of academic performance of university students, what evaluation mechanisms allow assessing the impact of the proposal designed for the development of intrinsic motivation through gamification in the improvement of academic performance of students, and what are the evaluation mechanisms that allow assessing the impact of the proposal designed for the development of intrinsic motivation through gamification in the improvement of academic performance of students?

The purpose of this article is to provide answers to these questions. The objective of the research is to determine the importance of developing intrinsic motivation through gamification strategies, evidencing its impact on the academic performance of students in the second semester of the Pedagogy Career of the Language and Literature, Languages and Psychopedagogy majors of the Faculty of Educational Sciences, Humanities and Technologies, Riobamba, Ecuador. The aim is to strengthen the intrinsic motivation of the student population, considering that this factor should be a primary requirement to be developed in students, since it generates commitment, allows greater social participation, increasing awareness for the achievement of knowledge and particular needs. All this can contribute to improve learning, and raise academic performance through the acceptance or rejection of the established hypothesis, to prove that the development of intrinsic motivation enhanced by gamification affects the academic performance of students.

On the other hand, according to Choudhury and Pattnaik, the greatest positive impact of the project falls on the students, in whom it is expected to develop intrinsic motivation through gamification. Gamification as a strategy that focuses on the involvement and participation of students, since the purpose is to help them feel more emotionally motivated and participate in the activities offered through gamification, in order to achieve more meaningful learning (Choudhury and Pattnaik, 2020). In this sense, gamification plays a key role in maximizing the involvement, involvement and integration of students in the learning process. Additionally, it is expected that with the development of the project, university professors will find new and innovative alternatives in terms of activities and strategies to be applied in the classroom and that students will work in intuitive and motivating learning spaces, where they can learn autonomously and independently, participating in each of the activities proposed, providing effective answers and solutions to the challenges presented.

As for the limiting aspects, it could be considered that students assume little relevant activities and little commitment when participating in the implementation of gamified activities that could be perceived more in relation to lower educational levels than the one they are at. Nevertheless, some tools and tasks were found to be relevant and appropriate to work with this type of population through gamification. These tools are perceived as useful and beneficial for the development of intrinsic motivation, contributing to the improvement of the academic performance of university students, who were actively involved and participated in them.

According to the criteria required for the realization of a research work, the following sections are developed: in section 2 the literature review is presented, which consists of the review of bibliographic sources related to the research topic. Section 3 details the methods and materials used to develop the research. Section 4 presents the results of the research.

Section 5 details the discussion of the results. Section 6 establishes the conclusions according to the results obtained.

2. Literature review

2.1 Intrinsic motivation

Motivation is what drives people to achieve certain actions and persist until they reach the goals and objectives previously established. In this sense, different types of motivation are found, such as internal and external, proceeding to discern in internal motivation being the case under study, which, according to Barrientos et al., (2019) refers to "the inherent and natural tendency that leads to the search for novelty and challenge, to develop and exercise one's skills, to explore and learn, which leads to do something according to one's own desire" (p. 3). In other words, the objective of intrinsic motivation is to achieve a goal, which inherently produces satisfaction and emotional overcoming, in this case it is urged that students complete professional training at the university level, showing a level of self-development, and of personality in the achievement of one's own goals, desires, aspirations and objectives.

For Fisher et al., (2019) a person with a strong internal motivation "can better apply different cognitive strategies, practically perform the necessary activities to promote learning, allowing high commitment and self-regulation" (p. 74). Additionally, as stated by Garcia and Pintrich (1994, as cited in Gonzalez, 2018), "high intrinsic motivation supports the mastery of appropriate learning strategies" (p. 4). As such, it emphasizes the desire to learn, develop oneself, improve learning and knowledge, in the face of which one must take the initiative to give convincing answers, solve problems and make decisions in the face of any situation that arises.

Extrinsic motivation, from the perspective of Fonseca et al. (2018) "is considered the main pillar of gamification, due to the fact that the game supports different spaces within the educational environment (classroom, teachers and educational community in general) that must be motivated to be effective in the process" (p. 25). Therefore, fostering the development of intrinsic motivation in students to enhance curiosity, effort and continuous participation, contributes to enrich knowledge and promotes satisfaction in the achievement of objectives and success. Given which, gamification represents a fundamental role in the maximum participation of students; likewise, the teacher's intervention is considered important in the creation of a close link between intrinsic motivation and academic performance, that is, his role is elementary to reinforce the interest in training in the specialty in which he is being trained, that he is trained, his professional field and personal fulfillment.

2.2 Gamification as a strategy for the development of intrinsic motivation

"Gamification facilitates peer-to-peer interaction involving a specific system of rules that defines a path or channel to follow to achieve certain results" (Corchuelo, 2018, p. 17). All this contributes, among other aspects, to the development of motivation, constant feedback, engagement and interest of students in the contents and completion of their tasks, which promotes significant, self-regulated and independent learning, which contributes to the improvement of school performance (Aranda and Caldera, 2018; Smiderle et al., 2019). In other words, gamification supported by the integration of technology-mediated game mechanics promotes the development of intrinsic motivation and student engagement, which naturally impacts the increase in academic performance.

The concept of intrinsic motivation associated with game design is exposed by Manzano et al. (2022) as "that in which the experiences lived by the subject are articulated and new internal and external perspectives are offered for the redefinition of these processes, from the stimulation of creativity, independent thinking and well-being of the player" (p. 30). From which four axes of motivation emerge: competition, learning, escape from reality and social interaction.

The intrinsic motivation raised by Fonseca et al. is proposed as the fundamental basis of gamification activity, considered as a game action that supports spaces related to pedagogical practices and the interactions that occur in these, where the main actors in these areas must be motivated, so that they can function effectively in the formative process (Fonseca et al., 2018). In this regard, Ortiz et al. confirm that gamification is a methodology that promotes motivation, which is based on two elements that emphasize the intrinsic of each individual, so it promotes the development of skills and virtues of those who participate in the development and implementation of playful-educational activities within a collaborative and interactive work in which the gamified action itself places the player at the center of the system, where the motivation of the participant and his own involvement with the other participants determines the outcome (Ortiz et al., 2018).

2.3 Intrinsic motivation developed through gamification strategies and academic performance.

The concept of gamification exported to the field of education "materializes when important contextualized didactic projects focused on promoting the transformation of teaching-learning are put into practice" (Álvarez and Polanco, 2019, p. 2). About which, Aranda and Caldera state that this resource, in addition to being used in a non-playful context, is constituted as a motivational mechanism that promotes concentration, effort and other positive values, allowing the student to benefit from their learning experiences, which favors the educational process to be more effective, dynamic, active, participatory and collaborative (Aranda and Caldera, 2018).

In other words, the purpose of gamification as a didactic and methodological resource is always aimed at achieving learning, that is, its objective is "to generate changes in behavior and learning through positive experiences that promote the development of intrinsic motivation" (Carrión, 2018, p. 4). This with the aim of achieving better academic results, assimilating knowledge, as well as certain skills and abilities, among all the purposes that lead to the development of intrinsic motivation, influencing the improvement of academic performance.

In this direction, Fuentes et al. state that the application of gamification as a methodology involves an active pedagogy that includes in its development various competencies that require intellectual and affective processes, the exchange of attitudes, participation, collaborative learning and knowledge that promote creativity and imagination. Therefore, gamification approaches and connects students to the acquisition of knowledge in a different, playful and creative way, even helps to release and prevent behaviors that hinder or limit the progress and achievement of goals, purposes objectives previously established (Fuentes et al, 2018). Therefore, they argue and corroborate that gamification is "a learning method that modifies the mechanics of the game in the pedagogical-professional field, to achieve better results, among them, a greater acquisition of knowledge, as well as, an improvement in the reward of specific actions" (Manzano et al., 2022, p. 3). Therefore, the gamification model is really functional, and manages to raise the levels of intrinsic motivation of students, encouraging and strengthening the spirit of improvement.

Currently, these resources use various mechanical techniques that have been extrapolated to replicate gamification to the educational process (Smiderle et al., 2019). Thus, from a pedagogical point of view, this strategy emphasizes the constructive strengthening of knowledge and attitudes, improves student performance and develops intrinsic motivation, enhancing skills that allow a performance in an environment immersed in constant transformation (Aranda and Caldera, 2018). Similarly, by applying gamification to education, the aim is to create meaningful and interactive learning experiences that overcome demotivation, encourage behavioral changes and open spaces for reflection. In this regard, it is mentioned that:

> when gamified, the user (student) experiences his own story, in the processing of which he actively participates, as this resource becomes an environment where multiple mechanisms and resources can be realized with which he can interact freely and spontaneously, through the social system provided by the game (Aleman et al., 2018, p. 1257).

According to this approach, "gamified processes (ludic/games) offer great potential in improving academic performance" (Fuentes et al., 2019, p. 18). In such cases, it is important that the appropriate gamification mechanisms containing a motivational, social and interactive element, where the participants involved (students) devote all their energy and interest to the proposed game.

In which it is important to raise a previous objective, convert learning skills, and knowledge into a game, create the challenges themselves, define clear game rules and a reward system, organize a motivational competition and reinforce the level of difficulty in an increasing way according to the acquired mastery (Virtanen et al., 2018). For which, certain steps to be implemented must be established, with which the functioning of gamification in the classroom is sought and, of course, in the achievement of the previously established objective, as well as the required learning in function to improve academic performance. To these stages or important parts of the game is added the feedback process, which generates the union between the correction and overcoming of errors through repetition, so that the student recognizes and accepts the error as a natural factor that can be corrected or rectified, in order to continue until the achievement of the final result, the outcome or the receipt of the reward, which would lead to the achievement of the goals and objectives of the educational process, as well as the improvement and increase of academic performance.

3. Methods and materials

The research was developed under a quantitative approach, in which "the collection of data and information is carried out based on measurements and numerical and statistical analysis with the application of an instrument, to establish patterns of behavior" (Hernández & Mendoza, 2018, p. 6). According to the design, the quasi-experimental method was considered as an approach in which the extent to which a treatment, intervention or strategy achieves the intended objectives is tested (Hernández et al., 2014). There the subjects are not randomly selected, so it is considered useful to study phenomena in which the situations cannot be totally controlled, even when the purpose is to have a greater possible control of some of the groups already formed, in the verification of the incidence of some of the variables under study on the other.

Similarly, the research was developed as a correlational study in that the phenomenon under study was observed, intervened and analyzed, with the purpose of determining the relationship between the variables subject to analysis, verifying the incidence of one of

these variables against the other (Ramirez and Lugo, 2020). In this case, we proceeded to approach a group to observe and analyze the object of research, to determine the incidence of intrinsic motivation developed through gamification strategies in the improvement of academic performance of students in the second semester of the Pedagogy Career in the mentions of Language and Literature, Languages and Psychopedagogy of the Faculty of Educational Sciences, Humanities and Technologies, Riobamba, Ecuador.

The unit of study was constituted by a population assumed as finite and considered significant, the census sample was taken because the students enrolled in the second semester were chosen, all of them have direct contact with the auditor, the totality of the sample was selected, composed of 129 students enrolled in the second semester of the Pedagogy Career of the National University of Chimborazo of Ecuador, located in the age group from 18 to 28 years old, of both sexes, according to the enrollment records provided by the secretary of the educational institution in question.

The selection criteria were based on the fact that they were students who presented low motivation to carry out school activities, which is considered a barrier that limits academic performance. The sample was selected intentionally, and at the convenience of the researcher, as a teacher of that area and career; as well as in line with the requirements of the ongoing research development (Oberti and Bacci, 2020).

This sample was divided into two study groups: the so-called control group made up of 65 students and the experimental group made up of 64 students, this selection being made with random probability sampling. It should be noted that the experimental group was intervened with the designed proposal, based on gamification activities for the development of intrinsic motivation in the improvement of the academic performance of the students who made up the sample under study. On the other hand, the control group was not approached by the designed proposal, who continued with the development of the classes in a normal, classical or traditional way. The binding characteristic was that all the students were enrolled in the Pedagogy program of the university under analysis, to which the researcher had access because of the professorship he teaches. From there, information was taken on the evaluation techniques of those students in their second year at the time of the research, from whom data were collected through the implementation of the pretest and posttest applied for this purpose. For which, once the sample was determined, the informed consent link was provided, so that each of the members of the sample declared their free and voluntary participation in the research, in accordance with the recommendations about the responsibility of informing the participants of all the characteristics of the study to be carried out (Fiallos, 2021).

To collect the information, a pretest and a posttest were applied, called Motivation and Learning Strategies Questionnaire - MSQL SF, which evaluates the criteria established from 1 to 5, with a Likert-type scale as follows: Always (5) - Often (4) - Sometimes (3) - Rarely (2)- Never (1). This instrument has been used in different previous investigations and has been validated by experts in more than 20 languages, whose values have been statistically reliable and the internal consistency measured by Cronbach's Alpha, with a sample of 129 subjects, 36 items; which yielded a Variance of Items (ST2) of 28.96 and a sum of Variance of the ítems Si2) of 379.6 that yielded a result of 0.93 considered as a high value represented in Table 1.

Total Items	Total Subjects	S_T^2	Si^2	a
36	129	28.96	379.6	0.93

Table 1. Cronbach's alpha calculation values

A correlation analysis was made between the questions of the instrument in a modified version of the original, used by Masso et al. 2012, composed of 36 items referring to motivation and learning strategies. For such analysis the Pearson correlation test was selected, which examines the relationship between two variables. It is used to determine whether there is a linear relationship between Motivation and Performance. In addition, it is the most appropriate in terms of the number of the sample (129) which is high, and better estimation accuracy is obtained. The questions are distributed as shown in Table 2:

Main factor	Specific factor	Dimension	Ítem
Learning strategies	Cognitive and metacognitive strategies	Elaboration	4, 16, 22, 24 y 30
		Organization	13, 14, 17, 18, 38, 40 y 41
		Metacognitive and behavioral self-regulation	1, 2, 5, 6, 7, 15 y 32
	Value component	Intrinsic goal orientation	10, 25, 34 y 35
	Resource management strategies	Time and resource management	8 y 33
		Effort self-regulation	9, 11, 19, 27, 28 y 37
Motivation	Cash component	Anxiety	3, 12, 21 y 29
	Value component	Assessment of the task	26, 39

Table 2. Distribution of the questions of the Motivation and Learning Strategies Questionnaire - MSQL SF by factors and dimensions and learning strategies. Source: Adapted from the Motivation and Learning Strategies Questionnaire - MSQL SF (Masso et al., 2021.)

This instrument applied as a pretest was used as a diagnostic to corroborate the conditions in which the groups of students were based to determine the level of development of intrinsic motivation, with which information was obtained that supported the decision to design and implement a proposal supported by gamification to foster intrinsical motivation in the improvement of the academic performance of the students who integrated the sample in study. They were divided into two groups: one control with 65 participants and another experimental with 64. The ratings obtained by students completing the first part of the class period were also analyzed, which provided evidence of the academic performance of the students at the time the research was carried out.

After the implementation of the proposal designed, and applied to the experimental group, the instrument referred to as postest was applied again to verify the change in behavior of the students, which will show the development of intrinsic motivation, after being addressed by the intervention. The ratings were also reviewed, corroborating the

improvement in academic performance of students in the experimental group addressed by the proposal. Access was made to the overall average of the first and second part of each of the students, which allowed comparisons to be made to have an objective metric of academic performance.

Finally, a comparison test was conducted that showed significant differences between the control and experimental group of students before and after the designed intervention. Thus, additionally, starting from the inquiry, collection and analysis of data, it was possible to establish, understand and analyse the significance of the association, the intrinsic motivation developed through gamification, and its impact on academic performance through the correlation test.

4. Results

This section presents the results of the survey applied to students of the second semester of the Foreign Language Pedagogy Career at the National University of Chimborazo in Ecuador. A sequence of steps wasined to obtain the results, and statistical tables and graphs were used to organize the information. A correlation analysis was also carried out to verify the relationship between the intrinsic motivation variables developed through gamification and their incidence with academic performance.

H0= The intrinsic motivation developed through gamification does not affect the academic performance of students in the second semester of the Career Pedagogy of the National University of Chimborazo, they are not independent.

H1= The intrinsic motivation developed through gamification affects the academic performance of students in the second semester of the Career of Pedagogy at the National University of Chimborazo, they are independent.

According to the description of the sociodemographic characteristics of the sample analysed, it was obtained that 129 students aged 18 to 28 participated (M=20.64; DT=3.32). The majority were between 18 and 22 years of age represented in Table 3:

Age Range	**%**
18 and 22 years	52.3%
23 and 28 years	47.7 %

Table 3. Distribution of the age range variable of the selected sample.

From the selected age range, the following variables are distributed as shown in Table 4:

Age Range 18 and 22 years old						
Female Sex	**Middle Class**	**Singles**	**Does not work**	**Mention studying**		
				Language and Literature	**Language**	**Psychopedagogy**

52.3%	69.70%	91.9 %	72.4%	44.3%	33.3%	22.4%

Table 4. Distribution of multivariate variables within the selected age range.

For the intrinsic motivation variable, the results shown in Figure 1 indicate that the participants in the study showed high indicators, according to the learning strategies analyzed.

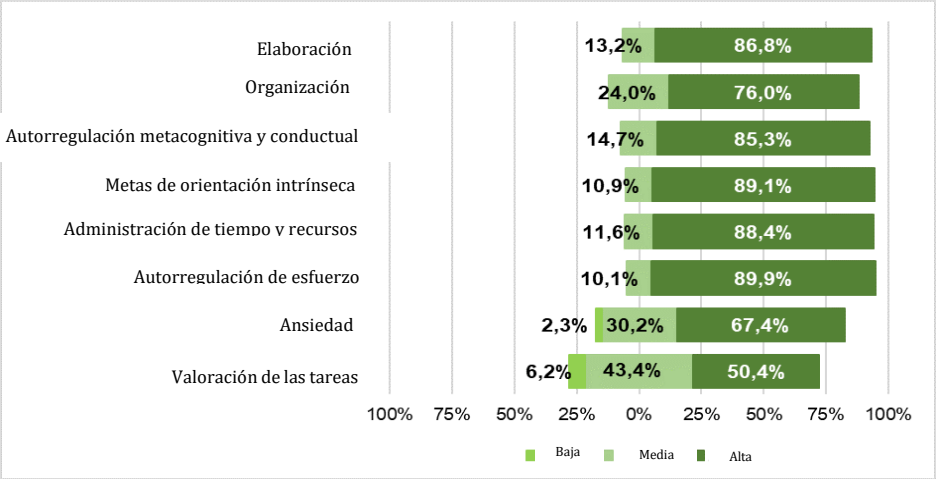

Figure 1. Dimensions of the Motivation and Learning Strategies Questionnaire - MSQL SF.

The calculation of the mean of the study of the univariates shown in Figure 1 was performed. When the percentage of the mean was calculated, 50% of the students involved in the study showed high indicators in the use of the different learning strategies: elaboration (86.8%), organization (76.0%), metacognitive and behavioral self-regulation (85.3%), intrinsic goal orientation (89.1%) and self-regulation of effort (89.9%), which corroborates the development of intrinsic motivation. However, with respect to academic motivation, there is evidence of a low valuation of the task (50.4%) and 67.4% present high test anxiety with an average of 33%.

Therefore, it can be deduced that intrinsic motivation is developed in 50% of the students with a high percentage in the indicators described above for 33% with low academic motivation.

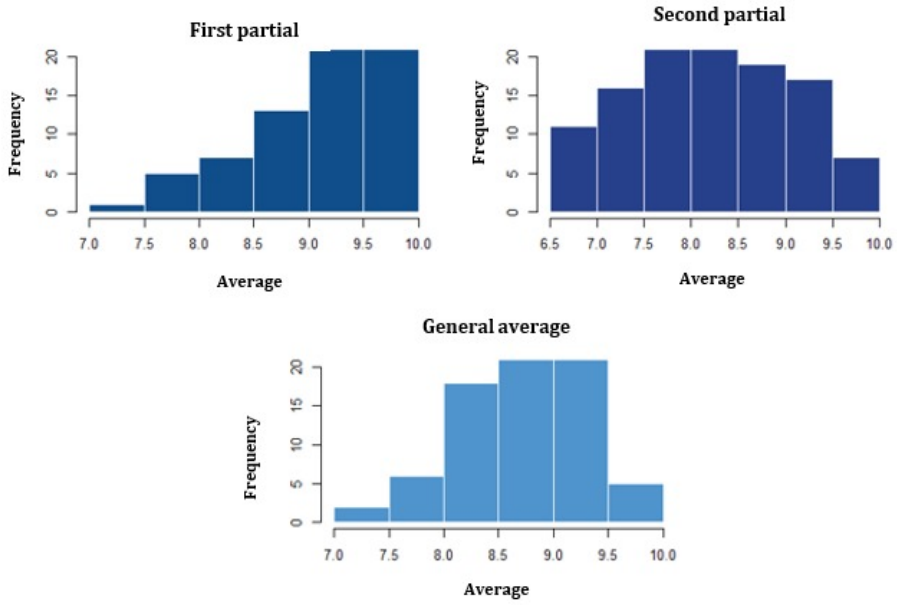

Figure 2. Average Academic Performance

Figure 2 shows the distribution of the average academic performance in each midterm after the intervention with gamification strategies in the sample under study. In this case, it is observed that in the first midterm the average is between 7.5 and 8.5 points; while in the second midterm these grades are between 8.5 and 10.0 points. On the other hand, it is observed that the general average was between 8.0 and 9.5 points..

Statistics	First partial	Second partial	Overall average
n	129	129	129
Minimum	7.29	6.52	7.16
Maximum	10.00	9.92	9.71
Mean	9.47	8.15	8.81
Median	9.79	8.09	8.84
Standard deviation	0.64	0.81	0.46
Coefficient of variation	6.8%	9.9%	5.2%

Table 5. Descriptive statistics of the average Academic Performance.

Table 5 shows that the academic performance in the first midterm ranged from 7.29 to 10.00 points with a mean of 9.47 ± 0.64; in the second midterm from 7.41 to 9.66 points with a mean of 8.15 ± 0.81; and the overall average from 7.16 to 9.71 points with a mean of 8.81 ± 0.46. The mean was higher in the first midterm and the coefficient of variation of 6.8% indicates that these grades are both more homogeneous and more homogeneous.

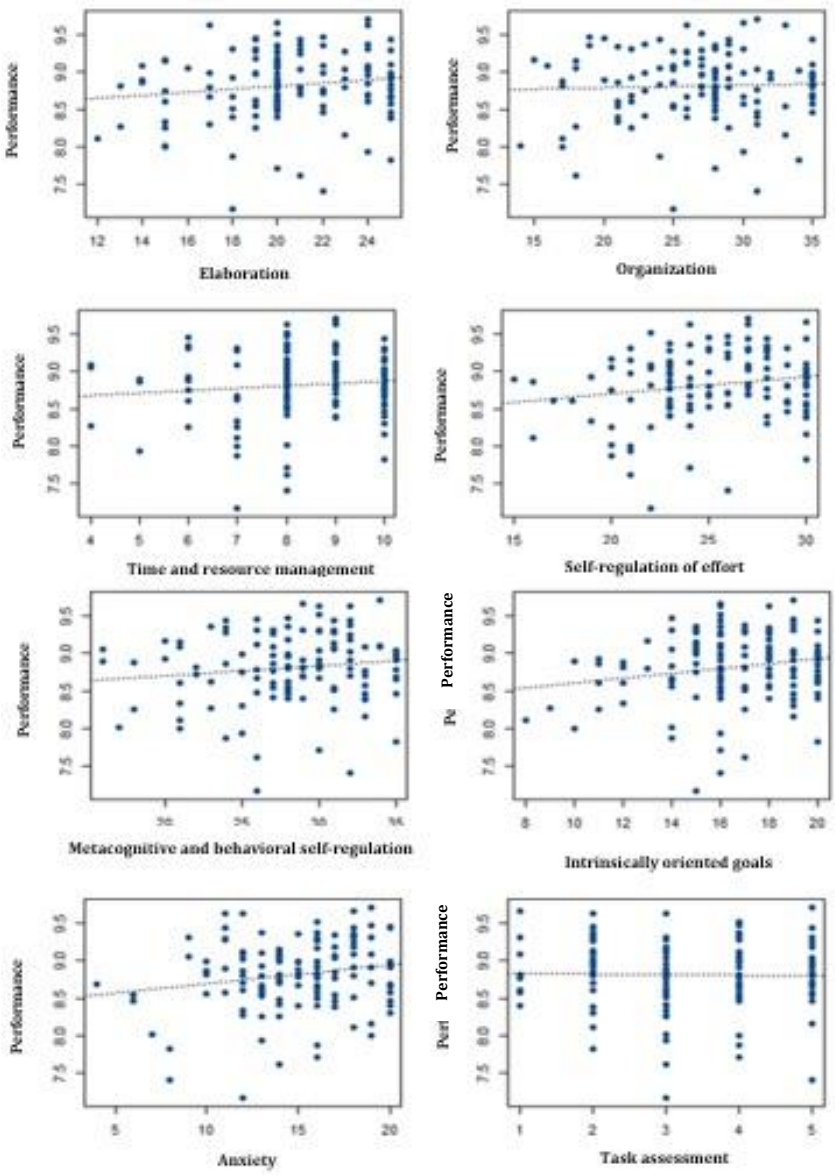

Figure 3. Correlation between Intrinsic Motivation and Academic Performance

Dimension	Correlation	p-value
Elaboration	0.1444	0.0925*
Organization	0.0307	0.6932
Metacognitive and behavioral self-regulation	0.1263	0.1538
Intrinsic goal orientation	0.1827	0.0382**
Time and resource management	0.0946	0.2861
Effort self-regulation	0.1715	0.0519*
Anxiety	0.1821	0.0388**
Task appraisal	-0.0138	0.8762
Total	0.1565	0.0765*
* The correlation test is significant at the 0.1 level.		
** The correlation test is significant at the 0.05 level.		

Table 6: Correlation tests. Source: Own elaboration based on the results of the correlation tests.

Figure 3 and Table 6 show a positive linear correlation between intrinsic motivation developed through gamification strategies and academic performance with learning strategies, as well as for anxiety; while in the case of task appraisal a negative or null tendency is observed. Table 3 shows that for learning strategies the correlation is significant: elaboration with a value of 0.14; intrinsic orientation goals with a correlation of 0.18. In the case of motivation, it can be seen that performance correlates significantly with anxiety (0.18). When a sample of 129 subjects was taken, the graph shows a dispersion of points due to the fact that many values are shown, but the result reflects a linear dispersion, since, if the value of the motivation variable is high, the value of the performance variable increases and they present a positive correlation, so they are highly associated.

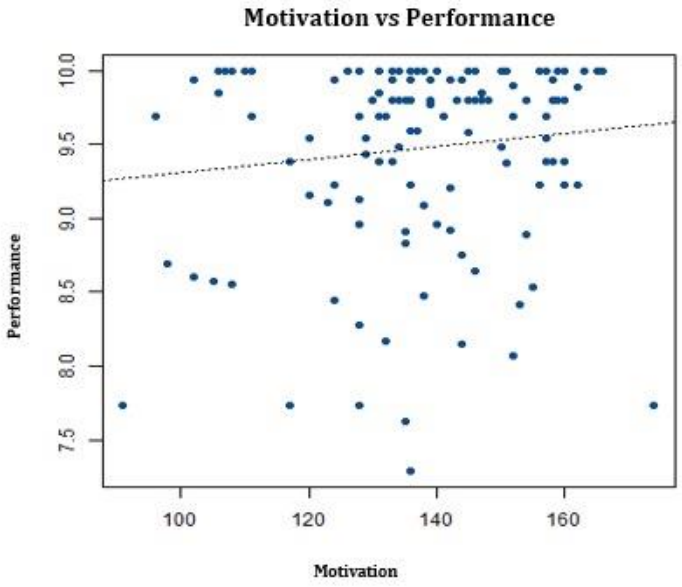

Figure 4. Correlation between Intrinsic Motivation and Academic Performance

Based on the results in Figure 4, it is evident that there is a positive association between Intrinsic Motivation and Academic Performance that can be expressed by means of the equation:

$$y = 0.30x + 8.41$$

Equation 1

Where e corresponds to academic performance and x the value assigned to the intrinsic motivation of each student. In this sense, it can be said that each student starts from a fixed score of 8.41 points of academic performance, and for each unit that increases the motivation will increase about 0.30 points the student's performance.

H0= The intrinsic motivation developed through gamification does not affect the academic performance of students in the second semester of the Career Pedagogy of the National University of Chimborazo are not independent.

H1= The intrinsic motivation developed through gamification affects the academic performance of students in the second semester of the Career of Pedagogy at the National University of Chimborazo are independent.

The throwing results of such Pearson correlation are +1 is rejected H0, which determines that the intrinsic motivation developed through gamification impacts on the academic performance of students in the second semester of the Career of Pedagogy at the National University of Chimborazo are independent. It is concluded that, as the student's motivation through gamification increases, the higher will be his performance.

For the validity of the questionnaire the Exploratory Factorial Analysis with the methods of univariants and multivariants was used. This method is the most used and suitable for the analysis of surveys and the relationship between the variables used, obtaining as a result a positive value, there is no difference with the correlation results of the variable used.

5. Discussion

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These results also coincide with previous researches in Aranda and Caldera 2018 and Smiderle et al. 2019 where cognitive and metacognitive strategies (elaboration dimensions, organization, meta-cognitive and behavioural self-regulation), for the value component (intrinsic orientation goals dimensions) and resource management strategies(time and resources management dimensions and self-revision of effort), confirmed a high intrinsic motivation that has a significant impact on the academic performance of university students. These findings support the importance of developing these skills to improve student academic performance. This indicates that teaching strategies, such as gamification, should continue to be implemented to develop the intrinsic motivation of students to contribute to improved academic performance.

However, the research results differed from the findings of the Manzano et al. 2022 study that good academic performance of students in the professional careers in which the research was developed regardless of the level of intrinsic motivation, showing that 41% of students average academic achievement and 16% good performance despite having low motivation. However, this information supports the assertion that, if intrinsic motivation is raised, academic performance could be increased.

6. Conclusions

The results of the study indicate that the study participants showed high indicators in the use of learning strategies of elaboration, organization, metacognitive and behavioral self-regulation, intrinsic orientation goals, and self-revision of effort. With regard to the academic motivation, there was a low evaluation of the task and high anxiety for the exams. These results show a close relationship between intrinsic motivation and the learning strategies implemented for achieving academic achievement, verifying the efficiency and effectiveness of the proposal implemented, so it is considered important to develop gamification strategies and activities that promote the creativity, commitment and connection of students in the attainment of educational goals and purposes.

The results of the study also revealed that strategies of elaboration, organization, metacognition and critical thinking, as well as effort and study habits are positively related to each other. Also, a strong relationship between learning and resource management was found in the student sample analysed, which in turn highlights the importance of time management and organization strategies as essential elements in the training process of university students. With regard to the effects of motivation, learning and resource management, it has been demonstrated that college students self-regulate by developing internal motivation which allows them to set goals, control and monitor their learning, and manage their own motivation.

The relationship between intrinsic motivation and academic performance was strengthened through the intervention, as according to the ratings they obtained in the first part was between 7.5 and 8.5 points; while in the second part these ratings are concentrated between 8.5 and 10.0, evidencing the effectiveness and effectivity of the interventions under which students, after having received training to develop intrinsical motivation through

gamification activities. It is also noted that the scores increased; it is considered that although the students' scores were not low in the first part, they improved significantly for the second part, demonstrating a significant increase in academic performance.

Additionally, according to the results obtained from the development of the research, a positive linear correlation was observed between intrinsic motivation strengthened by gamification strategies and academic performance with learning strategies, as well as for anxiety; whereas, in the case of task evaluation, a negative or zero trend was noted. It was demonstrated that for learning strategies the correlation result significant, for the elaboration, goals of intrinsic orientation and for the case of inherent motivation, it can be seen that there is a positive association with academic performance. This indicates that both the academic performance and the intrinsic motivation of the university students subject to analysis, improved by implementing the intervention with strategies and activities of gamification, which allows it to be recommended in future in its application in university contexts in which a similar problem situation as the present is observed, which was sought to solve with the actions taken for this purpose.

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REVISTA CÁTEDRA

Use of Information and Communication Technology for Quality Management in the Classroom

Uso de las Tecnologías de Información y Comunicación para una gestión de calidad en el aula

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Abstract

The purpose of this study was to analyze the use of Information and Communication Technologies (ICT) for quality classroom management at the Doctor Eduardo Mora Moreno High School in Loja, Ecuador. It was developed in the positivist paradigm, with quantitative approach, in a field research type with descriptive level, non-experimental transectional design with a population and census sample of fifteen (15) tenured teachers in classroom functions. To collect the information, an instrument containing twenty-four (24) items with response alternatives on an estimation scale (always, almost always, sometimes, almost never and never) was designed; it was subjected to content validity using the expert judgment technique and reliability with Cronbach's Alpha internal consistency method, where the result obtained was 0.92, indicating that the instrument presented strong reliability. For data analysis, descriptive statistics were used to obtain information from classroom teachers regarding the use of various ICT tools. In spite of the permanent training offered by the governing body, it was concluded that the classroom management of the professionals does not attend to the stages of planning, organization, leadership and evaluation with the use of ICT, which limits the achievement of educational quality in terms of equity, effectiveness and efficiency.

Keywords
Digital literacy, educational quality, education, ICT, teaching.

Resumen
El presente estudio tuvo como objetivo analizar el uso de las Tecnologías de Información y Comunicación (TIC) para la gestión de aula de calidad en el Colegio de Bachillerato Doctor Eduardo Mora Moreno en Loja, Ecuador. Se desarrolló en el paradigma positivista, con enfoque cuantitativo, en un tipo de investigación de campo con nivel descriptivo, diseño no experimental transeccional con una población y muestra censal de quince (15) docentes titulares en funciones de aula. Para recolectar la información se diseñó un instrumento contentivo de veinticuatro (24) ítems con alternativas de respuesta en una escala de estimación (siempre, casi siempre, algunas veces, casi nunca y nunca); el cual se sometió a la validez de contenido utilizando la técnica juicio de expertos y la confiabilidad con el método de consistencia interna *Alpha de Cronbach*, donde el resultado obtenido fue 0.92 señalando con ello que el instrumento presentó fuerte confiabilidad. Para el análisis de los datos se utilizó la estadística descriptiva que permitió obtener información de los docentes de aula en cuanto al uso de diversas herramientas TIC. A pesar de la capacitación permanente que ofrece el ente rector se concluyó que la gestión de aula de los profesionales no atiende a las etapas de planificación, organización, liderazgo y evaluación con el empleo de las TIC lo que limita el logro de la calidad educativa en cuanto a equidad, eficacia y eficiencia.

Palabras clave
Alfabetización digital, calidad educativa, enseñanza, TIC.

1. Introduction
Nowadays, progress in all areas of life allows us to see the so-called ICT in every individual and collective activity carried out by human beings in the personal, family, social, community and work spheres. In education, the application of these tools in an adequate way will allow to obtain the advantages to go from being the information society to the knowledge society. In this regard, Pacheco (2011) states that:

> We live in a technological culture that is advancing day by day and that marks in a matter of months a rapid obsolescence of many skills and the emergence of others. The impact of this culture is immense as it produces continuous transformations in economic, social and cultural globalization, and affects practically all aspects of personal life: work, commerce, bureaucratic management, leisure and education (p. 2).).

Therefore, the research work entitled Use of Information and Communication Technologies ICT for quality classroom management focuses on the contemporary educational environment, specifically in the Doctor Eduardo Mora Moreno High School in Loja, Ecuador. From this perspective the insufficient and ineffective use of ICT in the classroom by teachers and the deteriorated infrastructure limits the comprehensive education of students, the scarce incorporation of ICT in school activities and the lack of Internet access is also a need that has not been addressed by Ecuadorian government policies. In addition to this, there is also limited ICT training in this digital era, which poses a significant problem. Given this, it is required to intensify the use of ICT as a strategy and action that will allow it to be efficient,

effective, provide relevant and relevant learning; the above is summarized in that there is a need to provide quality service that is provided as a right of every citizen according to the current legal system in this nation.

In this sense, the present field research with descriptive level intended to analyze the use of ICT for quality classroom management in the Doctor Eduardo Mora Moreno High School in Loja, Ecuador. This leads to the identification of the current situation in the use of ICT by teachers, and the description of the necessary steps for effective classroom management with technological tools. The question that guided the research was: could the integral education of students be improved if teachers used ICTs effectively in classroom management? In this context, the idea is proposed that an efficient and consistent use of ICT by the teaching staff would allow a better integral formation of students, by facilitating an adequate classroom management supported by technological tools.

This article is divided into six sections: review of various sources with which the theoretical framework was constructed, composed of the background, the theoretical bases with the perspective of various authors to support the procedure to be executed; the methodological framework; with details of the nature of the research, in terms of the paradigm, approach, type and design selected to respond to the proposed objectives. The population, data collection technique and instrument, validity and reliability procedures were mentioned, in order to proceed to the data analysis with descriptive statistics. For the analysis and interpretation of results, the instrument was applied to thirty (30) teachers who were the primary source of the research. The analysis of the data was carried out according to the frequency and percentage obtained in each item, the tendency of each group was interpreted according to the indicators of each dimension of the variable; likewise, the results were contrasted with the theory that supported the research. Conclusions were drawn in response to the stated objectives, then recommendations were formulated for the target population of the study regarding the use of ICT for quality classroom management at the Doctor Eduardo Mora Moreno High School in Loja, Ecuador. Finally, references and annexes were presented.

2. Literature review

With technological advances in the order of the day, the use of computers and equipment is practically a daily activity in this 21st century; a premise that schools must consider when designing plans and curricula, since, more than complying with government policies on the subject, it is a matter of integrally educating each citizen. When referring to the subject, Ayala and Gonzales (2015) indicate that technology is "used to: create, store, exchange and process information in its various forms, such as: data, voice conversations, still or moving images, multimedia presentations and other forms, including those not yet conceived" (p 28). Therefore, he considers that the incorporation of ICT in society and, in particular, in the field of education has been acquiring increasing importance and has been evolving over the last few years. It invites each classroom teacher to use various tools to capture the student's interest, while creating a positive and constructive learning environment.

Therefore, according to the aforementioned source, the use of ICT in education has increasingly become a necessary and determining element in the achievement of educational quality. The presence of computers in the classroom, more than fulfilling a requirement or fashion, requires being a means and resources for teaching and learning, it is about the integral formation of the student. Indeed, it is important to promote the use of ICTs in the classroom, as Díaz-Barriga (sf) mentions, "nowadays, education cannot be disassociated from, and denied the support of, ICTs" (p. 4). Thus, from this perspective, it is

interpreted that any reform or effort to improve education as a process necessarily demands intensifying the use of various technological tools in the so-called classroom management that requires:

- **Training in the Use of ICT**: From the perspective of the Ministry of Education in Ecuador, a relevant aspect for quality teacher management is the use of ICTs; therefore, the teacher professional performance standard implies guiding, supporting and monitoring the action of the groups of actors that make up the National Education System for its continuous improvement. To this end, ongoing training is a state policy that seeks to update teaching professionals so that they can implement various ICT tools in their teaching practice, within the framework of disciplinary, pedagogical and professional ethics aspects that teachers must show in order to develop a quality teaching and learning process.
- **Digital literacy:** for López de Ramos et al. (2022) "must possess a set of specific knowledge and skills that allow them to search, select, analyze, understand and manage the enormous amount of information accessed through new technologies" (p. 161). ICTs have acquired great relevance in the educational context, offering multiple opportunities to improve the quality of teaching and learning. In the era of digitization, ICTs have become a crucial factor in all areas of life, including education. ICT can provide invaluable resources to improve learning and teaching, but its effective implementation is not an easy task in Ecuador. It must be strategic and address multiple aspects to be effective.

To create learning environments enriched with the use of ICTs, it is essential to intervene at two levels within educational institutions. At the first level, it is essential to comply with the five fundamental axes: institutional management, ICT infrastructure, ICT coordination and teaching, teachers from other areas and digital resources. These axes form the basis for an efficient and effective integration of ICT in educational processes and teaching. It is not enough to have the technology available; it must be incorporated in a deliberate manner, and focused on teaching practice and institutional culture. At the second level, the authors discuss the SAMR model, which provides teachers with a clear structure for understanding how ICT can transform traditional learning environments and can be understood as "educational environments that significantly expand students' possibilities for the transmission of knowledge and development of skills, abilities and attitudes" (Méndez, 2012, p. 201). It focuses more on explaining the characteristics of activities that incorporate technologies with the purpose of classifying them by levels according to how they enhance or transform educational tasks. The model of technology integration in education is described as follows. According to Ferreres (2011)

> The new social and informational landscape defined by ICTs demands a change in the traditional educational conception and in the roles that teachers and students have been playing in the classroom. The new educational idea is based on training a citizen with the ability to learn throughout his life and on a new teaching methodology where the student changes his traditional role of passive receiver of information for a new role that allows him to develop active tasks of exploration and search for information guided and facilitated by the teacher (p. 4).

Effective ICT integration, according to Cevallos et al. is not a single event, but a continuous and progressive process. It is essential to consider these levels in the design of pedagogical interventions with ICT to maximize their potential to improve the quality of education. On the other hand, the disinterest of students in certain subjects can represent a challenge for teachers in the transmission of knowledge, so seeking new methodologies that include ICT is essential, especially considering the familiarity of students with these technologies from

an early age. However, the lack of ICT skills of some teachers may limit their implementation. The reluctance of some teachers to integrate ICT into their teaching and the lack of motivation of students are consequences of the limited use of technology. The use of technological tools, such as Google Drive, WhatsApp, PowerPoint, Prezi, Slide Share, Educaplay and Edmodo can enhance learning by enabling communication and information sharing by providing engaging educational content that can be accessible from home (Cevallos et al., 2020, pp. 86-93).

They are also a crucial tool to foster the formation of digital citizens with ethical and participatory skills in the online society. In this context, UNESCO (2019) points out that.

> The effective incorporation of ICT in the classroom has the potential to transform pedagogy and empower students. To this end, the continuous training and updating of teachers in ICT competencies is essential, enabling them to guide students in acquiring skills related to the knowledge society (p. 1).

In response to this challenge, UNESCO has developed the ICT Competency Framework for Teachers, which aims to guide the initial and ongoing training of teachers in the use of ICTs in the education system. This framework advocates for strong political commitment and sustained investment in teacher education, with initial and ongoing training, tailored to the context of national and institutional goals, being essential for its successful implementation. According to UNESCO (2019) the professional development of teachers should be a continuous process throughout their lives and not a one-off activity. In this sense, three in-service training policies are proposed in a perspective of teacher learning throughout professional life.

> 1. To design in-service teacher training articulated to professional competencies and student learning.
> 2. Organize in-service teacher training through training itineraries corresponding to the roles of teacher, director and trainer.
> 3. To develop a decentralized model of training and regional participation (pp. 3-4).

These three phases are essential to ensure that teachers can acquire and effectively apply digital competencies in their educational practice, with the aim of improving teaching and learning, and forming citizens capable of thriving in the knowledge society. Pacheco (2011) "points out that we currently live in a technological culture that is advancing day by day and that marks in a matter of months a rapid obsolescence of many skills and the emergence of others" (p. 127). The impact of this culture is immense, producing continuous transformations in economic, social and cultural globalization, and affecting practically all aspects of personal life: work, commerce, bureaucratic management, leisure and education. For these reasons, technology urgently requires learning to live with it and to use its undoubted benefits.

Education in the 21st century focuses on learning to learn, therefore, in a new educational system, implementing ICT is viable and relevant. Navarrete (2018) taking into account these basic clarifications indicates that.:

> ICTs are means (applications) and not ends; they are tools that facilitate learning and the development of competencies.

> ICTs are generators of information and not of knowledge; of course, with proper mediation, this information can be converted into knowledge; for this to be so, the information must be analyzed, reflected upon and evaluated.
> In the classroom, ICTs are potential cognitive tools that can help students expand their intellectual capacities by opening new possibilities for individual and social development (p. 128).

Therefore, it is important to promote the use of ICT in classroom spaces, as Díaz-Barriga (sf) mentions, "nowadays, education cannot be disassociated from, and denied its support as a product of ICT" (p. 4). Thus, from this perspective, it is interpreted that any reform or effort to improve education as a process necessarily demands intensifying the use of various technological tools in the so-called classroom management, as follows:

- **Training in the Use of ICT:** From the perspective of the Ministry of Education (2012) in Ecuador, a relevant aspect for quality teacher management is the use of ICT; therefore, in the standard of professional teaching performance, it is implicit to guide, support and monitor the action of the groups of actors that make up the National Education System for its continuous improvement. To this end, ongoing training is a state policy that seeks to update teaching professionals so that they can implement various ICT tools in their teaching practice, within the framework of disciplinary, pedagogical and professional ethics aspects that teachers must show in order to develop a quality teaching-learning process.
- **Didactic material:** Morales (2012) defines as the:

> Set of material means that intervene and facilitate the teaching-learning process. These materials can be both physical and virtual, they assume as a condition to awaken the interest of the students, to adapt to their physical and psychological characteristics, and to facilitate the teaching activity by serving as a guide; likewise, they have the great virtue of adapting to any type of content (p. 10).

2.1 Classroom management

Educational management assuming the perspective of Ramírez-Orozco (2016) points out that management is a "process of organization and administration of resources to achieve organizational objectives through efficient management and where the educational manager leads and directs his teams towards the goals of the organization, motivating, stimulating, evaluating" (p. 5). It implies, then, leading the work in the institution itself, but also in relation to the environment.

Seen in this way, educational management has aspects related to the work of the manager, but also in the classroom, with a teacher who is called to be proactive, updated and assume his or her classroom management towards the achievement of quality in teaching and learning for the benefit of the integral formation of the student and quality management in the classroom. This also requires fostering meaningful learning experiences, making efficient use of available resources to train not only in theoretical content, but also in practical content. Indeed, classroom management is the implementation of a series of policies, guidelines and programs that govern a country and seek to streamline teaching and learning for the benefit of all stakeholders involved. In the words of Villalobos (2011)

> It develops between the interactions between the subject who teaches and the subject who learns in a micro society that is the classroom or the

> place where these interactions take place. Within this, the construction of meanings and new knowledge from the effective transfer of official curricular proposals to practice plays a preponderant role (p. 5).

In other words, classroom teacher management is derived from or has its framework of action in a series of educational guidelines and policies that should permeate their performance, their pedagogical practice manifested in a series of stages inherent to teaching and learning, namely developing planning, organization, leadership and evaluation.

1. **Planning:** for Carriazo et al. (2020) it is understood as "selection and organization of all curricular activities of the institution, based on objectives and human, economic and material resources, the interest and needs of the educational community, and the time available" (p. 88). Therefore, it is a theoretical model for future action. It begins by establishing the necessary plans to achieve them in the best possible way, it is necessary to be specific, to know where to go, how, when and with what. In the educational field, it is related to national and jurisdictional educational policy decisions, and to institutional contextualization, thus allowing the design and programming of its teaching practice not to be an isolated element, but at the same time respecting the independence and professional autonomy necessary for the development of its activity**.**
2. **Organization:** in the words of Robbins (2003) expresses how "organization includes determining what tasks will be performed, who will do them, how the work will be grouped, and who will report to whom and where decisions will be made." (p. 114). In other words, it involves determining and establishing the structure, procedures and resources needed to achieve the objectives established in the planning**.**
3. **Leading:** Evans and Lindsay (2008), state that leadership "is the ability to positively influence people and systems by provoking a determined attitude, under one's authority in order to have a significant impact and achieve important results" (p. 212). Therefore, leadership is the ability of a person to influence, motivate, organize and carry out actions to achieve their goals and objectives involving people and groups within a framework of values**.**
4. **Evaluate:** Díaz and Hernández (2000) "the evaluation of the learning and teaching process should be considered as a necessary activity, insofar as it provides the teacher with a self-control mechanism that will allow for the regulation and knowledge of the factors" (p. 352).

With the aforementioned stages of classroom management, i.e., planning, organization, leadership and evaluation, the teacher has a range of technological tools that allow him/her to respond to the needs of the student in a world in which digital scenarios are becoming more frequent.

2.2 Educational quality

According to the Real Academia de la Lengua (2012), the term quality comes from the Latin "qualĭtas, -ātis, and this calque from gr. ποιότηςροιότēs." and refers to the "property or set of properties inherent to something, which allow us to judge its value." (p. 241). The greater or lesser quality is produced by the gap or not between the definition of the vertebral principles and the social understanding of them in the facts, in everyday life. In this sense, the quality of education according to UNICEF (2020) indicates that:

> Under international law, States have a legal obligation to ensure that educational institutions are safe and conducive to a quality and inclusive

> learning environment. This includes school buildings, classrooms, libraries, sanitation facilities for both sexes, access to safe drinking water, availability of materials, recreational spaces, science laboratories, computers and infrastructure for technology and internet access, etc. (p. 64).

Quality education includes well-nourished students with a supportive family environment, an educational method with a curriculum that provides the necessary knowledge, a safe teaching environment, trained and skilled educators. These are a number of attributes for quality education, focused on the development of students, by producing permanent changes that at present cannot be disconnected from the use of ICT. There are different factors that determine the quality of education and depend on aspects such as society itself, a political stance, the development of science, history and culture. These factors are classified into human, technological, scientific, cultural, political and economic, and they contemplate different considerations such as the relevance of studies to the social reality and educational programmes in relation to their mission, values and what they contribute to the lives of students. Teachers should also enhance the training of students to innovate in the classroom and facilitate well-being. Consideration should also be given to sufficient flow for resources and for adequate and comprehensive infrastructure, the philosophy of continuous improvement to focus on teaching and learning, the matching of mission, vision and objectives, and training that enables students to be self-reliant and identify life projects.

Teaching and learning also includes pedagogical methods, evaluation, class size, values and skills in numbers, literacy, and skills for everyday life, taking into account the following elements of educational quality. The quality of education focused on responding to the needs of the environment, for the benefit of the students. According to Barba (2012)

> It represents a problem with multiple interpretations, which vary depending on its incorporation in the structuring of organizational processes, the constitution of organizational models and its relationship with the context. Properly, the notion is developed in the business environment, which, according to the author, responds to issues such as: efficiency, effectiveness, efficacy, change and flexibility. Together, the abstraction links the individual, group, organizational and social levels. (p 13).

Educational quality can be identified from indicators such as: equity, effectiveness and efficiency to strengthen competencies and skills needed to succeed in a profession and break the cycle of poverty, according to UNESCO (2016)

> Relevant teaching and learning methods and content that are appropriate to the needs of all learners and delivered by appropriately qualified, trained, paid and motivated teachers, using appropriate pedagogical approaches and supported by appropriate information and communication technologies (ICTs), on the one hand, and the creation of safe, healthy, gender-sensitive, inclusive and well-resourced environments that facilitate learning, on the other, are indispensable (p. 30).

3. Methods and Materials

The research was conducted between September 2020 and March 2021 with a focus on the use of ICT in quality management in the classroom. The place of study was the Doctor Eduardo Mora Moreno Bachelor's College in Loja, Ecuador. The research subjects were fifteen (15) teachers in class positions at this school who voluntarily participated in the study. Teachers taught different subjects and educational levels providing a diverse representation of teaching experience.

In order to gather information, the survey was applied as a technique, which is defined by Busot (2006) "as one that allows to know the opinions and attitudes that people show" (p. 148), and the instrument a questionnaire, which for the quoted author is "a set of questions regarding one or more variables to be measured" (p. 276). For study purposes, a questionnaire designed with twenty-four (24) closed items, with alternative responses on an estimated scale: always, almost always, sometimes, almost never and never, was used to measure the classroom quality management variables, dimensions in the use of ICTs (item 1 to 10); classroom management stages (item 11 to 18) and elements of educational quality (item 19 to 24).

A pilot study was conducted on ten (10) teachers, with characteristics and conditions similar to those studied. Subsequently, the Cronbach Alpha reliability coefficient was calculated, for having the instrument more than two (2) alternative responses, applying the following formula:

$$\alpha = \frac{n}{n-1} * \frac{St^2 - \sum Si^2}{St^2}$$

Equation 1. Cronbach's Alpha reliability coefficient.

A = Reliability Coefficient
St^2 = Total variance of the test
Si^2 = Sum of the individual variance of the items
N = number of items of the instrument

It should be noted that the result obtained with the application of this formula was 0.92, indicating that the reliability of the questionnaire presents high reliability, as indicated by Ruiz (2002).

N of Cases =	10					
N of Statistics for Scale	Mean	Variance	StdDev	Variables		
	75.1111	62.25	7.8899	24		
Item Variance	Variances	Mean	Minimum	Maximum	Range	Max/Min
	0.8647	0.2778	1.6222	1.333	5.8	0.0591
Reliability Coefficients	24 ítems					
Alpha =	0.9274	Standardized item alpha =		0.9243		

Table 1. Reliability analysis

Table 1 details the reliability analysis where 10 cases are considered, as well as statistics such as the average (75.11) variance (62.25), standard deviation (7.88) of the 24 observed variables. The variance analysis determines the minimum and maximum and the range used. The reliability or significance level (Alpha=0.9274) indicates that it is statistically significant. From the position of Hernández et al. (2014) the purpose of data analysis is to describe "variables and explain their changes and movements and the characteristics that make up it are the systematization, intensive use of statistics (descriptive and differential) based on impersonal variables in data collection" (p. 14).

With this basic argument the tabulation of the data collected in the application of the questionnaire was processed quantitatively, this provided the necessary automation for the effective handling of the information obtained. The data were analyzed using descriptive statistics, representing the information in charts and percentage bar figures, for analysis and interpretation with the respective theoretical support in formulating conclusions and recommendations.

4. Results

A 24-item, expert-verified and highly reliable data collection instrument was used in the present research. The data were summarized in tables and percentage bar charts addressing various indicators and stages of classroom management. The results were compared with the theory supporting the research to respond to the proposed objectives framed in the positivist paradigm to analyze the use of ICT in the educational context.

		ALTERNATIVE ANSWERS									
For quality management in the classroom, use ICTs:		**S**		**CS**		**AV**		**CN**		**N**	
		f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Participates in training activities at the institutional level	**1**	0	0	2	13	8	53	5	34	0	0
Participates in ongoing training programs in the use of ICTs	**2**	0	0	2	13	10	67	3	20	0	0
Average Values Indicator Training			**0**		**13**		**60**		**27**		**0**
In the digital literacy of students	**3**	0	0	0	0	6	40	9	60	0	0
In the achievement of competencies (from the simplest to the most complex) in the use of ICTs.	**4**	0	0	0	0	8	53	7	47	0	0
Digital Literacy Indicator Average Values			**0**		**0**		**46**		**54**		**0**
As didactic material in the collective construction of scientific knowledge.	**5**	0	0	0	0	15	100	0	0	0	0
As didactic material in the development of diverse procedural contents.	**6**	0	0	0	0	11	73	4	27	0	0
Average Values Indicator Didactic Material Indicator			**0**		**0**		**86**		**14**		**0**
As a source of information in the development of school assignments.	**7**	15	100	0	0	0	0	0	0	0	0
As a source of information on various	**8**	12	80	3	20	0	0	0	0	0	0

topics optimizing the quality of educational training.

Average Values Indicator Source of Information			**90**		**10**		**0**		**0**		**0**
As a tool to facilitate students to do school work	**9**	0	0	10	67	3	20	2	13	0	0
As a tool for cooperative learning	**10**	0	0	0	0	15	100	0	0	0	0
Average Values Indicator Instrument for Performing work			**0**		**33**		**60**		**7**		**0**
Average Values Use of ICT Dimension			18		11		51		20		0

Number of teachers= 15

Table 2. ICT Use Dimension

Table 2 shows the responses of 15 teachers interviewed by questionnaire, of which the response items are: always, almost always, sometimes, almost never and never, for the questions related to the use of ICT in the classroom, training, literacy and the didactic material used. In general, the results in Table 2 indicate that teachers are adopting ICTs in their educational practice.

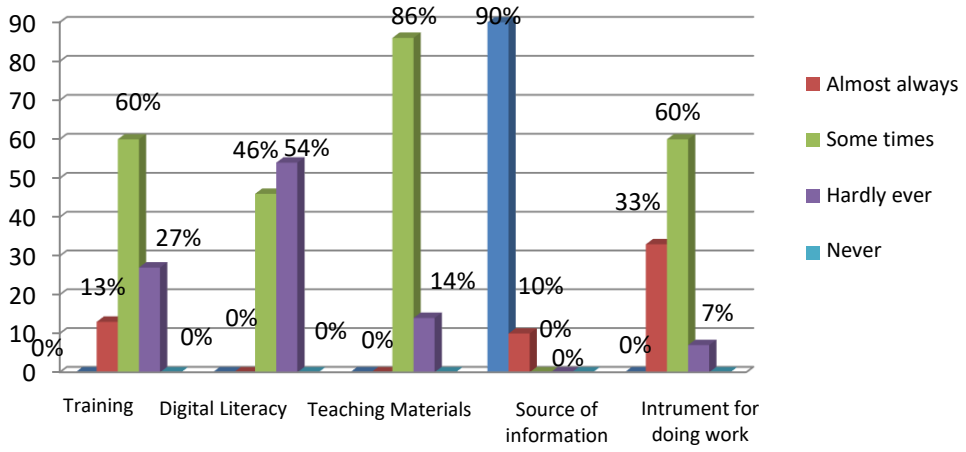

Figure 2. Percentage of ICT use dimensions

The general trend in the use of ICT for quality management in the classroom is irregular, with a predominance of "sometimes" responses. This inconsistency may be a barrier to improving the quality of education through the effective use of ICT at the Doctor Eduardo Mora Moreno High School in Loja, Ecuador. Greater consistency is needed in training, digital literacy and the use of ICTs as teaching materials and tools for work. Hence, it is necessary to enhance ICT in education for this purpose, the following can be mentioned:

On the indication in Figure 2 that precedes the average values of the ICT training indicator, it is observed that 60% indicates the option sometimes, 27% almost never and 13% almost always. On this data is evidenced the scarce importance that is given to the teaching training in the use of ICTs, there is a disadvantageous tendency to prevail the option sometimes, which is interpreted as an inconsistency in the teacher training that in the words of Sánchez (2009) “Luckily, they no longer serve only what the books say, since they can learn, more

and more, by themselves, to raise, plan strategies and solve situations in permanent transformation thanks to their accessibility to thematic environments" (p 43).

The average results of the digital literacy indicator are as follows: 54% in almost never option and 46% in the option sometimes, determining that for the majority of teachers (54%), almost never use ICT for digital literacy, despite the point by López de Ramos (2022) who emphasizes the purpose of "search, select, analyze, understand and manage the huge amount of information that is accessed through new technologies" (p. 161). In this case, such a tendency to deprive sometimes and almost never is a limit to the achievement of educational quality by the class teacher.

The mean values of the teaching material indicator include 86% in the option sometimes and 14% almost never, therefore, this discrepancy is interpreted as an unfavourable trend in the use of new tools in educational management. These results contradict what Morales (2012) pointed out, who emphasizes that "the teaching material lies in the influence that stimuli to the sensory organs exert on the person who learns, that is, puts it in contact with the object of learning, either directly or giving it the feeling of indirect" (p .10).

The results belonging to the indicator source of information is considered a favorable trend, 90% of the subjects of study always answer and 10% almost always apply and use ICT in the execution of school activities, which is a favourable factor in the pedagogical practice. The mean values of the instrument indicator for carrying out work, constitutes 60% in the criterion sometimes, 33% almost always and 7% almost never, so it is evident that the majority of the subjects of study there is inconsistency, weakness in the use of ICTs as instruments for performing work. This unfavourable trend limits the achievement of quality in the teaching practice of the teacher.

It is important to note that the predominance of frequency sometimes in the use of ICT is a weakness, since in terms of Cabrero (2019) "empowering students: importance of creating meaningful learning experiences that take into account the students' ideas. In addition, it emphasizes attention to diversity with ICT, ensuring equitable access to technologies" (p. 3). The diversity of tools allows to capture the interest of the student and in turn create a positive and constructive learning environment in the classrooms of the educational institution.

ALTERNATIVE ANSWERS											
For the achievement of educational quality, in its classroom management:		**S**		**CS**		**AV**		**CN**		**N**	
		f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Plans various activities for meaningful learning with the use of ICT.	**11**	0	0	0	0	15	100	0	0	0	0
Plans objectives focused on the use of ICT for educational quality.	**12**	0	0	3	20	4	27	8	53	0	0
Average Values Planning Indicator			**0**		**10**		**63**		**27**		**0**
Organizes the computer equipment available in the classroom for the intensive use of technology in school work.	**13**	0	0	0	0	15	100	0	0	0	0
Organizes didactic resources to promote the use of ICT in the classroom.	**14**	0	0	0	0	15	100	0	0	0	0
Average Values Indicator Organization			**0**		**0**		**100**		**0**		**0**
Leads the use of ICT as didactic material in the classroom.	**15**	0	0	1	7	6	40	8	53	0	0
Leads several pedagogical projects with the use of ICT.	**16**	0	0	1	7	9	60	5	33	0	0
Average Values Leading Indicator			**0**		**7**		**50**		**43**		**0**
Conducts diagnostic assessments to determine students' media competencies	**17**	0	0	0	0	12	80	3	20	0	0
Applies formative assessments to track student digital literacy goals	**18**	0	0	0	0	12	80	3	20	0	0
Average Values Indicator Evaluation			**0**		**0**		**80**		**20**		**0**
Average Values Use of ICT's Dimension			**0**		**4**		**73**		**23**		**0**

Number of teachers= 15

Table 3. Indicator of the dimension for the management of educational quality in the classroom.

Regarding the survey conducted for 15 (fifteen) teachers, there is a general tendency towards inconsistent and occasional application of the stages of classroom management in the context of ICT. Planning, this result suggests that there is a need to improve the planning of ICT use in the classroom. Teachers should consider the use of ICTs in the development of their educational objectives, and should plan activities and resources that take full advantage of the potential of ICTs for learning. Organization is positive, indicating that teachers are recognizing the importance of organizing ICT resources for use in the classroom. The use of ICT in the classroom will improve teacher leadership by enabling students to develop critical thinking, problem solving, collaboration and communication skills. Teachers create engaging and interesting assessments to evaluate, this helps to maintain student motivation and at the same time measure the impact of ICT use on student learning, and the results of the evaluations improve their teaching practice.

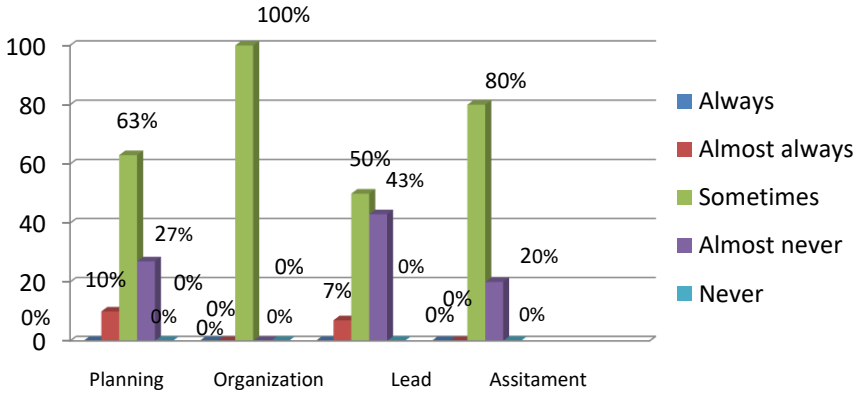

Figure 3. Dimension of the stages for classroom management

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When analyzing the results, it can be mentioned that: the results of the planning indicator are 63% in the option sometimes, 27% almost never and 10% almost always. This is an unfavorable trend that shows inconsistency on the part of these professionals in integrating the use of ICTs in planning, a stage that, in the words of Cabrero et al (2020), "considers what to do, how to do, for what, with what, with whom and when something should be done" (p. 88).

The average results of the organization indicator are 100% in the criterion sometimes, thus determining that most of the teachers working in the educational institution are inconsistent in their professional development of the organization as a stage of classroom management, so that the lack of implementation or limited compliance undermines the operational development of educational quality in terms of ICT management. This trend is unfavorable, since the organization stage is vital, as mentioned by Robbins (2003) "organization includes determining what tasks will be performed, who will do them, how the work will be grouped, and who will report to whom and where decisions will be made." (p. 114).

Leading corresponds to 50% in the option sometimes, 43% almost never and 7% almost always, which is evident that for most teachers (50%), they sometimes assume leadership in the performance of activities as part of classroom management, which does not allow the optimization of their professional performance, since this process corresponds in terms of Evans and Lindsay (2008) "ability to positively influence people and systems causing a determined attitude with intentionality to achieve educational quality" (p. 212).

The average values of the evaluation indicator are 80% in the criterion sometimes and 20% almost never. It is a trend that is interpreted as unfavorable in the application of the stages of classroom management, since according to the position of Díaz and Hernández (2000) it "should be considered as a necessary activity, since it provides the teacher with a self-control mechanism that will allow him/her to regulate and know the factors and problems that promote or disturb this process" (p. 364).

ALTERNATIVE ANSWERS											
In its classroom management, it addresses the following elements of educational quality:		**S**		**CS**		**AV**		**CN**		**N**	
		f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Equity in educating according to the individual differences of students.	**19**	0	0	0	0	6	40	9	60	0	0
Equity so that the educational service benefits students from the most disadvantaged social sectors.	**20**	0	0	0	0	4	27	11	73	0	0
Average Values Equity Indicator			**0**		**0**		**33**		**67**		**0**
Effectiveness in achieving institutional objectives	**21**	0	0	0	0	5	33	10	67	0	0
Effectiveness in keeping as many citizens as possible in the educational system.	**22**	0	0	0	0	2	13	13	87	0	0
Average Values Effectiveness Indicator			**0**		**0**		**23**		**77**		**0**
Efficiency with the adequate management of institutional resources for the use of ICTs.	**23**	0	0	0	0	11	73	4	27	0	0
Efficiency in the achievement of expected learning with students in terms of ICT use.	**24**	0	0	0	0	15	100	0	0	0	0
Average Values Efficiency Indicator			**0**		**0**		**87**		**13**		**0**
Average Values Elements of Educational Quality Dimension			**0**		**0**		**483**		**52**		**0**
Number of teachers= 15											

Table 4. Elements of educational quality

In Table 4. The equity criterion has a positive result, teachers are recognizing the importance of equity in the classroom through educational strategies. In terms of effectiveness, the result is positive, indicating that teachers can help students learn more about a wide range of topics and develop research and critical thinking skills.

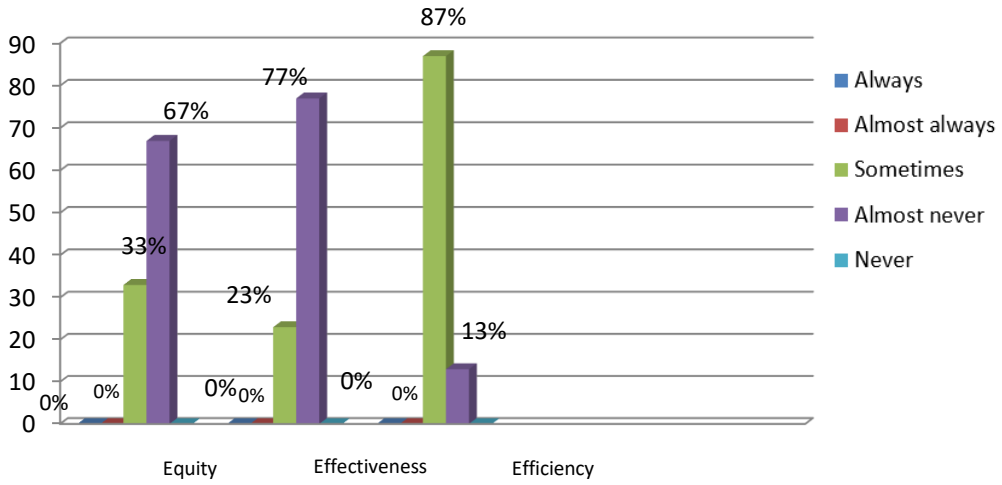

Figure 4. Dimension of elements for educational quality

On the other hand, Figure 4 shows the dimension of the elements for educational quality where they almost never adequately address equity, effectiveness and efficiency in their pedagogical practice. This represents an obstacle to the achievement of quality education, considering that these three elements are fundamental indicators of educational quality. Upon analyzing the data, the following can be mentioned: The average values of the equity indicator are as follows: 67% almost never and 33% sometimes, thus determining that most of the subjects of studies almost never emphasize equity as an element of educational quality, which is unfavorable for the integral formation of the citizen, since according to the postulates of Bracho and Hernandez (2005), "educate according to individual differences and needs, without economic, demographic, geographic, ethical or gender conditions being an impediment to learning" (p 9).

In the efficiency in the use of ICT is manifested in 77% as almost never, while 23% sometimes, therefore, it is a limitation and unfavorable trend in the management of efficiency as part of the elements of educational quality, since in terms of the National Institute for Educational Evaluation (2018) "they measure the degree to which a policy or social program is able to achieve the defined goals and objectives in the expected time and with the expected quality, regardless of the costs" (p 34). The average values of the indicator efficiency in the use of ICT translate into 87% in the option sometimes and 13% almost never, so most of the participating teachers sometimes address and use efficiency in classroom management as part of the elements of educational quality, which is limiting for the achievement of objectives, since according to postulates of UNESCO (2019), it is the relationship between "the expected educational objectives and the learning achieved, through the optimal use of the resources allocated" (p. 45). These terms are associated with the levels of achievement of indicators that are reached in a given period in terms of the effective use of available resources focused on the proposed objectives.

5. Discussion

The analysis of the data collected yields several interesting findings, all of which have significant implications for the quality of education provided at the Doctor Eduardo Mora Moreno High School in Loja, Ecuador.

In the area of equity, it is of concern that 67% of teachers almost never seek equity in their teaching, despite its importance in ensuring equitable access and achievement in education.

Equity enables all students to reach their full potential, regardless of their background. Therefore, the Sustainable Development Goals, established by the United Nations (2023) include "supporting the development, implementation and monitoring of policies aimed at reducing inequalities and overcoming all forms of discrimination" (p. 5). This implies promoting equity in education as a fundamental part of the global agenda for sustainable development. To achieve this goal, it is essential that teachers are aware of the importance of equity and are trained to implement equitable educational practices in the classroom.

Regarding the effectiveness of ICT use, the results indicate that 77% of them almost never address the indicator to achieve institutional objectives. This poses a problem in the way educational objectives are being achieved. Effectiveness is fundamental to measure the degree to which educational objectives are being met and is a crucial element of educational quality. On the other hand, Siemens (2010) notes that "the task of any trainer is to create and foster a learning ecology that enables learners to improve rapidly and effectively on the learning they already have" (p. 5).

In the context of current education, efficiency and the use of ICT are two fundamental aspects to improve educational quality, 87% of teachers occasionally employ efficiency in their teaching practice. However, it is important to highlight that the efficient management of resources, including ICT, plays a crucial role in maximizing learning and improving educational quality. In order to use these tools effectively in the classroom, it is essential to receive training and develop digital literacy skills. In contrast to Viñals and Cuenca (2016) state that:

> The teacher of the Digital Era must maintain an attitude of permanent inquiry, promote the learning of competencies (generate learning environments), maintain continuity from individual work to teamwork (bet on integrated educational projects) and encourage the development of an ethical spirit. Technology and information alone do not guide, help or advise students; therefore, the teacher's work in digital education is more important today than ever before.(p. 23).

The above results have important implications for the development of educational policies and pedagogical practices, both at the level of the institution and more broadly. These findings make it possible to provide teachers with the training and resource support needed to address these challenges. It is essential that teachers feel competent and supported to use ICT effectively, and thus address equity, effectiveness and efficiency in their teaching.

6. Conclusions

As part of the methodological procedure executed, once the information provided by the fifteen (15) classroom teachers at the Doctor Eduardo Mora Moreno High School in Loja, Ecuador was analyzed, we proceeded to formulate a conclusive synthesis, in accordance with the objectives set out, highlighting the following:

After identifying the current situation in the use of ICT, classroom teachers are mostly unconscious in training and participation to apply digital tools in the pedagogical practice with the intention of favoring the achievement of educational quality. As Roldán (2007) states "it is necessary a continuous system of teacher education and training, in which pedagogical, didactic, technical, technological and creativity converge" (p 171). In addition, we sought to describe the stages that are fulfilled for quality management in the classroom, where a weakness of professionals is that they do not constantly plan various activities for meaningful learning with the use of ICT. Likewise, they are inconsistent in organizing the

institutional equipment available for the intensive use of technology in school work, which hinders the achievement of equity, efficiency and effectiveness indicators. To address this situation, it is necessary for educational institutions to implement training and support programs for professionals so that they can use ICTs effectively. These programs should provide professionals with the knowledge and skills necessary to plan and implement meaningful learning activities using ICTs.

According to the survey results, teachers use ICTs in the classroom occasionally, either as didactic material or in pedagogical projects. However, they show weaknesses in conducting diagnostic and formative evaluations to determine students' media and digital competencies. When analyzing the use of ICTs for quality classroom management, it is observed that most professionals are inconsistent in their use, whether for training, achieving digital literacy, or as didactic material. In most cases, ICTs are used only as a source of information or to carry out work, which limits the comprehensive training of students. Classroom teachers do not incorporate the use of ICTs in the planning, organization, leadership and evaluation stages. This limits equity, effectiveness and efficiency in quality classroom management.

Acknowledgment

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REVISTA CÁTEDRA

Open research in laboratory practice to learn Chemistry in high school students

Investigación abierta en la práctica de laboratorio y el aprendizaje de la Química en los estudiantes de bachillerato

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Abstract

Experimentation as a methodological strategy used in the teaching-learning process in chemistry presents a stagnation in the acquisition of knowledge, skills, and indispensable abilities. Currently, practices are based on methodically following the procedure given in a laboratory guide, causing a passive learning, where the student is not directly involved in building their own knowledge. For this reason, the purpose of this study was to apply open research in laboratory practice, since it is a methodology based on constructivist learning. Its relationship with the learning of chemistry was investigated, in addition to determining its influence and identifying its contribution to it. This research was non-experimental and correlational in scope. On the other hand, a survey and an evaluation test were applied to 125 high school students of the Nuestra Familia Educational Unit. As main results, a positive, moderate, and significant correlation was obtained between the open investigation in the

laboratory practice with the learning of Chemistry. In addition, the results of the evaluation test show a positive influence by obtaining 75% of students who reach and master the learning. While 73.60% of students consider that the open research contributes considerably in the acquisition of learning. As a consequence, the applied methodology presents a superior cognitive contribution by developing and strengthening the research process and executing it in the laboratory.

Keywords
Learning, experimentation, open inquiry, laboratory, Chemistry.

Resumen
La experimentación como estrategia metodológica empleada en el proceso de enseñanza-aprendizaje en la Química presenta un estancamiento en la adquisición de conocimientos, destrezas y habilidades indispensables. Actualmente, las prácticas se basan en seguir de manera metódica el procedimiento dado en una guía de laboratorio, provocando un aprendizaje pasivo, donde el estudiante no se involucra directamente en construir su propio conocimiento. Por esta razón, el presente trabajo de estudio tuvo como finalidad aplicar la investigación abierta en la práctica de laboratorio, al ser una metodología basada en el aprendizaje constructivista. Se investigó su relación con el aprendizaje de la Química, además de determinar su influencia e identificar su contribución en la misma. Esta investigación fue de tipo no experimental y de alcance correlacional. Por otra parte, se aplicó una encuesta y un test de evaluación a 125 estudiantes de bachillerato de la Unidad Educativa Nuestra Familia. Como principales resultados se obtuvo una correlación positiva, moderada y significativa entre la investigación abierta en la práctica de laboratorio con el aprendizaje de la Química. Además, los resultados del test de evaluación demuestran una influencia positiva al obtener un 75% de estudiantes que alcanzan y dominan los aprendizajes. Mientras que el 73.60% de estudiantes consideran que la investigación abierta contribuye considerablemente en la adquisición de aprendizajes. Como consecuencia la metodología aplicada presenta un aporte cognitivo superior al desarrollar y fortalecer el proceso investigativo y ejecutarlo en el laboratorio.

Palabras clave
Aprendizaje, experimentación, investigación abierta, laboratorio, Química.

Introduction
The Ministry of Education of Ecuador promotes the maximum development of students' capabilities. Through the application of pertinent methodologies related to participation, individual and/or collaborative, favoring critical and rational thinking, by carrying out reading and research activities. In this regard, Brito et al. (2019) states that: "it contributes from two areas: the cognitive related to intellectual development and the formative-axiological, related to personality development" (p. 304). For this reason, the use and management of educational laboratories is recommended. In order to strengthen the quality of education, mainly in the acquisition and strengthening of scientific skills in students.

It should be mentioned that the teacher's job is to guide the learning process using different methodologies and teaching strategies in the classroom. In this way, the student constructs his own knowledge individually and/or collaboratively. In this study, experimentation is

used as a didactic strategy where the student analyzes the phenomena directly. In addition, Cueto and García (2017), indicate that: "significant learning occurs. Students, who already have some previous theoretical knowledge, will be able to relate practice with theory" (p. 48).

Currently, at the experimental level, traditional methodologies are applied, as is the case of experimental practices. For this type of practice, the use of laboratory guides is used. During this process, a certain cognitive stagnation is perceived in the students, due to the fact that all the information is provided in this document. Therefore, the student does not make an effort to reflect, investigate, or get involved in constructing his own knowledge. This problem has been pointed out by Llorente, (2016) in his article, where he examines the impact of experimental practices on student learning and motivation. Although, he highlights that experimental practices can motivate and generate good learning outcomes, he also warns about the need to move towards more challenging approaches. His study concludes that consecutive application of experimental practices can slow down cognitive development. In addition to limiting students' ability to reflect, investigate and actively participate in the construction of their own knowledge.

In view of this problem, a non-experimental research, with correlational scope, was carried out to study the teaching-learning process. The open research methodology was used through the planning and elaboration of a relevant model in the laboratory practices, called road map. The study was carried out on high school students of the "Nuestra Familia" Educational Unit. Thus, the present study proposes to analyze open research in laboratory practice and its relationship with the learning of chemistry. Considering Stoichiometry as the main axis of learning at all high school levels. For which we wish to determine the influence of the open laboratory practice in order to identify the process of open research.

The relevance of this study lies in the fact that, upon performing an exhaustive search in local and national databases, no similar research was found where the independent variable of this study, i.e., open research in laboratory practice, is considered. However, we did find degree works where experimental practices are employed with the use of a laboratory guide as a didactic tool. Therefore, this study is useful to expand and update the data on the learning of chemistry. As well as, proposals to improve the educational quality and the teaching-learning system in Ecuador.

This study faces several difficulties and challenges that may affect the interpretation of the results and the generalization of the conclusions. First, the implementation of open-ended research in laboratory practice may encounter lack of familiarity among students, which could influence the effectiveness of the proposed methodology. Finally, the difficulty in controlling all external variables that could influence the teaching-learning process may affect the internal validity of the study. Despite these challenges, addressing these difficulties will provide a solid foundation for future research, and improvements in the implementation of open-ended research in the educational context of Chemistry.

Despite the ambitious objectives and identified relevance, this study faces certain limits that must be considered when interpreting its results. First, there is the geographical and educational level limitation that could affect the generalization of the findings to other educational institutions or academic levels. Also, the selection of stoichiometry as the main focus of learning may limit the applicability of the results to other branches of chemistry. Finally, the study does not address external factors, such as socioeconomic or cultural conditions of the students, which could influence the results. These limits offer opportunities for future research that could expand and contextualize the findings of the

present study. The present paper is articulated within the research line "Education, science, technology and innovation" and summarizes the most important elements and considerations that were fully developed in the thesis work of (Faican-Juca, 2023).

This article follows a clear and systematic organization, beginning with a literature review that establishes the context and grounds the research. It then details the methodology employed in the study, providing a description of the procedures used to obtain meaningful data. The results derived from the execution of the data collection instruments are presented in a comprehensive manner, followed by a discussion. Finally, the article concludes with a section summarizing the main contributions and conclusions drawn from the study.

2. Bibliographic review

2.1 Teaching and learning of chemistry

Currently, Garcés et al. point out that the teaching and learning of chemistry continues to be a complex process. It not only consists of the acquisition of theoretical knowledge, it also aims to acquire and strengthen skills, abilities and competencies in the student body (Garcés et al., 2018, p. 231-345). These being critical thinking, problem solving, cognitive and communication skills, ability to formulate hypotheses, experimentation and interpretation, among others. For this reason, Rodriguez and Cruz state that" it is crucial that a teacher possesses not only a deep knowledge of the subject he or she teaches, but also solid pedagogical skills" (Rodriguez and Cruz, 2020, p. 1). "The ability to communicate complex concepts, motivate students and evaluate their progress are essential aspects that derive from a pedagogical training, thus contributing to a more comprehensive and meaningful education" (Lorduy and Naranjo, 2020; Martínez et al., 2018).

2.2 Experimentation as a didactic strategy

According to Neira, through experimentation, the teacher optimizes and strengthens meaningful learning. While, with the planning and pertinent design of laboratory practices, the acquisition of new knowledge and its relationship with previous knowledge is guaranteed (Neira, 2021). In this way, experimentation is an effective strategy by providing students with ideal moments for learning and strengthening their autonomy and curiosity. As Molina et al. (2018) verify by stating that:

> The teacher determines to a great extent the attitudes of the students and their performance in a course, the way he/she conducts the course and the use of didactic methodologies can generate a better or worse training (p. 54)

As shown in Figure 1, Hernández discusses that the methodology applied in theoretical and experimental teaching differs in the intervention and action of the students, therefore, there is also a difference in the cognitive process to be developed. During a theoretical teaching, the student is indirectly involved with the phenomenon given and explained by the teacher, producing a passive and receptive learning. This implies a low cognitive process related to the acquisition of knowledge. Hernandez also emphasizes that, in experiential teaching, the student has a direct participation in the learning process. Because cognitive processes such as observation, analysis, deduction among others are involved, provoking interest, curiosity and inquiry (Hernández, 2013, p. 86-108).

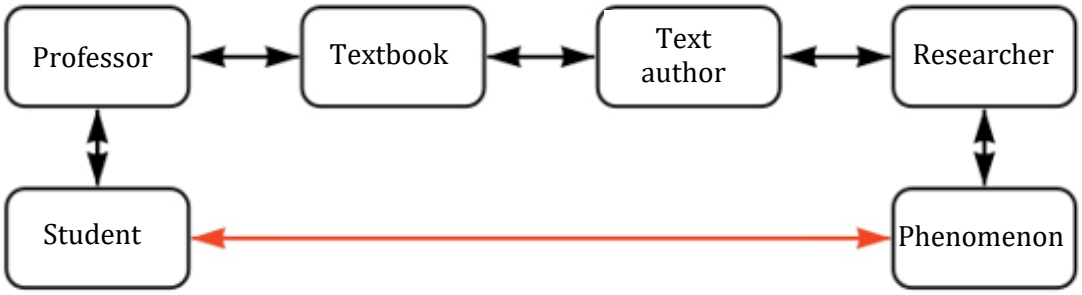

Figure 1. Comparison between theoretical and experimental teaching. Taken from: (Hernández, 2013, p. 92). Note: The figure represents the relationship between theoretical teaching (black arrows) and experimental teaching (red arrow).

2.3 Laboratory practices

The work done in the laboratory is essential, therefore, different methodological strategies should be used in the planning of the class (Rodríguez, 2017). There is a great variety of types of laboratory practices, which have been classified by Herrón 1971 and by Priestley 1997. These two authors proposed a scale of five and seven levels of openness respectively (Neira et al., 2021). "The levels of openness are based on the roles of the student and the teacher, when the role of the student is greater in the learning process the level of openness is high" (Cueto and Garcia, 2017; Zorrilla et al., 2020). The most commonly used laboratory practices are:

- Demonstrative practices. Valverde states that in this type of practice the student acts as observer and receiver, and the teacher is in charge of the whole experimental process. Both the objective, material, method and solution are given, so it is at the first level of openness and the cognitive process developed is knowledge acquisition (Valverde et al., 2006, p. 62).
- Experimental practices: according to Llorente, in these practices, the teacher develops a laboratory guide and the student is in charge of the execution following the given procedure, in these practices the objective, material and method are given completely, as for the solution it can be delivered in part. It is considered as second or third level of opening, developing knowledge and understanding as a cognitive process (Llorente, 2016, p. 8-9).
- - Open inquiry practices: Zorrilla focuses on the scale proposed by Herrón, open inquiry practices are distinguished by adopting an investigative approach, where the teacher establishes the objective, and the student assumes the responsibility of exploring the materials, methods and possible solutions to address the proposed problem (Zorrilla, 2018, p. 34). In Priestley's taxonomy, this type of practice is placed at level 6, characterized by the assignment of the problem by the teacher. While the student is in charge of developing the appropriate procedure and reaching their own conclusions. Both classifications highlight the ability of open inquiry practices to actively involve the student in the learning process. In addition to fostering high-impact cognitive processes, such as analysis and synthesis. This is confirmed by Jiménez, who indicates that this approach not only promotes the acquisition of knowledge, but also stimulates critical thinking and intellectual autonomy of the student. Finally, it contributes to deeper and more meaningful learning (Jiménez et al., 2005, p. 9).

Laboratory practices are fundamental for the scientific and comprehensive training of students by employing different processes and complying with basic work standards, as explained by (Hernández et al., 2018):

> with the approach of the experiment to the research activity, as well as the requirements for management, constitute the foundations on which the didactic procedures for the contribution to scientific training from laboratory practices are based (p. 325).

3. Methodology

This research presented a non-experimental design because it dispensed with the intentional manipulation of variables. "It seeks to understand the intrinsic dynamics of the phenomena, providing valuable information about their nature and causal relationships without disturbing their natural course" (Monje, 2011, p. 26). Its approach "was quantitative and correlational in scope where it was determined as an independent variable, open research in laboratory practice, for being manipulable and modifiable in the research process" (Hernández et al., 2014). As a dependent variable, the learning of chemistry, as it is the one whose behavior is affected by the previous variable. The primary purpose was to analyze whether open research in laboratory practice is related to the learning of chemistry, this being the hypothesis put forward. For which, we worked with 125 high school students of the Unidad Educativa Nuestra Familia, "no sampling was applied, because it was a small population" (Paniagua and Condori, 2018, p. 45.

For the open investigation in the laboratory practice, the following phases were followed:

- Planning phase, the teacher prepared a document detailing the problem and the objective to be achieved, called a roadmap. In this document, a contextualized problem based on stoichiometry was included, in addition to specifying the activities to be carried out during the pre-laboratory, laboratory and post-laboratory phases.
  - Execution phase, the student's work was divided into three parts:
  Pre-laboratory which consists of the research process, this is the first part where students inquired aspects about the use and employment of reagents, materials, procedure to be applied, adequate and relevant chemical methods, analytical calculations and safety standards to meet the objective and solve the problem posed.
  Laboratory is the second part, which consisted of the execution of the practice, complying with the previous research and constant teaching support.
  Post-laboratory is the last part, where students were responsible for preparing and presenting the corresponding report, in addition to completing the questionnaire and *Google Forms test.*

3.1 Research techniques and instruments

For data collection, two techniques were applied with their respective instruments, which were previously validated by professional experts and statistically tested in a pilot population. Cronbach's Alpha Coefficient was calculated, where a reliability of 0.8008 was obtained, which was subsequently interpreted with the scale described in the work of (Supo, 2013). The result presented a significant reliability range. Therefore, the instruments applied to the study population of "Nuestra Familia" were duly validated and reliable.
The first technique applied was the survey by means of a questionnaire as an instrument, the same one elaborated in the Google Forms program. The students received the invitation

through the Classroom platform and responded online, individually, voluntarily and anonymously. This form contained a total of 15 questions for the two variables. Eight questions were posed with more than one answer option. They were aimed at investigating the application, didactics and frequency of laboratory practices, as well as the roles of teachers and students. These questions allowed collecting data for the independent variable (open investigation in laboratory practice). On the other hand, for the dependent variable (learning chemistry), five questions were posed. These addressed the relationship between previous knowledge and acquired knowledge, as well as the attainment of skills, abilities and competencies.

The second technique was the evaluation instrument using a diagnostic evaluation test. This test consisted of 10 questions generated through Google Forms and shared with the students by Classroom. It was used to determine the scale of learning obtained. Its questions were based on the work done in the laboratory such as use and function of materials and reagents. In addition, about physical-chemical processes and stoichiometric contents. The quantitative results of this test contributed to the dependent variable. That is to say, they allowed knowing and analyzing the learning of the students by using the scale of learning achieved (qualitative scale) governed in the educational institution.

3.2 Data processing and analysis techniques

For data processing, the results of the questions corresponding to the same dimension were grouped and the arithmetic mean was determined. Subsequently, these averages were taken to the statistical software Minitab Statistical 20, in which contingency tables were made with a greater representation. In addition, it was "determined the trends of the responses according to the frequencies obtained" (Hernández et al., 2014), To test whether the open-ended research in the laboratory practice is related to the learning of Chemistry. That is, for hypothesis testing, the normality test and a nonparametric measure such as *Spearman's coefficient* were performed.

4. Results

In order to specify the most relevant aspects in the development of laboratory practices, the types of practices used in the educational institution were analyzed. Table 1 shows the types of laboratory practices applied in the teaching of chemistry and their frequency. From the students' point of view, they state that the most used are experimental practices with 56.35%. Next are the demonstrative practices with 23.20% and finally the practices with open research with 20.44%. Regarding the cognitive contribution, the types of laboratory practice and their impact on the acquisition and understanding of knowledge were compared. According to the students' perspective, 44.27% indicated that experimental practices have a greater impact, 28.73% stated that demonstrative practices and 27.00% declared that practices with open research have a greater impact.

Types of practices	Frequency	Cognitive contribution
Demostrative	23.20 %	28.73 %
Experimental	56.35 %	44.27 %
Open research	20.44 %	27.00 %
Total	100.00 %	100.00 %

Table 1. Types of laboratory practices and their characteristics

In Table 2, for the degree of complexity, 65.60% of students revealed a high level of complexity when performing practices with open research. They mainly indicated difficulty during the investigative and analytical phase (stoichiometric calculations). Analyzing the teaching support in this methodology, only 24.53% of students considered it to be optimal, constant and adequate in each phase of the process. Regarding the complexity when studying stoichiometry, considering that this is the axis of study, 64.80% of students indicated a minor or low complexity. On the other hand, 35.2% stated a high or higher complexity, in relation to the difficulty in understanding the problem posed and the analysis of the chemical reaction produced in the laboratory practice.

Level	Open research		Stoichiometry
	Complexity	Teacher support	Complexity
High	65.60 %	24.53 %	35.20 %
Low	34.40 %	75.47 %	64.80 %
Total	100.00 %	100.00 %	100.00 %

Table 2. Open research characteristics and stoichiometry complexity.

Table 3 reflects the students' perspective on the benefits derived from the intervention and application of open-ended research in laboratory practice. According to their evaluations, the collaborative approach of this methodology has contributed significantly to the development of key skills. Evidenced by outstanding percentages: 78.40 % in collaborative work, 76.80 % in organization, 68.00 % in problem solving and 65.60 % in analysis.

Level	Skills			
	Analysis	Troubleshooting	Collaborative work	Organization
High	65.60 %	68.00 %	78.40 %	76.80 %
Low	34.40 %	32.00 %	21.60 %	23.20 %
Total	100 %	100 %	100 %	100 %

Table 3. Skills obtained

In Table 4, the data reveal that 74.40 % acquired a high level of experimentation, 68.80 % in observation, and 66.40 % in research, evidencing significant skills and competencies. These results suggest that the implementation of open inquiry has had a positive impact on strengthening essential skills for students. In comparison with other forms of laboratory practices, such as the demonstrative and/or experimental ones employed throughout their secondary education. These findings highlight the particular effectiveness of open inquiry in fostering fundamental skills, abilities, and competencies for scientific learning.

Level	Skills and competencies		
	Observation	Research	Experimentation
High	68.80 %	66.40 %	74.40 %
Low	31.20 %	33.60 %	25.60 %
Total	100 %	100 %	100 %

Table 4: Skills and competences obtained

The learning process was evaluated through the application of a test with 10 questions that collected information on the use of materials. Where 98.4%, 95.2% and 48% of students were correct in questions 1, 2, 3 respectively. Questions 4, 5, 6, 7 determined the understanding of physical-chemical processes, obtaining that 91.2%, 69.6%, 45.6% and 73.6% of students choose the correct answer for each question. Regarding stoichiometric calculations, for question 8, 49.6% got it right, for question 9, 84.8% got it right, and for the last question, 88% of students got it right.

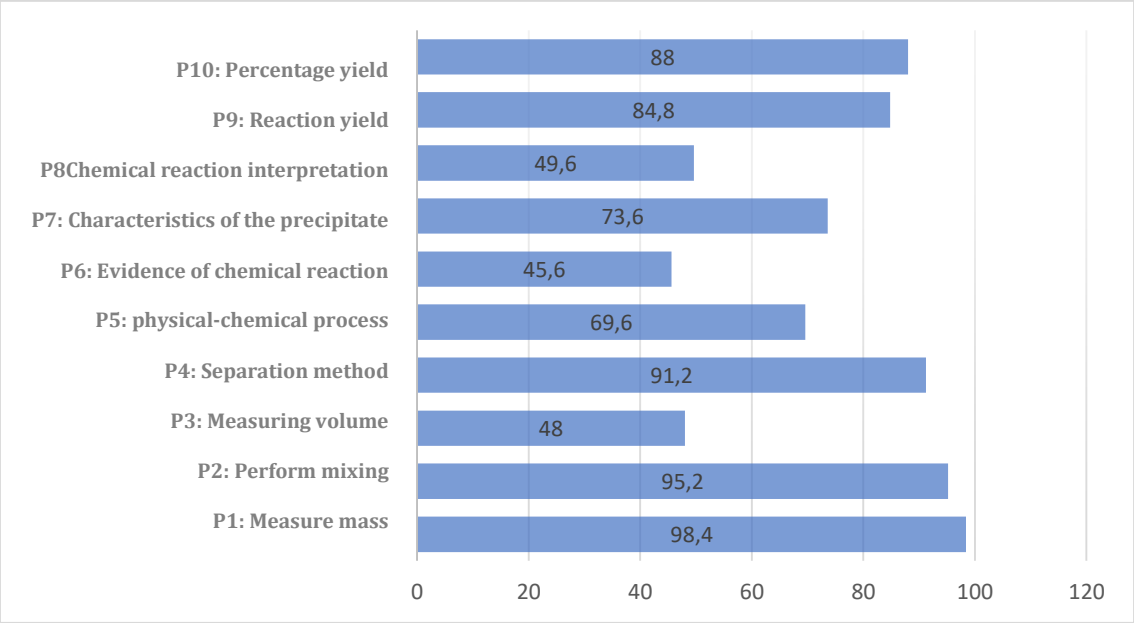

Figure 2. Percentage of correct answers by question

Each test had a final evaluation of 10 points and the scale of learning achieved was used. It was obtained that 28% of the students mastered the learning, because they obtained a score higher than 9/10. 47.20% of the students achieve the learning, whose valuation was between 8.99 and 7. Finally, 4.80% do not achieve the learning related to stoichiometry, as well as the correct use and function of materials and reagents, as shown in Table 5.

Scale of learning achieved	Range	Students	Percentage
Master the required learning	10 – 9.00	35	28.00 %
Achieving the required learning	8.99 – 7.00	59	47.20 %
Is close to achieving the required learning	6.99 – 4.01	25	20.00 %
Does not reach the required learning	4.00 – 0	6	4.80 %
Total		125	100.00 %

Table 5. Learning scale. Taken from: (Subsecretaría de Fundamentos Educativos, 2016, p. 8).

In order to test the study hypothesis, which consists of relating the open investigation in the laboratory practice with the learning of chemistry, the hypothesis test was performed. Considering that the variables were quantitative and discrete, which did not present a normal distribution in the normality test. The significance level was 95%. Therefore, a non-parametric measure was used and Spearman's correlation coefficient was calculated. A value of 0.550 was obtained for rho, as can be seen in the scatter diagram, Figure 3.

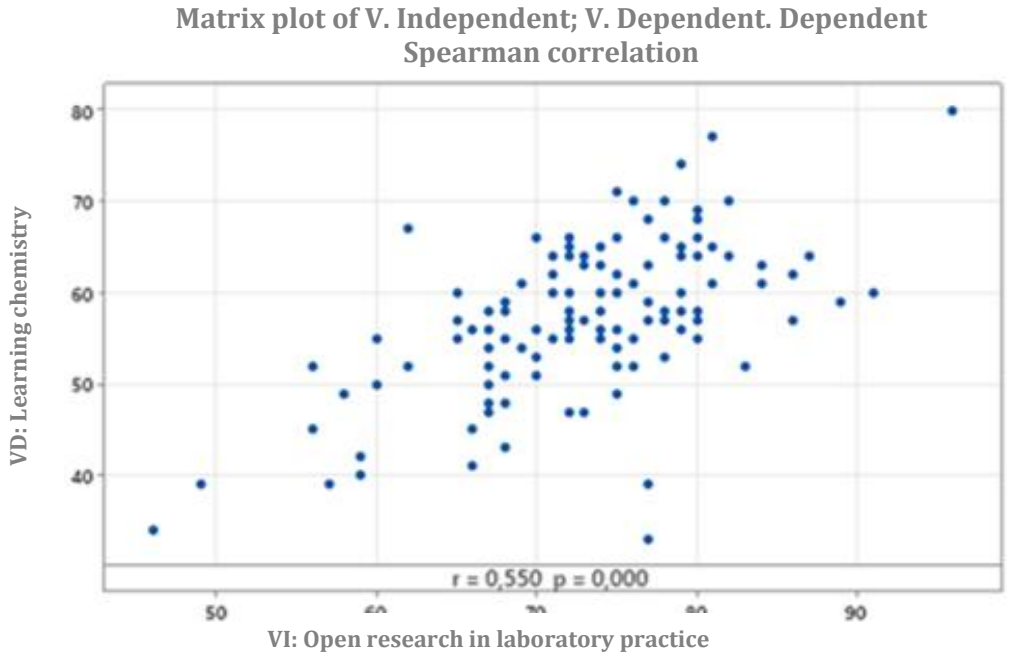

Figure 3. Spearman's correlation coefficient

Therefore, when performing the hypothesis test based on Spearman's correlation, it was determined that the open investigation in the laboratory practice is related to the learning of Chemistry. The interpretation of the rho value, as analyzed in Table 6, shows a positive, moderate, and significant relationship or association. By obtaining a rho value of 0.550, considering a level of significance of 0.05.

rho range	Interpretation
- 0.76 a – 1.00	Negative correlation between strong and perfect
- 0.51 a - 0.75	Negative correlation between moderate and strong
- 0.26 a - 0.50	Negative correlation between weak and weak
- 0.01 a - 0.25	Negative correlation between weak and null
0	Null correlation
+ 0.01 a + 0.25	Positive correlation between weak and null
+ 0.26 a + 0.50	Positive correlation between weak and weak
+ 0.51 a + 0.75	Positive correlation between moderate and strong
+ 0.76 a + 1.00	Positive correlation between strong and perfect

Table 6. Interpretation of Spearman's correlation. Adapted from: (Roy et al., 2019).

- Positive correlation whose meaning lies in the fact that the learning of chemistry increases as the application of open-ended research increases.
- Moderate correlation means a moderate strength of association between the variables by obtaining a value of 0.550.
- Significant correlation when generalizing these results to other study populations.

5. Discussion

The results derived from the investigation, Figure 3, determined a positive, moderate and significant association between the independent variables "open investigation in laboratory practice" and the dependent variable "learning Chemistry". From Spearman's correlation test, it is inferred that Chemistry learning is related to laboratory practice using open-ended inquiry. According to the rho value of 0.550 which shows a positive association. This result is corroborated with the study conducted by (Villanueva and Concha, 2020), in which it demonstrates the importance of research in the experimental process. Although this methodology has a moderate relationship with respect to learning, it should be considered that there are other factors that prevent increasing this relationship since it does not depend only on practice.

Experimentation with open research has a positive influence on the learning of high school students, as shown in Table 1. However, 44.27 % of students still prefer traditional practices, considering that the student is immersed in this paradigm where all information is given to him/her in full. This result has been verified by Zorrilla et al., 2020 in their doctoral thesis, where they indicate that the most developed experimental classes correspond to low levels of openness. In these practices the student requires basic cognitive processes, such as knowledge, application. Consequently, the student feels more comfortable with traditional practices. Whereas, in open inquiry practices, it generates a higher level cognitive development, because the student is fully involved in the process of research and experimentation.

The teacher's action is considerably reduced, as shown in the analysis of Table 2. That is why 24.53% of students indicate having obtained optimal support from the teacher throughout the experimentation process. For a significant acquisition in relation to learning, the student must demonstrate basic knowledge of experimentation. This is corroborated by the result, where 65.60% of participants consider that open research presents a higher degree of difficulty in its execution and is preferred by only 27% of the students. These results are supported by the study of Llorente, 2016 where he recommends open research practices for a greater scope in learning, considering the predisposition of the student. Likewise, Cueto and García, 2017 demonstrated through their thesis the effectiveness of research-based methodologies, even indicating that it facilitates learning and improves achievement.

It should be emphasized that, these results differ with those obtained in Table 3 and 4, where an optimal contribution of open inquiry is identified. By producing in students the acquisition of skills, competencies and abilities. It was obtained that more than 65.60% of the students acquired and strengthened skills such as: collaborative work, organization, problem solving and analysis. Likewise, more than 66.40% acquired a high level of experimentation, observation and research as skills. However, certain important aspects should be considered, such as: teacher support, proper planning and elaboration of the road map by the teacher, as well as research in reliable sources and equitable work, complying with safety standards. Coinciding with the research of Hernandez et al., 2018 that proved that, when considering the levels of openness in laboratory practices provide exceptional and high-level results, for the scientific and academic training of students. In this study, it was found that the level of openness, open research in laboratory practice positively influences and contributes to the learning of Chemistry.

In Table 5, the results when evaluating the learning of stoichiometry applying the learning scale achieved, given by the Ministry of Education. Favorable results were obtained,

indicating that 75% of the students reached and/or mastered the learning, by obtaining a grade higher than 7/10. Considering that the questions addressed stoichiometric contents, differentiation of physical-chemical processes and the appropriate use of laboratory materials. This result contrasts with the study of Raviolo and Lerzo, 2016, where it is indicated that, in order to guarantee the understanding of stoichiometry, and therefore the obtaining of optimal evaluative results, it is necessary to develop experimental methods for its teaching.

6. Conclusion

From the results obtained in this research, it is concluded that a positive influence was determined between open research in laboratory practice and the learning of chemistry, by presenting a moderate and positive relationship between the application of open research and learning, although only 27% of students considered that open research has a high cognitive contribution in the process. It should be emphasized that a considerable contribution to learning was identified, since open research intervenes in the acquisition of abilities and skills and competences with a percentage of 73.60% and 69.60% in the students, respectively. In addition, the process was evaluated through the application of a test, as a result it was obtained that 28% of students master the required learning and 47% reach the learning, these values indicate a learning of Chemistry mainly of stoichiometry. Finally, it was established that there is a considerable percentage of students, 44.27%, who still prefer traditional laboratory practices mainly using laboratory guides.

In the course of the research, factors that impede the practice of open research were identified, the main one being the educational curriculum, including the temporality and frequency of its application. For future lines of research, it is recommended to carry out studies that analyze the application of open inquiry in laboratory practice, considering the use of materials and reagents of daily or home use. Also, to study the influence of open inquiry in the laboratory and STEAM projects.

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REVISTA CÁTEDRA

Obtaining vegetable dyes as a didactic resource in Biology laboratories

Obtención de Colorantes Vegetales como Recurso Didáctico en los Laboratorios de Biología

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Abstract

Natural dyes are millenary discoveries that have been used since ancient Greece to color numerous objects such as sculptures but have lost their usefulness and have been replaced by artificial dyes that can be harmful to health. The purpose of this study is to obtain a natural vegetable dye from the hibiscus flower using vinegar as a solvent, to be used as a didactic resource in the experimental practices of the biology laboratory. The hypothesis of the study indicates that a useful colorant can be obtained from the calyxes of the hibiscus flower, demonstrating its function in the experimental observations in the practices of mitosis and meiosis. The method used was descriptive and observational since experimental activities were carried out applying the reagent and dye obtained. The dyes and reagents required for such practices are of high cost and those obtained as a result of this research were of low cost, the acetic orcein in the market has a value of $31.3 for 60 ml, while in the research carried out the cost of the pigment was $0.76 for 60 ml and the reagent that replaced the hydrochloric acid that in the market costs $6 for 500 ml, the reagent obtained had a value of $2.36 for 500 ml; the products obtained had a similar performance to those acquired in the industry. The results contribute with resources that will allow for better.

Keywords

Learning, dyes, experimental practices, didactic resources, vinegar.

Resumen

Los colorantes naturales son descubrimientos milenarios que se utilizaban desde la Grecia antigua para dar color a numerosos objetos como las esculturas, pero que han perdido su utilidad siendo sustituidos por los colorantes artificiales que pueden resultar dañinos para la salud. El propósito de este estudio es obtener un colorante vegetal natural a partir de la flor de jamaica empleando como solvente el vinagre, para utilizarlo como recurso didáctico en las prácticas experimentales del laboratorio de Biología. La hipótesis del estudio indica que se puede obtener un colorante útil de los cálices de la flor de jamaica demostrando su funcionamiento en las observaciones experimentales en las prácticas de mitosis y meiosis. El método empleado fue descriptivo y de observación, ya que se realizaron actividades experimentales aplicando el reactivo y el colorante obtenidos. Los colorantes y reactivos que se requieren para dichas prácticas son de alto costo y, los que se obtuvieron como resultado de esta investigación fueron de bajo costo, la orceína acética en el mercado tiene el valor de $31,3 los 60 ml, mientras que en la investigación realizada el costo del pigmento fue $0.76 los 60 ml y el reactivo que reemplazó al ácido clorhídrico que en el mercado cuesta $6 los 500 ml, el reactivo obtenido tuvo un valor de $2.36 los 500 ml; los productos obtenidos tuvieron un funcionamiento similar a los que se adquieren en la industria. Los resultados aportan con recursos que permitirán mejorar la calidad de la enseñanza–aprendizaje en el laboratorio de Biología.

Palabras clave

Aprendizaje, colorantes, prácticas experimentales, recursos didácticos, vinagre.

1. Introduction

Obtaining dyes from vegetables is one of the activities that were performed for many centuries as evidenced by the objects found in cultures since Greece. According to Yusuf, Shabbir, and Faqeer (2017).

> nature has always dominated the synthetic or artificial, since the beginning of this world since nature was the only option for humans to acquire elements, materials of natural origin present characteristics that are advantageous over synthetics, giving them priority (p. 124).

"New technologies are allowing the obtaining of pigments from natural dyes, making them efficient, causing synthetic pigments to be rejected" (Cuesta, 2018, p. 1). The high cost of dyes in the industry where, the value of acetic orcein which is a pigment to give color to chromatin reaches $31.3 the 60 ml in the chemical industry. The scientific experience allows the student to give answers to questions, strengthening their meaningful, lasting and practical learning, enriching their scientific knowledge, in the certainty of being able to live in this world without destroying it and keeping it in good condition for future generations. "Constructivism involves the student to be the constructor and protagonist of his own learning, who brings his knowledge that serves as a support to strengthen the new knowledge" (Miranda-Núñez, 2022, p. 81).

Experimental activities have been considered as a methodological and didactic instrument that supports the academic-scientific training process of students. Teachers who teach subjects in the area of natural sciences frequently incorporate laboratory practices based on a pedagogical model, adapting them to the peculiarities of the environment, to the usable inputs, and to the training needs, since, in addition to supporting the theoretical classes, they awaken and develop the curiosity of the students, motivating them to solve problems (Zorrilla et al., 2022).

The purpose of the research is the extraction of the dye from the calyxes of the hibiscus flower using vinegar as a solvent to substitute acetic orcein, which is commonly used in laboratory practices for the observation of the phases of mitosis and meiosis (chromatin); likewise, lemon and vinegar will substitute hydrochloric acid in the softening of the plant tissues of the samples used in these practices. This dye can be used in Biology laboratories as a didactic resource for the realization of experimental practices, considering that the experiences obtained in the laboratory are fundamental in the teaching-learning process. This will allow the participation and development of students as active beings who construct their own knowledge, obtaining a scientific experience, since they will develop investigative thinking for the understanding of natural phenomena. This knowledge and information can have a new application in the field of formal education and could contribute to the creation of alternative didactic tools to improve the educational process of biological sciences. Hence, it has become mandatory to look for alternatives to obtain dyes by experimental methods such as the one presented in this research, where through the calyxes of hibiscus flowers, the dye was obtained at a cost of $0.76 for 60 ml of the dye.

In this sense, it is necessary to stimulate the biological conditions that allow human beings to construct knowledge. Science teaching is carried out based on pedagogical practices in an interaction that focuses on teaching and learning the contents of the scientific discipline. This space requires a constructivist and contextualized educational practice. The knowledge based on the production of vegetable dyes constitute constructs in the biological

sciences, the teacher must deepen in the inquiry which will allow the student to reflect and conceptualize using knowledge and knowledge derived from nature.

Regarding the structure of the article, section 1 contains the introduction in which the reader is familiarized with the context of the work. Section 2 presents the theoretical reference where the documented information on the research topic is gathered. Section 3 details the methods and instruments used to develop this research. In section 4, the results obtained as a result of the study carried out in a theoretical and practical manner are detailed. Section 5 shows the discussion in which the results are extrapolated, interpreted and summarized. In section 6, conclusions are drawn according to the results obtained.

2. Theoretical reference

It is possible that the taste for color in human beings is the result of the change of the seasons of the year, and has been shaped by the use of pigments obtained from plants and flowers and even blood and ashes. The accelerated development according to Dupey, and the flourishing of craftsmanship supported mainly by the establishment of Mexican territories, provoked and stimulated the leap from basic dyes (made with earth) to a wider and wider range of dyes. For this reason there was a variety of resources with which colorations applicable in pottery, fabrics, ideograms, rituals, food, and even in the bodies of kings, priests and warriors were obtained (Dupey, 2016). In this regard, Villaño et al. (2016) mention that "the origin of dyes and their classification are due to their biological properties and based on the biological characteristics that dyes possess, the features of their physical properties to their chemical structures are evident" (p. 1).

Thus, according to Valenzuela and Pérez, a variety of colors can be obtained using vegetables, fruits and spices that have diverse applications, since they can be used to dye fabrics, paint wood, color canvases, color homemade soaps, among others. Plant pigments include a wide variety of ranges of components and colors, among the most important we can mention flavonoids, anthocyanins, carotenoids, betalains, chlorophylls among others (Valenzuela and Perez, 2016). "Since the appearance of synthetic dyes in the industry, natural pigments have been relegated, since the synthesized ones present greater stability, wide range of colors and lower cost" (Rolón, 2018, p. 11).

Amchova et al. (2015) state that "in the industry, a series of tests are carried out for the use of different colorants in order to detect the different forms of toxicity" (p. 2). "Natural type colorants are obtained from foods such as fruits and vegetables with intense color and through maceration or boiling processes the colorant can be extracted" (Ulloa, 2017, p. 3). The following table shows the types of colorants with characteristics and examples.

Natural	Artificial	Vegetables
Animals: hematoxylin	Synthetics: obtained by fractional distillation of the footprint: Gentian violet	Tornasol, saffron.
By its constitution or dye affinity		
Direct or substantive: methylene blue and hematoxylin.	Indirect: ferric hematoxylin.	Indirect reversible: indirect hematoxylin.
Dyes that require a chemical reaction or development: periodic Schiff's acid.	Dispersed: sudans	Metachromatics: toluidine blue.
Reagents: allow superior durability and homogeneity.	Hybrids: higher resistance to degradation by radiation at temperature.	By chemical affinity: blue generated by epifluorescence.
By degree of acidity		
Acids: sulfonium and carboxyl groups	Basic: contain amino groups with organic groups to form a salt.	

Table 1. Dye classes Source: (Garrido, 2021).

Thus, "There is little knowledge of the properties of natural colorants" (Ulloa, 2017, p. 2). According to Galarza (2013)

> the production of synthetic pigments is no longer as convenient for producers and buyers, as costs are high, and they are perceived by the public as hazardous to health and the environment, and products containing them are consumed in increasingly smaller quantities (p. 7).

In the words of Jácome et al. (2023) currently, there is "a great interest in natural additives, especially colorants, because these natural compounds have no associated side effects and most of them are functional ingredients, acting as health promoters" (pp.1477-1478). Due to research that has been advanced in reference to the toxicity of synthetic pigments "the interest in natural colorants is growing daily as a result of the continuous eliminations of artificial colorants" (Marcano, 2018, p. 8). Nowadays, people pay more attention to the ingredients in their food and the resources they use on a daily basis.

Hibiscus flowers also called Guinea sorrel, Obelisk, Rosamorada or Karkadé belongs to the Malvaceae family and its scientific name is Hibiscus sabdariffa (Table 2), it is native to Africa where it is considered a very important plant both in its medicinal and nutritional properties, it can reach up to 3 meters in height and its reproduction is carried out by self-

fertilization. The hibiscus "is a source of bioactive compounds such as polyphenols, flavonoids, ascorbic acid, among others; this composition gives it antioxidant activity" (Sumaya et al., 2014, p. 2).

Realm	**Plantae**
Sub-realm	Tracheobionta
Division	Magnoliophyta
Type	Magnoliopsida
Sub-type	Dieeniidae
Hierarchy	Malvales
Family	Malvaceae
Subfamily	Malvoideae
Genre	Hibiscus
Species	*Hibiscus sabdariffa L.*
Common name	Jamaica

Table 2. Taxonomic characterization of hibiscus Source: (Moposa, 2019).
)

According to Sumaya (2014) "the composition of hibiscus exerts pharmacological effects that produce therapeutic functions in the body that are beneficial to health" (p. 3). According to Pantoja (2022) "hibiscus has different uses, as a medicinal plant to lower cholesterol, triglycerides, decreases body weight, stimulates the functioning of the liver and kidneys and contributes in the absorption of certain minerals." (p. 27). Sumaya (2014) states that

> the cultivation of hibiscus is widespread in Mexico, Central and South America and Southeast Asia, its cultivation and production is expensive because it is often damaged by excessive rainfall, drought or pests, and its harvest requires a high amount of labor to avoid contamination and loss of safety (p. 2).).

It is also known to possess phytochemical compounds such as flavonoids, phenolics, b-carotene, polysaccharides and ascorbic acid. Cruz-Moreno et al. point out that the persistent red color in its calyxes is what gives flavor and color to infusions and prepared beverages, this is due to the content of anthocyanins and the acid flavor to the content of organic acids such as malic, citric, hibiscus and tartaric acid (Cruz-Moreno et al., 2020). On the other hand, flowers contain several natural antioxidant compounds that also act against various viruses and bacteria. One of them "is hisbiscus acid and its derivatives, chemical compounds with antimicrobial properties were identified in them" (Portillo-Torres et al., 2019, p. 2). In the calyxes are found: anthocyanins 1.5 percent, organic acids 15-30 percent, mucilaginous polysaccharides 50 percent, flavonoids, saponins, phytosterols, pectin and fiber. The organic acids and anthocyanins have been shown to have antimicrobial and antioxidant activity. All these components have good bioavailability and have shown therapeutic potential. Other phytochemical components that calyxes possess "are composed of elements rich in anthocyanins, phenolic acids, flavonoids and organic acids." (Izquierdo-Vega, et al., 2020, p. 3).

Jamaica, according to Urbina is an annual herbaceous plant, Malvaceae family that often reaches 1 to 2 meters in height, the stem, leaf petiole and calyxes have a dark or light red color with a tendency to purple or lilac; the flowers are usually born solitary in the axils of the leaves with yellowish petals, and red calyx that usually take one to two days to fall then appear the apices and the fruit or capsule of 5 compartments. The mature plant enveloped by the fleshy calyx is ovoid in shape and contains numerous reniform seeds, pubescent with reddish thread, which take 3 to 4 weeks to develop (Urbina, 2009). Figure 1 summarizes the process of the Jamaican flower.

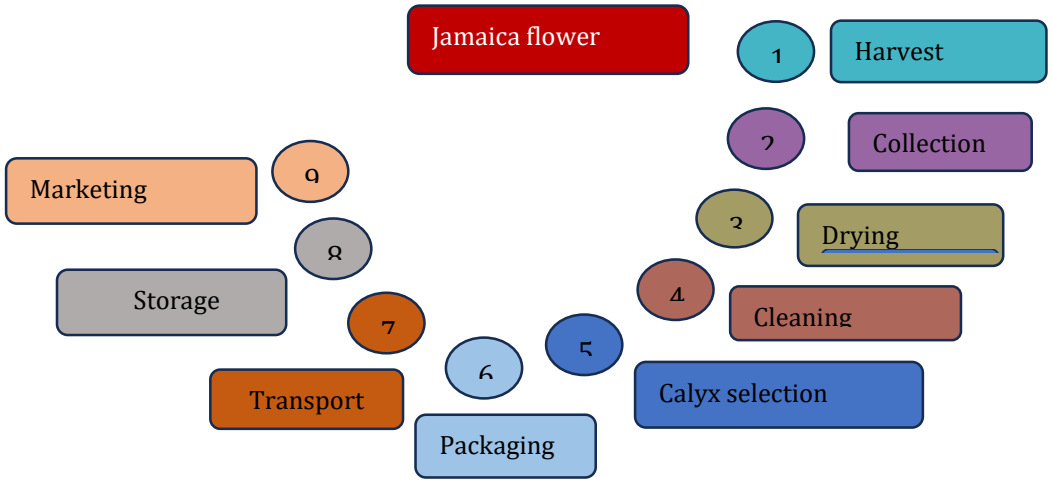

Figure 1. Processing of Jamaica

The process for the commercialization of the hibiscus flower has nine stages (Figure 1). "At the time of ripening of the first calyxes and capsules, the plant is cut from the root, then the calyxes are separated and promptly taken to dehydration" (Rosado, 2020, p. 40). According to Galarza, there are several techniques for the separation of substances such as extraction that allows the organic product to be separated from a reaction mixture or to be isolated from its natural sources, observing the formation of two phases so that the process can be carried out: in the first case a solid and a liquid phase, while in the second case there are two immiscible liquid phases (Galarza, 2013).

There is a diversity of plants that "present special characteristics in their structure that generate pigments such as the red Geranium (Pelargonium hortorum) that has a pale green center contrasting with the margin and flowers arranged in umbels of red, violet pink or white colors" (Estrada, 2021, p. 6). "As for the Red Dahlia (Dahlia pinnata), the expansion of a number of types, colors and sizes offers a solid possibility to the increase of its production" (Jimenez, 2015, p.). "Beetroot (beta vulgaris) is grown mainly for its juice and nutritional value and its roots are blood red with thin skin" (Lopez et al., 2019, p. 368). "Red bell pepper (Capsicum annuum) its odor and color make it attractive for consumption, come from its biochemical components: flavonoids, phenols, epicatechin, rutin, β-carotene, capsanthin, lutein, resveratrol and acids: gallic, chlorogenic and ascorbic" (Martinez et al., 2016, p. 38). Knowing the properties of plants helps the development of experimental practices. Hence,

according to López and Tamayo, they are fundamental in the teaching and learning process of science, since, by relating theory with practice, the development of skills and abilities is promoted, the promotion of reasoning abilities, critical and creative thinking providing the student with the construction of knowledge and the strengthening of science with society and culture (López and Tamayo, 2012). Directing the educational process of Natural Sciences in function of satisfying the expressed demands "involves thinking and reasoning, as he observes and experiences the different situations, which allow him to act and establish his own theoretical understanding of the surrounding reality and everything related to it" (Paladines-Condoy et al., 2018, p. 59).

Knowledge management is increasing so it is important to address issues related to innovation and updating of the educational system. Precisely, education must "establish methodological strategies for the development of the class, with the enormous purpose of obtaining positive results for the improvement of teaching in its scientific development" (Calero, 2019, p. 10). Biology laboratory practices should be "encouraged in students by applying simple steps and feasible and easily available domestic resources to strengthen creativity" (Susantini et al., 2017, p. 216). In the Natural Sciences teacher should "prevail the need to be trained to be the student's guide to be a more independent being in the search and assimilation of scientific knowledge through experimentation" (Ramirez, 2023, p. 6).

According to Castellanos (2017) "teachers seek different skills oriented to teaching not only theory, but also towards the convergence of theory and practice, so that there is true meaningful learning" (p. 235). In the same sense, Gil-Álvarez et al. (2017) point out that "the critical-social paradigm, considers the dialectical unity of the theoretical and the practical, as an inseparable whole" (p. 74). It has become visible that stimulation and imagination play an important role in learning and understanding science (Gómez, Ortega, & Lafaid, 2017; González & Palomeque, 2017).

For Reyes (2020) the laboratory is "a great opportunity where the student verifies theoretical concepts that constitute the first contact with the reality that the future professional will face" (p. 63). The use of experimental practices from the constructivist framework "strengthens knowledge and achieves the development of scientific competencies by promoting student participation, so that they are the ones who propose and execute practices that address conceptual, procedural and attitudinal dimensions" (Espinoza-Ríos et al., 2015).

For this reason, it is necessary to stimulate the biological conditions that allow human beings to construct knowledge. Science teaching is carried out based on pedagogical practices in an interaction that focuses on the teaching and learning of contents specific to the scientific discipline. This requires a constructivist and contextualized educational practice. The knowledge based on the production of vegetable dyes constitutes constructs in the Biological Sciences; the teacher must deepen in the inquiry, which will allow the student to reflect and conceptualize using knowledge and knowledge derived from nature. Coronado and Arteta indicate that students are expected to strengthen some skills, for example, seek or formulate reasons to phenomena or problems, create logical and propositional arguments of what is perceived, explain equal phenomena using conceptual characters appropriate to different degrees of complexity, establish cause-effect relationships, combine ideas in the construction of texts, employ mathematical ideas and techniques (Coronado and Arteta, 2015, p. 9). For this, didactic resources that are fundamental in the development of laboratory practices in Biological Sciences are required,

such as dyes, since they have been able to make organic matter visible and to identify the cellular structure that allows life to exist.

3. Methods and instruments

En la investigación se aplicó el método descriptivo y de observación, ya que se realizaron prácticas experimentales, aplicando el reactivo y colorante obtenidos, mismos que permitieron la visualización de las diferentes fases que conforman la meiosis y mitosis. Dichas prácticas fueron realizadas adaptando los protocolos de Andrade et al. 2005 en los que se observa células sexuales y somáticas vegetales.

3.1 Material and Methodology

The material selected to replace acetic orcein which in the market reaches a price of $31.3 per 60 ml, was hibiscus flower which produces a very strong dye used in the manufacture of textiles (Arrascue, 2018), and its cost is $0.84 per 30g and vinegar was used as solvent which has a cost of $0.86 per 500 ml. Therefore, the total cost of dye obtained in the research (acetic soda[1]) is $0.76 per 60 ml. On the other hand, the reagent (hydrochloric acid) with which the softening of the vegetable tissues is carried out has a cost in the chemical industry of $6 for 500 ml, being replaced by lemon juice which has a value of $2.75 for 700 g and vinegar at 5%, thus the definitive value of the reagent that replaced the hydrochloric acid (Auran acetic acid[2]) is $2.36 for 500 ml.

3.2 Obtaining the dye

3.2.1 Phase 1 test:

As shown in Table 3, prior to the final standardization of the dye, different plant tissues possessing a red color were tested, thus 20 ml of 5% vinegar was diluted with 6 g of red geranium Elargonium hortorum, 20 ml of 5% vinegar with 2. 3 g of red dahlia Dahlia pinnata, 50 ml of 5% vinegar with 40 g of beet Beta vulgaris and 20 g of red bell pepper Capsicum annuum with 20 ml of 5% vinegar and did not obtain a pigment that allows to clearly color the chromosomes in the nucleus.

3.2.2 Phase 2 preparation of plant extract

The calyxes of hibiscus flowers available in the city's markets were acquired and those in good condition were selected. Then, to extract the dye, 6 g of calyxes were subjected to two tests, one with 70% alcohol and the other with 5% vinegar, which were used as solvents, leaving them to stand at room temperature for 48 hours in an amber-colored flask. Then, the dye was filtered and it was observed that the vinegar extracted the pigment from the calyxes with a higher concentration.

3.2.3 Sample Standardization Phase 3

Different amounts of 5% vinegar were tested with different grams of Jamaican flower calyxes (Table 4), showing that 6 g of calyxes and 20 ml of 5% vinegar resulted in an optimum violet color for coloring the chromosomes in mitosis and meiosis. This substance

[1] Sabda acetic acid is the name given to the dye obtained as a result of this project that replaces acetic orcein in chromatin observation.

[2] Auran acetic is the name given to the reagent obtained as a result of this research that replaces hydrochloric acid in the softening of plant tissues.

was left to stand at room temperature for 48 hours in an amber-colored flask, after which the dye was filtered to remove organic residues.

3.3 Obtaining the reagent

3.3.1 Quantity and time modification Phase 1

1 ml of lemon juice was extracted and mixed with 1.5 ml of 5% vinegar, this reagent was added to the root apices of Allium cepa and the anthers of Lilium candidum, placing these elements on different watch glasses for 10 minutes, no flaming was used in this phase and there was no softening of plant tissue (see Table 5).

3.3.2 Phase 2 quantity and time modification 2

1.5 ml of lemon juice was extracted and mixed with 1.5 ml of 5% vinegar, this reagent was placed on the root apices of Allium cepa placed on a watch glass for 18 minutes. The same process was carried out with the anthers of Lilium candidum. No flaming was used and there was no softening of plant tissues (see Table 5).

3.3.3 Pre-standardization Phase 3

1.5 ml of lemon juice was extracted and mixed with 1 ml of 5% vinegar, this mixture was placed on the root apices of Allium cepa placed on a watch glass, 2 intervals of flaming for 1 minute and 2 intervals of rest of 1 minute were performed, similar process was performed with the anthers of Lilium candidum, only the external tissue was softened (see table 5).

3.3.4 Phase 4 reagent standardization

In 1 ml of lemon juice and 1 ml of 5% vinegar, this reagent was placed on the root apices of Allium cepa located on a watch glass where 4 intervals of flaming for 1 minute and 4 intervals of rest of 1 minute were carried out, with the anthers of Lilium candidum the same steps were followed. There was total softening of the root tissue and anthers (see Table 5).

4. Results

In graphs 2, 3, 4 and 5 it is appreciated that the obtained colorant (Sabda acetica) colors in a similar way to acetic orcein, the obtaining of this pigment was made through the dissolution of 6 g of calyxes of the hibiscus flower in 20 ml of vinegar at 5% (see table 4) and to replace the hydrochloric acid that allows the softening of the vegetable tissues 1 ml of lemon juice was used with 1 ml of vinegar at 5% (Auran acetica) for a total of 8 minutes. By combining the flaming (4 intervals of 1 minute) with the resting time (4 intervals of 1 minute), which should be interspersed with 1 minute of flaming and 1 minute of resting to complete the 8 minutes established for softening (see Table 5). This process allowed coloring and softening the plant tissues in a similar way to the procedure developed with acetic orcein and hydrochloric acid in the observation of the phases of mitosis and meiosis (graphs 2, 3, 4 and 5).

Species	**Grams of the species**	**5% vinegar**
Red geranium *Elargonium hortorum*	6 grams	20 ml
Red Dahlia *Dahlia pinnata*	2.5 grams	20 ml
Beets *Beta vulgaris*	40 grams	50 ml

Red bell pepper *Capsicum annuum*	20 grams	20 ml

Table 3. Obtaining the material

Table 3 shows the experimental procedure describing how the optimum biological material was chosen for the elaboration of the dye, which was obtained by relating the weight of the different flowers of the various species with different ml of 5% vinegar.

Jamaica	**5% Vinager**	**Color**
3 grams	35 ml	Pigmented red
4 grams	35 ml	Munsell Red
4 grams	30 ml	Pantone Red
5 grams	25 ml	Crimson Red
6 grams	20 ml	Violet red

Table 4. Dye concentration standardization process.

Table 4 shows the experimental procedure describing the standardization of the colorant, which was obtained by relating the weight of hibiscus to the ml of 5% vinegar.

Test of experimentation	**Lemon**	**5% vinegar**	**Flamed**	**Resting time**	**Result**
1	1 ml	1.5 ml	0 minutes	10 minutes	No flaming was used. No tissue softening.
2	1.5ml	1.5 ml	0 minutes	18 minutes	No flaming was used. No softening of the fabric.
3	1.5 ml	1ml	2 intervals of 1 minute	2 intervals of 1 minute	Joined flaming intervals with rest intervals. Softening of external tissue only.
4	1 ml	1ml	4 intervals of 1 minute	4 intervals of 1 minute	Joined flaming intervals with rest intervals. Total softening of plant tissue.

Table 5. Softening process of plant tissue for the observation of meiosis and mitosis.

En el cuadro 5 se aprecia el procedimiento experimental. Allí se describe la estandarización de la substancia que permitió el ablandamiento de las raíces de cebolla *Allium cepa* y anteras de lirio *Lilium candidum* para observar las fases mitosis y meiosis respectivamente.

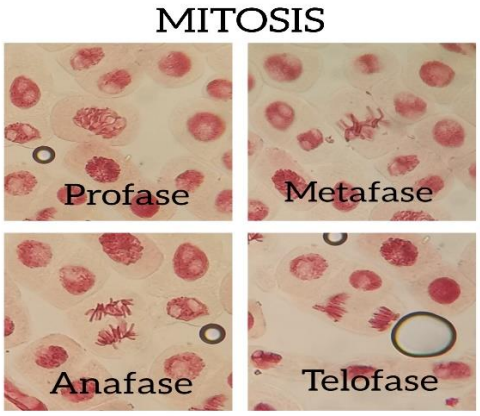

Figure 2. Application of the dye Sabda acetica for the observation of the phases of mitosis in root tissue of Allium cepa.

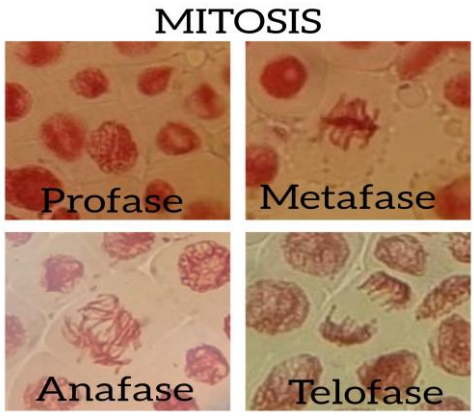

Figure 3. Application of acetic orcein dye for the observation of mitosis phases in root tissue of Allium cepa.

Graph 2 clearly shows the mitosis carried out with onion roots (Allium cepa) using the organic dye hibiscus (Sabda acetica) and the softening of the plant tissue with the mixture of lemon juice and vinegar at 5% (Auran acetica), which allowed the visualization of the phases. Figure 3 shows the mitosis using the dye acetic orcein and hydrochloric acid to soften the plant tissue, showing that the dye produced with calyxes of hibiscus flowers pigments in the same way as with acetic orcein and the mixture of lemon juice with vinegar softens the plant tissues as well as hydrochloric acid.

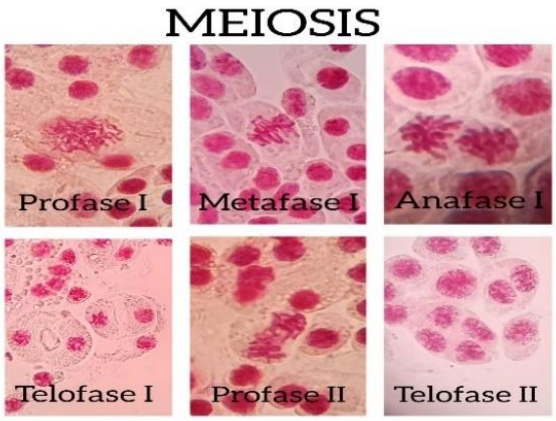

Figure 4. Application of Sabda acetic dye for the observation of meiosis phases in anthers of Lilium candidum.

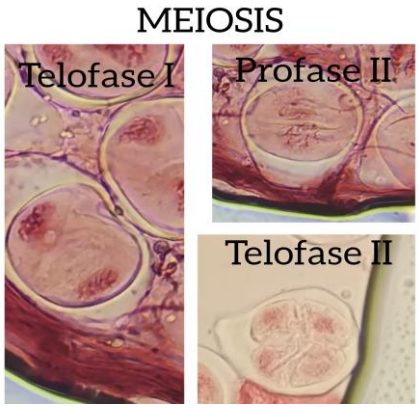

Figure 5. Application of Sabda acetic dye for the observation of meiosis phases in anthers of Lilium candidum.

Figure 4 clearly shows the meiosis carried out with onion lily (Lilium candidum) anthers using the organic dye of hibiscus (Sabda acetica) and the softening of the plant tissue with the mixture of lemon juice and vinegar at 5% (Auran acetica), which allowed the

visualization of the phases. Figure 5 shows the meiosis using the dye acetic orcein and hydrochloric acid to soften the plant tissue, demonstrating that the dye produced with calyxes of hibiscus flowers pigments in the same way as with acetic orcein and the mixture of lemon juice with vinegar softens the plant tissues as well as hydrochloric acid.

5. Discussion

The dyes found in the chemical industry used for laboratory practices are of high cost, which prevents the execution of experimental practices in educational institutions both at middle and higher levels. Therefore, it is necessary to look for new alternatives for the elaboration of low-cost dyes that are affordable, such as the one developed in this research (Sabda acetica), so that the practical component can be carried out in subjects such as Biology in educational institutions that do not have the necessary economic resources.

Similarly, for the procedure of softening plant tissues, hydrochloric acid is commonly used for experimental practices; however, it was proposed to obtain a substitute that fulfills the same function of this reagent from the mixture of lemon with vinegar (Auran acetic acid), demonstrating that its application has the same function as hydrochloric acid. It should be emphasized that the methods used in the experimental part established the basis for the collection of data and later analysis of the information obtained. At the time of the experimentation, several tests were carried out until reaching an effective standardization, once the softening and staining process was established, it was possible to observe the division of plant cells.

6. Conclusions

Plant dyes are indispensable resources that have diverse applications in the industry and as didactic resources in experimental practices in the teaching-learning process of biology; therefore, it is important to strengthen research on obtaining this type of dyes. The study employed a technique that significantly reduces the economic resources that are invested to obtain the inputs that are used to carry out the laboratory practices in plant and animal tissues in which chromatin (chromosomes in mitosis, meiosis, polytene chromosomes and Barr bodies) can be clearly observed.

Generally, for the softening process of plant tissues, reactive hydrochloric acid is required, which is expensive and presents a risk in its handling during experimentation. However, mixing 1 ml of lemon juice plus 1 ml of 5% vinegar for 8 minutes and flaming this compound for 4 minutes minimizes the danger and cost of its use. Acetic orcein is a high-cost dye used in experimental practices to stain chromatin, which makes it necessary to look for alternatives to obtain dyes that fit the budget of educational institutions. In the research carried out after developing several tests, the dye was standardized by diluting 6 g of calyxes of hibiscus flowers with 5% vinegar, which allowed a similar or better visualization of chromatin in plant tissues in comparison with acetic orcein.

The resources used to replace acetic orcein, which in the market reaches a price of $31.3 per 60 ml, were the calyxes of the hibiscus flower that produce a very strong dye and its cost is $0.84 per 30g and vinegar was used as solvent, which has a cost of $0.86 per 500 ml, the total cost of the dye obtained in the research (acetic soda) is $0.76 per 60 ml. On the other hand, the reagent (hydrochloric acid) used to soften the vegetable tissues has a reference value in the chemical industry of $6 per 500 ml, being substituted by lemon juice which has

a value of $2.75 per 700 g and vinegar at 5%. The definitive value of the reagent that replaced hydrochloric acid (Auran acetic acid) is $2.36 per 500 ml.

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REVISTA CÁTEDRA

In bioethical criteria in demonstrative and experimental practices with animals in the Career of Pedagogy in Chemistry and Biology

Criterios bioéticos en prácticas demostrativas y experimentales con animales en la Carrera de Pedagogía en Química y Biología

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Abstract

Demonstrative and experimental studies with animals over time have been part of the practical teaching of different contents that have contributed to the biological, medical and pharmacological sciences. However, progress in scientific and educational activity has brought with it bioethical difficulties from the academic perspective in the importance of using animals to consolidate theoretical knowledge and from the bioethical-legal perspective in the requirement of good animal management. The objective of the research was to analyze the application of bioethical criteria in demonstrative and experimental practices that use animals in the Pedagogy of Experimental Sciences in Chemistry and Biology. The study had a qualitative-descriptive approach. The interview technique was applied to three laboratory professionals and to an external teacher expert in animal practices. In addition, laboratory observation was carried out using an observation card with nine indicators and four dimensions in 32 practices with animals. A structured survey of 11 questions was also applied. These instruments were applied to a population of 155 students in their third, fourth and eighth semesters. The survey, interview and observation form were validated by three expert teachers. The results indicated that 68.75% of the practices work with dead individuals, 21.87% with insect vivisection and 9.38% with preserved exotic animals. In conclusion, most of the practices (78.13%) are in accordance with the framework of the Bioethical Regulations set forth at national and international level and have taken care of animal welfare, avoiding unnecessary sacrifice of animals.

Keywords

animals, bioethics, bioethical principles, didactic material, demonstrative practices.

Resumen

Los estudios demostrativos y experimentales con animales a lo largo del tiempo han formado parte de la enseñanza práctica en diferentes contenidos que han aportado a las ciencias biológicas, médicas y farmacológicas. Sin embargo, el avance en la actividad científica y educativa ha traído consigo dificultades bioéticas desde la perspectiva académica en la importancia de utilizar animales para consolidar conocimientos teóricos y desde la perspectiva bioética-legal en la exigencia del buen manejo animal. El objetivo de la investigación fue analizar la aplicación de criterios bioéticos en prácticas demostrativas y experimentales que emplean animales en la Carrera de Pedagogía de las Ciencias Experimentales Química y Biología. El estudio tuvo un enfoque cualitativo-descriptivo. Se aplicó la técnica de la entrevista a tres profesionales de laboratorio, y a un docente externo experto en prácticas con animales. Además, se realizó observación en laboratorio empleando una ficha de observación de nueve indicadores y cuatro dimensiones en 32 prácticas con animales. Así también se aplicó una encuesta estructurada de 11 preguntas. Instrumentos que se ejecutaron en una población de 155 estudiantes de tercero, cuarto y octavo semestres. Encuesta, entrevista y ficha de observación, fueron validados por tres docentes expertos. Los resultados indicaron que en 68.75% de las prácticas se trabaja con individuos muertos, 21.87% con vivisección en insectos y 9.38% con animales exóticos preservados. En conclusión, la mayoría de prácticas (78.13%) se ajustan al marco de las Normativas Bioéticas expuestas a nivel nacional e internacional y han cuidado el bienestar animal, evitando sacrificio innecesario de los mismos

Palabras clave
Animales, Bioética, material didáctico, prácticas demostrativas, principios bioéticos.

1. Introduction
Throughout time, demonstrative and experimental studies have been carried out using animals for the development of the teaching-learning process. In this sense, animals have become an ideal resource for the advancement of several areas of knowledge related to the study of life and its processes; biological sciences, medical sciences and pharmacological sciences are an example of this.

Despite the benefits offered by these studies for the good of humanity, progress in scientific and educational activity has brought implicit bioethical difficulties. Complications from the point of view of respect for life that are framed in the bioethical-legal perspective and the demands of good animal management. The present research and the reality of the Universidad Central del Ecuador (UCE) in relation to laboratory practices are taken as a background. According to Altamirano, within the execution of demonstrative and experimental practices with the use of animals, the (UCE) through its Animal Research Studies Committee (CEIA) is organizing the regulatory support for the management of animal species (Altamirano, 2021).

In the I Course on Research and Bioethics in Animal Experimentation developed at the UCE, Gavilánez pointed out that the Higher Education Institution is developing a set of instructions for demonstrative practices in the classroom as part of the commitment to respect animal life (Gavilánez, 2023). In this regard, the present research constitutes a precedent of respect for the work with animals that is being carried out in the Faculty of Philosophy, Letters and Educational Sciences.

Bioethical criteria for experimental and demonstrative studies are one of the main topics of discussion in careers that are part of the area of Zoology, General Biology, Molecular Biology, Zootechnics, among others. Because at a practical level, animals or specimens are used pedagogically for anatomical and physiological explanations. In addition, the practices carried out may or may not include bioethical criteria in the sacrifice and waste management prior to the demonstrative or experimental practice. The objective of the research was to analyze the application of bioethical criteria in demonstrative and experimental practices that use animals in the Pedagogy of Experimental Sciences, Chemistry and Biology. It was a feasible study, since we had the time, financial, human and material resources. In addition, because it can help to solve a specific problem that is linked to the application of bioethics in the career.

The study consists of the following parts: introduction, where a brief vision of the investigated problem is simplified, theoretical framework that supports the research, description of the methods and materials, which indicate the type of research methodology. The results and discussion are also found, presented in relevant qualitative-quantitative data of the study. Finally, the conclusions are presented as a synthesis with the most significant findings regarding the objective of the research on bioethics applied in demonstrative practices with animals of the Pedagogy of Experimental Sciences, Chemistry and Biology career.

2. Literature review

The use of animals in educational and experimental practices has allowed great advances in biological, medical, pharmaceutical and scientific knowledge. However, their use involves responsibility in welfare from the bioethical point of view, in good practices and animal management. In this regard, Rojas (2021) states:

> teachers must be aware that working with students based on scientific and bioethical principles will contribute to the formation of responsible and critical citizens and thus to the construction of a more humane and just society. In this sense, it is recognized that education is a strategic way for students to assume a commitment to their environment, respect for all forms of life and the promotion of animal health and welfare (p.18).

The development of demonstrative and experimental practices with animals should offer the opportunity to work on improving learning, as well as the formation of students with scientific and bioethical principles. In this way, we seek not only to form critical students, but also good human beings who respect all forms of life and care for animal welfare. From the bioethical point of view, in laboratory practices with animals, good animal management should be taken into account through good animal husbandry practices:

- **Restraint. W**hen maneuvers or methods are applied to immobilize an animal they can be simple such as normal restraint of the animal using the hands; physical, when we use accessories or special surgical instruments; and chemical when we use tranquilizing drugs or anesthetics (Institutional Animal Care and Use Committee, 2021, p. 2).
- **Injection.** According to Varcellini and Principi, this technique uses agents or concentrated administration to cause depression of the nervous system and death (p. 247). According to the aforementioned authors, to avoid previous animal suffering, anesthetics should be used to inhibit pain in the animal. Needle insertion is an injection method that can be used for birds, fish, amphibians and reptiles by introducing a needle through the foramen magnum to the base of the brain. It is necessary to anesthetize the animal first to decrease pain (Varcellini and Principi, 2021, p. 250).
- **Analgesia**. "It is the absence or use of procedures that suppress pain in the animal" (Varcellini and Principi, 2021, p. 245).
- **Anesthesia.** "It is the temporary absence of sensation or pain of some part of the body or of an organ" (Varcellini and Principi, 2021, p. 239).
- **Euthanasia.** According to Varcellini and Principi it is the act of animal sacrifice with minimum pain, fear, anguish or stress. The technique should be painless and practiced by experts who have knowledge of the biology, physiology, handling and restraint of the species with which they are working. The choice of a method of euthanasia must be governed by current regulations and must be evaluated by a bioethics committee to endorse the experimental results (Varcellini and Principi, 2021, p. 243).

The academic knowledge for the good handling of animals in demonstrative and experimental practices in both teachers and students is important, since bioethical education will imply the critical development in the cognitive, affective, emotional and valorative, for this it is necessary to consider activities that forge the development and bioethical knowledge such as bioethical workshops; to expose fundamental elements of a bioethical topic on which teachers and students debate, reflect, and take perspective, in

these they can share their personal experiences. In educational institutions it is necessary to organize seminars or conferences, since their attendance and participation will be important to be informed about bioethical dilemmas, which can be bibliographical or developed through different sources, and the critical level of the positions should always be present. In addition, formal courses encourage analysis and universal approaches to bioethics through sessions of diverse ideologies as foundations for studying bioethics. Creating research units is also beneficial because through the experience of the teacher or students will help to experience and feel the needs of this subject of study.

2.1 Bioethical Principles

They are important for the good training of professionals in a society where scientific progress prevails. According to the Bioethics Advisory Committee (2009) they mention that "the ethical endorsement is essential for the supervision of a research project for the welfare of living beings and compliance with bioethical protocols" (p. 23), which is considered that institutions using animals should rely on this document for compliance with bioethical protocols. According to the Bioethics Advisory Committee, environmental legislation allows for regulation through national and international statutes designed to protect the environment and enhance its ethical principles through standards. They are not considered laws, but act within a regulatory framework (Bioethics Advisory Committee, 2009, p. 23). This leads to responsibility, another bioethical principle that implies the proper practice of knowledge in bioethical regulations considered for the proper handling of animals, as it takes as a principle the sustaining of the life of an animal or a person (Bioethics Advisory Committee, 2009, p. 22).

Ethics committees in charge of coordinating and supervising activities and procedures aimed at animal care, as well as related research projects should be governed by institutional authorization according to their protocols (Institutional Animal Care and Use Committee, 2021, p. 13). With this, the principle of non-maleficence should be considered prior to the use of animals, i.e., harm-benefit balance. The use of animals is acceptable when their study is of significant importance (La Rosa, 2012, p. 253). Vilches and Zurita (2014) establish the principles of ethics and teaching with animal models, as follows:

> The use of animals should be avoided when there is an alternative method that provides satisfactory results. The final benefit of the use of experimental animals should be clearly defined in each protocol. Tests that include animals as experimental models should be performed in registered user establishments. The minimum number of animals possible should be used in each trial to ensure statistically reliable results (p. 16).

The following principles of ethics and teaching are based on animal welfare. Hence, there must be a correct development of natural animal behavior, avoid using a maximum of animals for experimentation, let those involved lead a dignified life, and let them always comply with codes and principles for their mental, physical and emotional health. Furthermore, in order to avoid any kind of suffering, it is necessary to look for different but satisfactory alternatives.

2.2 Bioethical Principle of the Three Rs

Under the vision of sustainability and care in ethics, a set of strategies are presented on which international law is based when using animals in demonstrative and experimental practices. The principle of the three Rs (reduce, replace, refine) was established by Russell

and Burch (Cardozo and Mrad, 2008, p. 46). The purpose of these three principles is to ensure that animals used for experimentation or demonstrative practices feel the least possible suffering or harm in the pharmacological or dissection processes. Cardozo and Mrad point out that the application of the three Rs implies an expression of values, quality and validity at the level of research because it promotes an awareness of respect on the part of researchers in the case of clinical experimentation or in students during the execution of demonstrative practices (Cardozo and Mrad, 2008, pp. 46-71).

Principle	Definition	Strategies or alternatives
Replace	Group those methods that allow experiments to be performed without the use of animals.	In vitro systems, audio-visual aids, dead animals, slaughterhouse equipment, models, software.
Reduce	Describe methods for obtaining comparable levels of information from the use of few animals in scientific procedures.	Animal model selection; sanitary quality, environmental genetics; cryopreservation, advanced statistical methods, data bank, access to specialized literature.
Refine	Group those methods that alleviate or minimize pain and distress to maintain animal welfare.	Animal care and welfare, personnel skills and training, improvement of pain detection methods, use of anesthetics, analgesics and tranquilizers or use of non-massive techniques, early euthanasia, etc.

Table 1. Bioethical principles of the three Rs. Garcés and Giraldo (2012, p.162)

As shown in Table 1, each of the bioethical principles has a simple and understandable definition for all audiences. It is also easy to understand that for each principle there is a specific alternative to avoid, reduce or minimize pain and thus offer welfare guarantees to the animal under study.

2.3 National and International Regulations

2.3.1 Animal Research Ethics Committee (CEIA) Universidad Central del Ecuador. Functions of the CEIA-UCE

In the I Course on Research and Bioethics in Animal Experimentation Vargas mentions that the functions established in the Committee are those that are directly related to the present research work. B). To evaluate, from the approach of ethics and welfare for the animals involved in the research, the methodological, ethical and legal aspects of the research and degree programs and projects presented. C). To know and issue recommendations to the guidelines for academic, research and social practices that include handling and experimentation with animals. D). To train researchers and teachers in their tasks and responsibilities regarding the ethical aspects of animal handling and experimentation, so that they are incorporated in the micro curricula of the pertinent professorships, which guarantee animal welfare. E). To guarantee that the personnel involved in animal handling procedures have the appropriate training to carry out the tasks entrusted to them and to execute the research protocol as established by the national and international regulations in force. Or suggest professionals with the appropriate training. G). Ensure that the animals subjected to research do not suffer unnecessarily and that they are provided, when

necessary, with analgesics, anesthetics or other methods designed to eliminate pain, suffering or distress as much as possible (Vargas, 2023).

Of the nine functions established in the Committee, research work is related to six, that is, to most of them. It is therefore necessary to work according to the functions established by the CEIA in those mandatory practices that involve the handling of animals within the training process of new professionals. According to the I Course on Research and Bioethics in Animal Experimentation developed at UCE, the projects classified as exempt from review must be reported by COIF to the president of CEIA and will be those that meet the following characteristics:

- Make use of inanimate animal models or simulation software in curricular teaching areas.
- Research projects involving observation of animals or biodiversity with or without photographic or video recording. Studies that involve direct contact or observation of endangered animals, other species in conservation or that inhabit natural and/or protected areas in national or international territory will not be exempt from review.
- Review and use of specimens deposited in museums and biological collections.

2.3.2 Organic Law on Animal Welfare (LOBA)

Today, it is universally accepted that the use of animals in teaching is unavoidable due to learning objectives, which implies that it is necessary to examine the bioethical conditions that make it permissible. Hernandez and Fuentes mention that the five rules that Marshal Hall proposed in 1831 for scientific research were pioneering in establishing the goal of reducing animal suffering in science (Hernandez and Fuentes, 2018, pp. 112-113).

- Experimentation should not be performed if observation can be substituted for it.
- No experiment should be performed without a clear objective.
- Scientists, researchers and teachers should be well informed about the studies of their colleagues, to avoid unnecessary repetition in the use of animals.
- Justified experiments or practices should be carried out with as little pain as possible.
- Each experiment should be conducted under circumstances that give rise to clear results that avoid repetition.

Therefore, the LOBA translates into an international guide of respect for animal life and offers guidelines to teachers who need to carry out practices to ensure that these are optimal and that the maximum possible benefit is obtained from them.

2.3.3 World Organization for Animal Health (OIE)

In the I Course on Research and Bioethics in Animal Experimentation, Vargas mentions that the Terrestrial Animal Health Code established by the World Organization for Animal Health (OMSA) issues guidelines for the use of animals in research and education, and recognizes the essential role and accepts the use of live animals in research and education. The OMSA animal welfare guidelines stipulate that the use of animals offers an important contribution to human and animal welfare, as well as underlines the importance of the 3Rs. This worldwide code accepts the use of animals for educational purposes, however, it does not neglect the bioethical importance and therefore emphasizes the application of the 3Rs in the execution of academic and research practices (Vargas, 2023).

2.4 Demonstrative and experimental studies with animals

In the 20th century, biomedical advances took place, with the appearance of anesthetics, which facilitated the use of live animals in experimentation, reducing their pain. Nowadays, society increasingly tends to demand that the welfare of animals be guaranteed during experimentation and there are ethics committees that determine when a project can be carried out with animals and under specific conditions. So it can be concluded that animal experimentation has always existed, although it is true that it is increasingly practiced with greater consideration for the animal (Vilches and Zurita, 2014, pp.5-9).

According to Vilches and Zurita as the years go by science and teaching about a field change, i.e., nowadays as in ancient times animal experimentation has played a fundamental role in the process of teaching and science. On the other hand, while experimentation has helped to decipher multiple aspects of health and its preventive diseases, it has also left ethical thoughts. That is why it is necessary to experiment based on certain protocols, articles, laws, etc., that guarantee animal welfare. Animal experimentation is defined as the use of an animal for a scientific purpose that may cause pain, suffering, distress, among others. These experiments can even cause births with malformations. An experiment begins when an animal begins to be prepared for its use and ends when no further observations are to be made on said animal, in addition the satisfactory use of analgesics or anesthesia or other methods, will not exclude the animal from being considered within this definition (Vilches and Zurita, 2014, p. 4).

It refers to the process of subjection of an animal for some purpose, scientific or demonstrative, however, the processes of experimentation are painful and traumatic for the animal. It begins with the preparation, observation, stay, among other aspects, and ends when it is no longer necessary to test the animal. It must be emphasized that all the analgesic aspects do not compensate for the pain in experimentation. With respect to demonstrative studies in educational institutions Arias, León and Reyes refer that "the use of animals for teaching is a practice that has been carried out for many centuries and has contributed great advances for the teaching of Anatomy, Physiology, Pharmacology, Zoology and Toxicology." (Arias, Leon, & Reyes, 2015, para. 3). Using an animal in teaching aims to put into practice theoretical concepts that allow the application in a model.

Given that the experimentation or use of animals in demonstrative practices are part of the teaching processes in different subjects in the biological sub-branches to avoid the excessive use of animals or the sacrifice of species that are in danger of extinction. Biotheriums are an alternative because they are spaces with animals used for laboratory purposes "where they are bred, kept and used for research as biological models. In it, species of mammals, birds, reptiles, amphibians and fish are kept in environments that provide them with the requirements and needs to survive and reproduce" (Vargas, Ambriz, Navarro, Trejo, Rodríguez, & González, 2018, p. 9). In addition, this ranch shelters species with excellent genetic and microbial quality previously studied in a laboratory. These animal farms examine that the species used do not present criteria of vulnerability (extinction), are domestic, of human consumption or of easy accessibility that are adjustable to the bioethical criteria exposed in the experimentation or use of demonstrative practices with animals.

2.5 Alternative methods to the use of animals

The end of the 20th century saw an increase in in vitro teaching studies, with alternatives accounting for more than 50%, as opposed to a decrease in the use of animals. This achievement is due to various factors, both ethical, logistical, scientific and economic. Among them are: audiovisual systems, computer simulations, virtual laboratories, virtual

reality systems, in vitro tests, didactic material with preserved animals, where cell cultures or serum are used to observe cellular and molecular reactions or human and veterinary clinical practices, which allow the student to participate in the professional's routine.

However, the procedures are designed by the investigators themselves and are generally not validated, so that the only requirement for approval is acceptance by reviewers at the time of publication or if applying for research grants. However, legal compliance with animal welfare protection and safety regulations is of imperative (Vilches and Zurita, 2014, p. 42). In addition, Ortiz (2016) cited by Dewhurst (2005)):

> He conducted an investigation to compare and evaluate the learning of two groups of upper level students in physiology and pharmacology classes at the University of Sheffield, UK. In one module of the physiology course, on epithelial transport, one group used a computer program simulating laboratory experiments, while the other was taught in the traditional method using rats to learn about isolated sacs and discharges from their small intestines. Apart from that difference, both groups were given conventional lectures and attended seminars. The result of that and several other studies reported by the researchers was that CAL (computer-assisted learning) can be effective in replacing or enhancing traditional laboratory lectures in undergraduate biomedical science courses, and it is clear that replacing a proportion of traditional hands-on lectures with computer simulators would not disadvantage students and could, in fact, enhance their learning (para. 8).

In this paragraph the author analyzed the use of animals in higher education, the research has two aspects, the first is pedagogical, which means that the option of using animals is didactically equal, less or more effective than doing it without them, and the ethical justification, which tries to answer the question of whether it is morally correct to use and/or kill animals for students to learn. In the field of teaching, teaching strategies are constantly changing and technology has become an indispensable tool for transmitting knowledge. The changes have been manifested mainly in biology, anatomy, physiology or related subjects, where the development of mathematical or virtual models that facilitate the integration of information and visuospatial learning of the student is sought. These alternatives favor the acquisition of knowledge without invasive manipulations on animals. In the experimental field of action, the use of animals is replaced by cells and tissues. However, in both fields it is stated that technology, in certain aspects, cannot replace the use of animals. That is why knowledge of the Bioethical Norms is considered as the starting point for the proper handling, manipulation and use of animals in the educational and scientific fields.

2.6 Vivisection and Dissection

According to García, dissection is a technique that consists of separating an organism into parts so that the structure and anatomical relationship with other species can be studied (García, Mejías and Castillo, 1999, para. 4). When talking about education, for Montemayor, dissection used as a way of learning "allows students to approach the object of study, the human body, in a real context, where small anatomical variations, origin and trajectories are highlighted" (Montemayor, 2008, p. 6). Therefore, it can be concluded that this method has a long history and is currently used as a form of teaching in higher education. The term "vivisection" derives from the Latin vivus, alive, cut, and refers then to the performance of cuts or dissections in a living organism, which has been practiced with defenders and

detractors in different periods of history, both in human and non-human animals. In "antiquity vivisections were performed on death row inmates or prisoners; today it is clear that this practice is not ethically acceptable" (Alvarez, 2007, para. 1).

3. Methods and materials

The study has a qualitative approach. It aims at the global analysis of the application of bioethical criteria in demonstrative and experimental practices with animals. It is descriptive because it characterizes a phenomenon that is the application of bioethical criteria. It is a longitudinal study because it is carried out in the practices that are executed during the course of the semester with the same students and teachers. It refers to a laboratory study because it was carried out in a space of the Career destined to the manipulation of biological samples, and which has the adequate infrastructure for it. It is a feasible type of research, since it had the time, financial, human and material resources and because it tends to provide a solution to a specific problem that is linked to the application of bioethics in the career.

The interview technique was applied based on a questionnaire of six questions. These were focused on: 1. Conditions of maintenance, 2. Position of the researcher regarding animal sacrifice methods, 3. Bioethical training of the laboratory instructor, 4. Application of bioethical criteria, 5. This research instrument was directed to 3 laboratory professionals of the Pedagogy Career of Experimental Sciences, Chemistry and Biology. The questionnaire was also applied to 1 external teacher expert in animal practices who has experience in demonstrative and experimental practices, and is the Coordinator of the Ethics Research Commission of the UCE.

An observation sheet with six dimensions and nine indicators was applied in the laboratory in 32 practices with animals. The dimensions were: 1. Use of space for care, 2. Type of animals used in the practices, 3. Organization of groups of students as a mechanism for optimizing the number of animals sacrificed, 4. The nine indicators were: 1. domestication status, 2. conservation status, 3. vulnerability status, 4. extent of distribution, 5. use of virtual tools, 6. replacement of specimens, 7. reduction of specimens, 8. refinement of specimens and 9. Actors in the teaching-learning process.

Finally, a survey was applied whose questionnaire was structured by 11 questions, related to the six dimensions and 9 indicators mentioned above. This research instrument was applied to a population of 155 students in their third, fourth and eighth semesters. The three research instruments, survey, interview and observation form, were validated by three expert professors, including the Biology Area Coordinator. The data were processed using Atlas ti (interviews), Microsoft Excel (observation sheets) and Google Forms (surveys). The analysis of the information was carried out through triangulation of the results between the survey, interview and observation sheet.

4. Results

DIMENSION	CODES	RELEVANT DATES
Conceptual standards and scope of action	Animal housing conditions: nutrition, sanitary and spatial (T, D)	"Provide the animal with water and food to carry out educational practices" (D).

	Academic training (T, D) Good practices (T, D, E)	"Basic sanitary measures such as apron, gloves, dissection kit are complied with" (T, D). "There is no suitable space for animal care" (T). "Live species are not handled in the laboratory because it does not have the space or resources" (T). "Our teaching and research orientation has to focus on bioethics" (D). "In the faculty of veterinary medicine, virtual atlases are used and plastinated organs can be requested" (D). "We are in the obligation to train ourselves to employ new methods or protocols of bioethics and teach students" (D, T). "Hand manipulation to observe limbs and external structures" (T, E). "Euthanasia was never applied in the course" (T).
Legal basis and bioethical principles	Reduction (D, T, E) Replacement (D, T, E) Refinement (D, T, E) Legal basis (D, T) University Code of Ethics (D, T)	"We work with collections or preserved specimens from the laboratory" (T, E). "There is less use of animals in demonstrative practices" (T, E). "Animals are replaced by computer models" (E). "In the Organic Law of Animal Welfare, the codes of ethics for handling species are complied with" (D). "Animals for human consumption that do not merit slaughter are used" (T, E). "It would be important to outline animal bioethics in the code of ethics" (T). "The University has certain regulations for animal handling; however, bioethics is not implemented due to lack of information" (D).
Didactic material	Audiovisual tools (D, T, E)	"Most of the laboratory practices use animal biological material" (T, E).

	Laboratory practices with biological material (T, E) Laboratory practices without biological material (T, E)	"Alternative methods to the use of animals are employed: 3D videos, simulators, mock-ups, virtual reality, preserved specimens, taxidermic boxes" (T, E). "The best teaching is complemented with the experimental part by applying the principles of bioethics" (D, T)
Animal experimentation	Animal utilization (T, D, E) Dissection (T, D, E) Vivisection (T, D, E)	"Working with specimens is required because they contribute significantly to student learning" (D, T). "Dissection techniques are applied to dead specimens and vivisection of insects" (T, E). "It is possible to work with collections or preserved specimens available in the laboratory" (T). "It is necessary to have a balance of when it is necessary to use a live animal to sacrifice it in the laboratory" (D, T).

Table 2. Dimensions and codes with relevant quotes. T= Technician; D= Teacher; E= Student.

With respect to the application of bioethical criteria in the demonstrative and experimental practices with animals in this study, this was analyzed from the following dimensions: 1. Conceptual standards and scope of action, 2. In the first instance, the results of the first dimension corresponding to conceptual standards and field of action in experimental and demonstrative laboratory practices using animals are presented (Figure 1). In this graph, the triangulation of results between the survey, interview and observation sheet indicates an association of three components: 1. Under the component of animal housing conditions, three categories emerged: nutritional, sanitary and spatial conditions. It was evident that the experts and interviewees were aware of the terminology and the aspects involved in each of the categories. This is reflected in the expressions "provide the animal with water and food", "maintain hygienic conditions to maintain the animal's integrity..." and "comply with basic sanitary measures" indicated by the interviewees.

Similarly, there was criticism regarding the educational reality. The interviewees indicated that the Central University of Ecuador does not have the space or infrastructure to establish the bioethical conditions in a suitable manner and as stipulated in the International Regulations, for nutrition, sanitary and spatial protocols. This is supported by the expressions "there is no suitable space for animal care", "live species are not handled in the laboratory because they do not have the space or resources" and "there is no classification for waste in the laboratories" (See Figure 1). In the academic training component, a cause called field of action is annexed, referring to research and teaching. The research shows that there is continuous training of research teachers and implementation of new methods or bioethical protocols. The teachers seek alternatives to animal experimentation, for example:

virtual atlases, plastinated[1] organs and courses for future professionals linked to bioethics. Thus, the interviewees expressed expressions such as "in the Faculty of Veterinary Medicine, virtual atlases are used and plastinated organs can be requested", "we are obliged to train ourselves to use new methods or protocols of bioethics and to teach students".

The codes corresponding to good practices are: restraint, injection, anesthesia, analgesia and euthanasia. Restraint is one of the most commonly used practices, according to experts, laboratory technicians and students. This is ratified by expressions such as "manipulation with the hands to observe the extremities and external structures". It is also revealed that injection, analgesia and anesthesia are the least used methods in good practices. The analyzed group affirms that injection, analgesia and anesthesia are the best methods due to their lethargy and decrease of pain in the animal. However, they are not frequently used due to the demand of economic resources that they imply.

In euthanasia, there is a contradiction between the information collected from the respondents, interviewees and the observation sheet. The students affirm that euthanasia has been performed, but the technical teachers affirm that in the Pedagogy of Experimental Sciences, Chemistry and Biology career, this practice has never been performed and the concept is not addressed in its entirety during the experimental practices. The following is the network of relationships within the dimension 1. Conceptual standards and field of action.

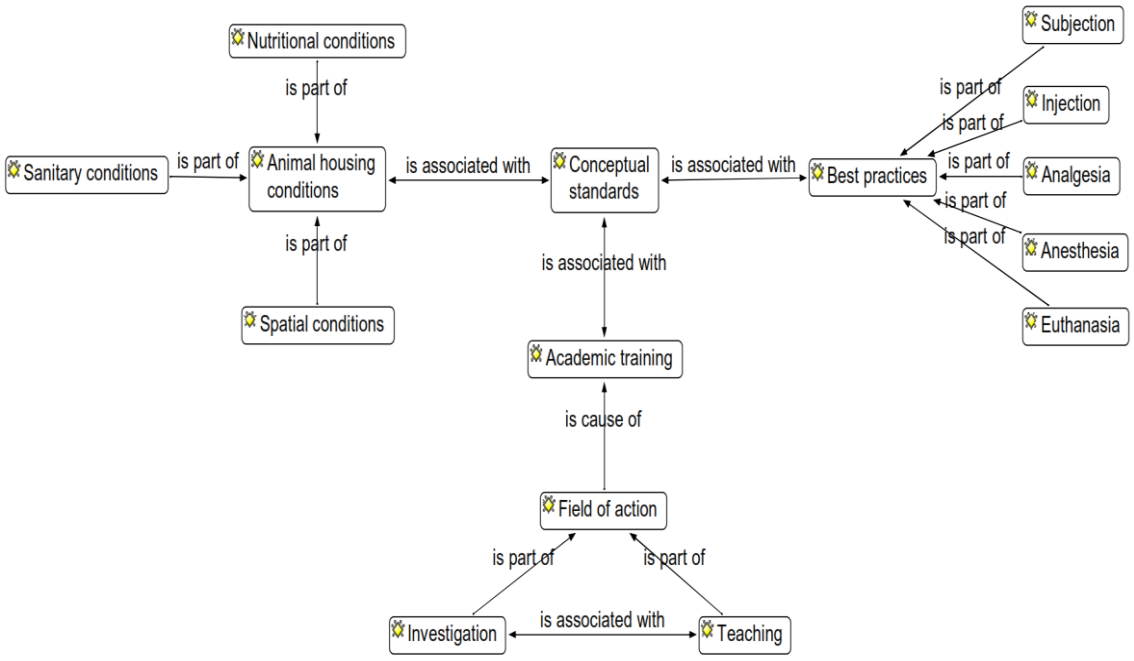

Figure 1. Conceptual standards and scope of action

It is evident that although the Universidad Central del Ecuador has supported the implementation of training processes in the area of animal handling, it has neglected to provide the necessary infrastructure for animal maintenance. Regarding the techniques

[1] Plastinate is a technique of animal preservation through the formation of plastic models.

used, it is clear that the best ones are injection, analgesia and anesthesia; however, the lack of economic resources makes it necessary to use the restraint technique.

Regarding the second dimension related to Bioethical Principles, International Regulations and the Code of Ethics of the Central University of Ecuador, three categories are considered in the experimental and demonstrative laboratory practices that use animals. These categories are shown in Figure 2 and are: reduction, replacement and refinement. In this dimension it was specified that the three categories in the University are used in the execution of practices on a smaller scale, in a limited way and adjusting to a great extent to the basis of the principle. This is due to the fact that there is less use of demonstrative practices. This is supported by the expressions "we work with preserved collections or specimens available in the laboratory" and "there is less use of animals in demonstrative practices". For this reason, improvement alternatives are sought with computer and didactic models.

In addition to the above, the responsibility of the person, the integrity of the animal in relation to demonstrative and experimental practices is added. It is pointed out that these seek animal welfare, as well as the presentation of responsibility reports when using species in experimentation or observations that are in accordance with the University's code of ethics. From the legal principles, the interviewees were supported by the Organic Law of Animal Welfare, International Regulations for Animal Research, Environmental Legislation and the Code of Ethics of the University. This can be evidenced by expressions such as "the Organic Law on Animal Welfare complies with the Codes of Ethics for handling species", "Animals for human consumption that do not merit slaughter are used" and "it would be important that the Code of Ethics outlines animal bioethics". It was clarified that it is not necessary to work with a large number of species.

It should be noted that after the study of this second dimension, it was determined that there is a Code of Ethics of the Universidad Central del Ecuador, as well as protocols, but not an approved and current regulation that allows regulating demonstrative and experimental practices with animals. The Code of Ethics in turn can regulate the links, research with the use of animals and propose a bioethical profile that relates in a respectful and considerate way the human and the animal and these can be extended to the level of faculties. Currently, the Formative Research Commission and the Animal Research Ethics Committee as a regulatory body (CEIA) are working on the Regulation to grant ethical endorsements and carry with them the responsibility of complying with environmental legislation, the Organic Law on Animal Welfare and the International Regulations for animal research.

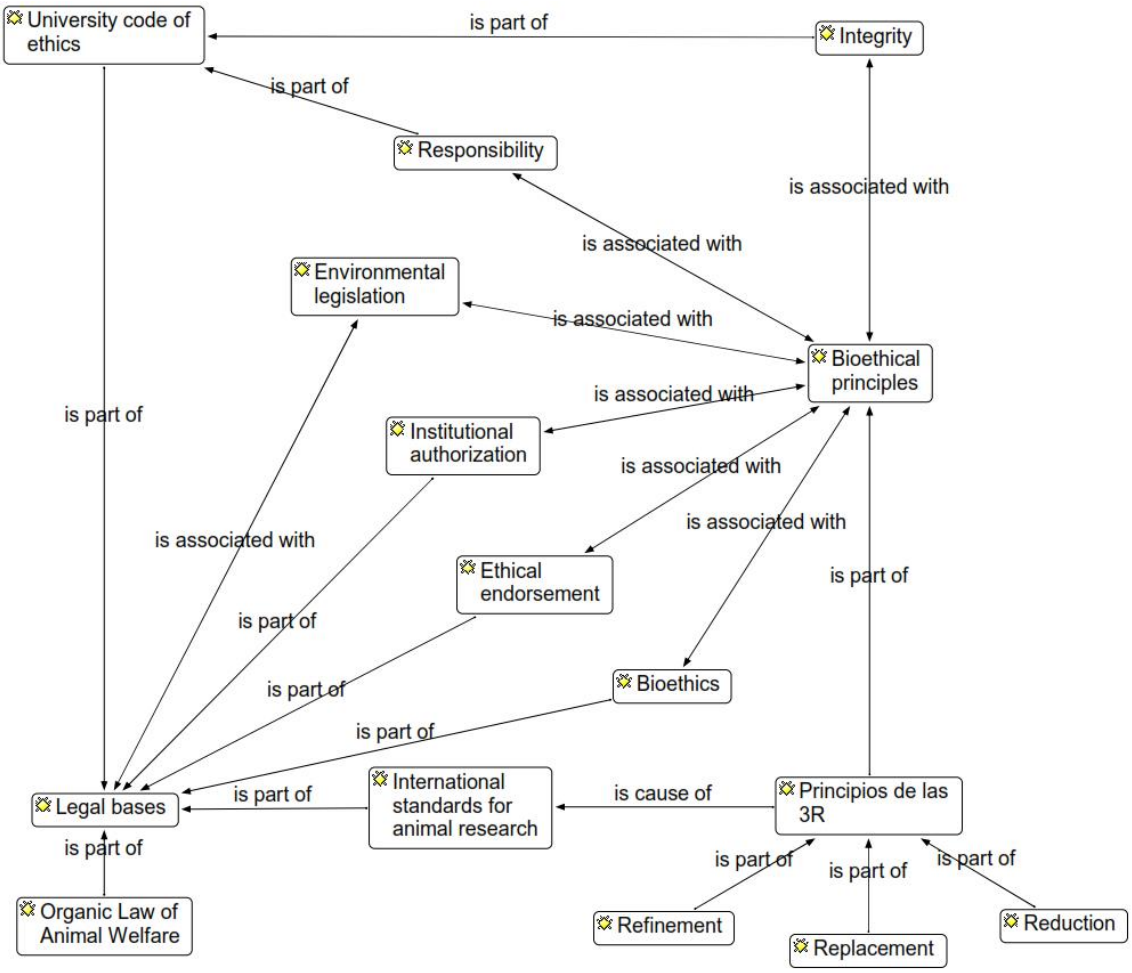

Figure 2. Legal Bases and Bioethical Principles

Through the work it has been determined that reduction, replacement and refinement as components of the dimension studied, are used on a smaller scale and in a limited way, so alternatives are sought with computer and didactic models. One aspect that is added to the respect for animal integrity, in addition to those mentioned above, is the responsibility of the person who performs the practices. The professionals who carry out practices with

animals are supported by international and national laws. For its part, the University is working on the regulation to grant ethical endorsements for animal studies and thus comply with the regulations.

With respect to the third dimension, related to didactic material as a replacement or alternative to the use of animals in experimental and demonstrative laboratory practices (Figure 3), it is indicated that there is the use of various materials. On the one hand, there are audiovisual tools, laboratory practices without biological material and, on the other hand, laboratory practices with biological material. In both cases, the existing alternative material satisfies the learning demand because they complement each other. The alternatives for the use of animals are specified in the use of videos, 3D videos, practices with reality and computer simulators, mock-ups, preserved specimens and taxidermic boxes, which are combined with demonstrative practices using biological material such as prepared plates and specimens for human consumption.

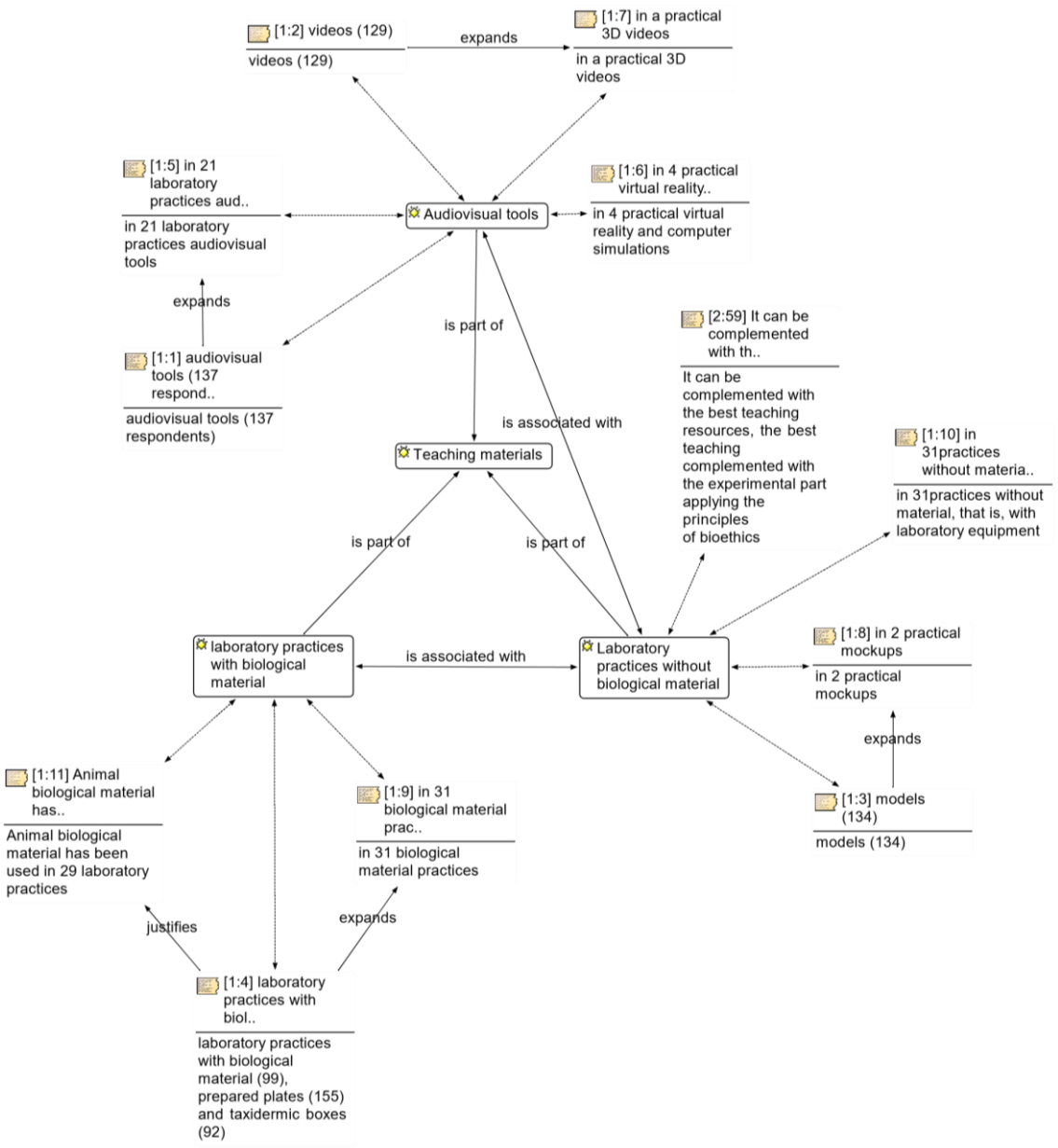

Figure 3. Didactic Material

Therefore, in this third dimension, there is the feasibility of having a variety of didactic material that is combined with biological material, which favorably affects student learning. It should also be noted that, although there are no approved internal legal regulations, teachers have worked in accordance with the principles of international regulations.

The analysis related to the fourth dimension of study, called animal experimentation practices, is shown in Figure 4. Here, it is indicated that animal experimentation carried out in laboratory practices at a demonstrative level is necessary for students' training. This affirmation is given because they contribute significantly to learning, to mental functions, as well as to the relationship and comparison of anatomical structures. This is evidenced in expressions such as "it is necessary to work with specimens since they contribute

significantly to the students' learning", "dissection techniques are applied to specimens and vivisection of insects".

It is worth mentioning that the need to work with technological alternatives with connections or preserved specimens was mentioned in order to have a balance between the practices that require and do not require the use of animals. Expressions such as "it is possible to work with collections or preserved specimens available in the laboratory" and "there must be a balance between when it is necessary to use an animal and when technological alternatives can be an option" were remarked.

Among the most used methods of animal experimentation, it was determined that dissection is one of the most used at the level of demonstrative practices, while vivisection is the least used method because it requires a live animal to be sacrificed in the laboratories. The results were contrasted with the information obtained in the observation sheet, where out of the 32 practices, dissection was applied in 22 of them, and vivisection was performed on fly larvae in 7 practices. Among the specimens most used for animal experimentation are those for human consumption because they do not require sacrifice and are more accessible to students. Finally, three practices used exotic animals due to their protected and vulnerable status. In addition to the contribution to the ecosystemic balance, field trips are used to observe the fauna, taxidermic boxes and preserved specimens, which are kept at the Gustavo Orcés Zoology Museum.

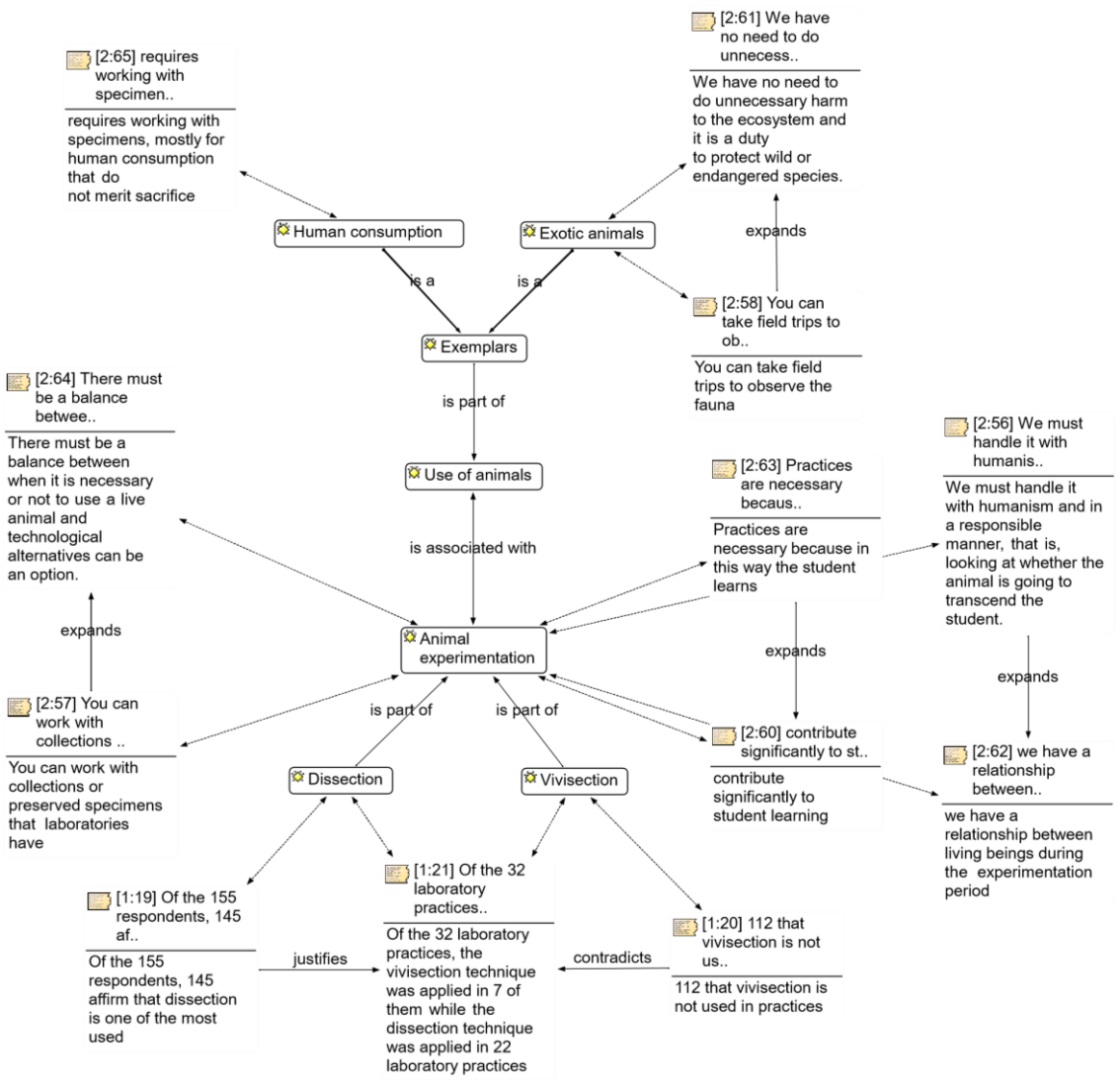

Figure 4. Animal experimentation

In this dimension, emphasis is placed on the need to use live material because there is a greater guarantee that students will achieve significant learning and contribute to the relationship and comparison of anatomical structures. However, technological alternatives and preserved specimens help to achieve a balance between practices that require animals and those that do not. In relation to the most used methods in demonstrative practices, dissection is the most common, while vivisection is the least used method. Finally, it should be pointed out that the practices with exotic, protected or vulnerable organisms are not used, but are alternated with field trips that allow observation of the fauna, preparation of taxidermical boxes and preserved specimens.

5. Discussion

After the analysis of the application of bioethical criteria in the demonstrative and experimental practices with animals, it was determined that in dimension 1. Restraint is the

animal technique most frequently used in the laboratory of the career. This is possibly due to

to the easy understanding of the term and the simple application of this good practice by the students. This is in agreement with what is expressed by Nicasio, Bermúdez, Lemus and Salvador, who point out that among the practices of graduate students are restraint, manipulation and sexing (Nicasio et al., 2021). This allows inferring that, although there is a variety of practical aspects of manipulation in laboratory work with animals, nevertheless, the restraint technique is a common procedure within the academic practices.

On the other hand, injection, analgesia and anesthesia as opposed to restraint were shown to be the least employed codes. This is due to the demand of economic resources required for their application. However, they are the best methods to decrease pain in the animal. Varcellini and Principi state that the criteria for selecting the use of anesthetics and analgesics depends on the animal biology, the experience of the person and the easy acquisition of equipment and resources for the practice (Varcellini and Principi, 2021, pp. 236-239). According to what has been expressed, it can be evidenced that the economic factor is one of the determining elements at the time of choosing the technique to avoid suffering in the animal during its manipulation, and from the context it is determined that this is a limiting condition, not only in the higher education center in which the research has been carried out.

The bioethical principles of the "3Rs" (Reduction, Replacement and Refinement) are important to apply in order to value the respect, care for the health and life of animals for use in research and demonstrative practices. The principle of the three R's was established by Russell and Burch. The aforementioned researchers state to reduce the number of animals used, to replace live animal material with other techniques, to refine the techniques to reduce animal suffering (Mrad, 2005, pp. 163-183; Sanchez, 2000, pp.199-208). The bioethical principles of the "3Rs" are applied to a limited extent in the laboratories of the Race. The most frequently applied principle is "Replacement", since alternatives to the use of animals are sought. The options that help in the replacement of animals are audiovisual tools, videos, 3D videos, computer simulators, among others. The use of didactic material available in the laboratories, such as preserved specimens and prepared plates, allows the practice of "reduction". In the absence of didactic resources, live animals must be used in the practices as long as the experience is significant in the training of the students and the specimen to be sacrificed is really irreplaceable.

Regarding "Refinement", it is a bioethical principle that in the career, the respondents indicate that it is applied in the demonstrative practices. However, in the observation sheet it was not possible to determine any procedure that allows ratifying what was expressed by the surveyed population. Regarding what was stated, Martinez points out that "in some cases the methods have been modified, including reduction and/or refinement, but replacement methods are increasingly accepted" (Martinez, 2021, pp. 81-97). It can be inferred from the above that the application of refinement methods is less frequent due to the tendency to include other methods. One of the most used techniques in the present study was dissection in animal structures. This is also supported by the results of an anonymous survey applied by Romero-Reverón, where students described dissection as 52.22% positive and 34.25% very positive (Romero-Reverón 2007, pp. 848-849). This shows that dissection practices are a resource frequently used in laboratories that carry out demonstrative practices.

6. Conclusions

With respect to the bioethical criteria in the demonstrative and experimental practices in the laboratories of the Pedagogy of Experimental Sciences, Chemistry and Biology, these are adjusted to the educational reality and to the economic situation of the students. They also adhere to the procedures socialized in the University, since there is no specific regulation governing the demonstrative practices established in the syllabus as an educational process of professional training in the teaching of anatomical structures in various subjects. Regarding the 32 laboratory practices in which animals were used, it is indicated that most of them are animals for human consumption that are easy for students to acquire (cow, hen, pig, bull, guinea pig, duck), which do not require sacrifice in the laboratory, but rather are dead specimens where the dissection technique is used.

On the other hand, among the least used techniques is vivisection, which in the case of practices is used with invertebrate animals for the study of fly larvae, cultivated in banana by the students. Experimental practices in the career are not applied because the institution has an educational purpose and not an experimental one. In addition, because within the training of the students of the career there is a connotation of replicability in the educational institutions of secondary education. In relation to bioethical management in demonstrative practices that use animals, the bibliographic study indicates that these should be governed by the International Regulations set forth by the UN, MERCOSUR, the Organic Law of Animal Welfare (LOBA) and the Bioethical Principles associated to the 3Rs. Under the framework of the National Legal Regulations, the environmental legislation, Municipal Ordinance and the Ethics Committees formed in the higher education institutions, which are in charge of regulating, regulating and supervising the demonstrative and experimental practices in research and educational training processes. However, in the Pedagogy of Experimental Sciences, Chemistry and Biology career, they still work under the criteria given by a biosafety manual.

Finally, the study can be replicated in different faculties of the university to identify whether the application of bioethics is part of the professional training of university students in faculties that use animal organisms in their training.

Acknowledgment

We express our gratitude to the First International Congress of Experimental Sciences organized by the Pedagogy Career of Experimental Sciences, Chemistry and Biology of the Faculty of Philosophy, Letters and Education Sciences of the Universidad Central del Ecuador, which took place from July 31 to August 4, 2023. Thanks also to the authorities, teachers and students of the faculty for their support and facilities for the execution of this research.

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REVISTA CÁTEDRA

Incidence of procrastination on the academic performance of the subject of Chemistry

Incidencia de la procrastinación en el rendimiento académico de la asignatura de Química

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Abstract

Procrastination is the intentional delay of an activity. This action has negative effects on education and society. In the case of students in the academic field, it can have an impact on their performance during their study activities. During the research, the causes of

procrastination in learning the subject of chemistry were determined, and subsequently its effects on the subject were verified. The research presented a qualitative-quantitative paradigm with correlational research, and likewise with a socio-educational approach. Techniques such as interview and survey were used to identify the various causes of procrastination. It should be mentioned that the statistical analysis was carried out based on the comparison of the types of procrastination with the academic performance of the first semester. The research presents a negative inverse correlation in passive procrastination, a value of -344 was obtained in Pearson's r and in Bilateral sig. a value of 0.001. Likewise, in decisional procrastination, Pearson's r obtained a value of -221 and in the Bilateral sig. 0.015. In other words, in both cases procrastination has a negative impact on academic performance in the subject of Chemistry. The survey results showed that the main causes of procrastination were emotional stability along with the use of social networks and technological devices. Procrastination is an involuntary act that currently affects the academic performance of students.

Keywords
school failure, procrastination, chemistry, academic achievement, academic routines.

Resumen
La procrastinación consiste en el retraso de una actividad de manera intencionada. Esta acción conlleva efectos negativos en la educación y la sociedad. En el caso de los estudiantes en el ámbito académico puede impactar en el rendimiento durante su actividad de estudio. Durante la investigación se determinó las causas de la procrastinación en el aprendizaje de la asignatura de Química, y posteriormente se verificó sus efectos en la misma. La investigación presentó un paradigma cualitativo-cuantitativo con una investigación correlacional, y así mismo con un enfoque socioeducativo. Se utilizó técnicas como la entrevista y la encuesta en donde se logró identificar las diversas causas de la procrastinación. Se debe mencionar que el análisis estadístico se realizó a partir de la comparación de los tipos de procrastinación con el rendimiento académico del primer quimestre. La investigación presenta una correlación inversa negativa en la procrastinación pasiva, se obtuvo un valor de -344 en la *r* de Pearson y en sig. Bilateral un valor de 0.001. Así mismo, en la procrastinación decisional en la *r* de Pearson se obtuvo -221 y en la sig. Bilateral 0.015. Es decir que en ambos casos la procrastinación incide de manera negativa en el rendimiento académico de la asignatura de Química. Los resultados de la encuesta demostraron que las principales causas de la procrastinación fueron la estabilidad emocional junto con el uso de redes sociales y dispositivos tecnológicos. La procrastinación es un acto involuntario que en la actualidad afecta el rendimiento académico de los estudiantes.

Palabras clave
Fracaso escolar, procrastinación, Química, rendimiento académico, rutinas académicas.

1. Introduction
Procrastination is the postponement or delay of activities. In the educational field it is considered as the failure to comply with academic activities. It is an involuntary act, however, with the passage of time it becomes a habit, according to this Atayala and Garcia (2019) argues that "procrastination starts from adolescence and is determined in adulthood" (p. 2). However, in some cases procrastination starts from childhood. Students,

feeling pressure from parents, tend to feel fear of failure and delay their activities. Each activity requires an established time and order so the student's behavior or emotions are important to comply with the activities, for the same reason, Quan and Sanchez (2012) argue that "behaviors related to the postponement of tasks are related to the student's emotional stability" (p. 6). The emotions that the student presents during classes are essential to understand the topics presented and to adequately perform their activities. Moreover, nowadays, procrastination is progressively increasing, becoming a social problem.

Procrastination in the educational environment affects the student's academic performance; this problem is frequently found in the American continent. According to some figures, Steel (2007) mentions that "around 95% of people recognize that they procrastinate, 25% of the same percentage argue that it is a chronic characteristic" (p. 3). Likewise, Guzman (2013) details that between "80% and 95% of students procrastinate occasionally; of these, 70% consider themselves procrastinators and almost 50% procrastinate consistently and problematically" (p. 2). The percentages with respect to procrastination are high, most procrastinate intensively, students substitute their activities for those of less relevance or importance, so it is important to consider the different causes in the delay of activities.

The subject of chemistry requires concentration and academic routines on the part of the student. However, learning is delayed by irrelevant actions, which impair academic performance. Therefore, this research aims to determine the causes of procrastination and its effect on academic performance in the subject of chemistry. Currently, academic procrastination is a topic that is considered important due to its consequences in the academic aspect; however, there is little research in the country on procrastination, so this research will serve as a basis for future research that will allow proposing alternative solutions to this problem.

This article consists of a brief introduction, in the theoretical reference the causes, types and models of procrastination will be addressed. In methods and instruments, we will describe how the research was carried out and finally the most relevant results will be analyzed together with their discussion and conclusions.

2 Theoretical reference

2.1 Procrastination

Procrastination is the postponement of activities, and when these involve school activities it is referred to as academic procrastination. Milgram (1992) argues that "procrastination is a disease that nowadays develops easily in first world countries" (p. 84). Students nowadays procrastinate as a matter of course. It should be mentioned that procrastination is involuntary, but, over time it becomes a habit, so it is considered a social problem. In addition, procrastination is also a problem in underdeveloped countries, due to the lack of resources for education. The factors that affect procrastination correspond to different causes. The analysis will range from the social aspect to the technological aspect. Each aspect will then be discussed in relation to the teaching and learning process.

2.2 Social aspect

There are positive or negative factors involved in student academic performance. Cardozo, et al. (2018) state that

> the social context intervenes in the teaching-learning process. The student is immersed in a constant change of experiences that affect him directly or indirectly; these factors can be exogenous, that is, everything that is outside the educational institution, and endogenous, everything that happens within the educational institution (para. 41).

The social context is an important characteristic during learning; personal or social problems diminish the student's concentration, so that the student easily postpones his academic activities. When mentioning the social aspect, reference is made to the family and economic context, and even to the student's emotional stability.

2.3 Familiar context

The family assumes an important role in the student's education. When there is a stable family environment, the student concentrates on his or her activities properly. On the other hand, family conflicts or illnesses prevent the student from concentrating properly on his or her activities, and thus directly affect academic performance. Martínez et al. (2020) state that "the family is the first base in the formation of the human being's personality, where values and principles are fostered" (para. 3). The family has the capacity to influence the development of each person. In addition, it is an important factor in the personal life of each individual, so that a good or bad family relationship directly affects the student.

Generally, conflicts between the student and the family begin in the adolescent stage, due to the physical and emotional changes that he/she presents. Llacsa (2018) mentions that it is "necessary to know the family environment, even more so when they go through the stage of adolescence because of the changes that adolescents go through. Young people go through a process of adaptation to adulthood" (p. 7). At this stage, the student experiences different changes that hinder a correct family environment, which can affect their concentration.

2.4 Economic context

The lack of economic resources in education is a problem; the economy is fundamental for quality education. The World Bank in Ecuador (2022) assures that "the health emergency caused by covid-19 provoked a deep recession that influenced a spike in poverty. This crisis amplified the macroeconomic imbalances that the country had been trying to redress since the middle of the last decade" (para. 1). In Ecuador, economic possibilities are low and in the wake of the 2020 pandemic, the country significantly reduced the education budget, affecting student learning. Most of the students who drop out of school are due to lack of economic resources. In the pandemic this problem was clearly evidenced, there were students who did not have the necessary resources to access classes, both for the lack of technological devices and for the poor or non-existent connectivity available in their homes. These aspects contribute to the student not delivering or not fulfilling their academic obligations in the established time. On the other hand, social investment in Ecuador leaves much to be desired; social investment involves the health, labor, culture, social welfare and education sectors. Education only receives 2.53% of the budget allocated for social investment. Gomez, (2020) mentions that "Ecuador's budget and investment from 2017 to 2020 has decreased in the health and education sectors" (para. 1). A reduced budget has a significant negative impact on education, due to the impossibility of accessing a quality education.

2.5 Emotional stability in procrastination

The different emotions experienced by the student in class are essential for a correct learning process. When there is emotional stability, students can adequately perform their academic activities. Robayo, (2020) mentions that "students are currently at a stage where their family, school and work environment are unstable, and unexpected events around them can change their mood and impair their concentration in the activities they must perform" (p. 7). Adolescent students are in a vulnerable stage. Their emotions are constantly changing from joy or motivation to sadness or anxiety. These changes affect the emotional stability of students, the same emotions that prevent them from paying attention in class, and procrastinate in their activities. For the same reason, the student must have a stable social and family nucleus that allows regulating the emotions that the student presents.

2.6 Technological devices

Nowadays, there is constant mention of technological devices in education and their positive impact. Each technological resource presents different characteristics that allow students to access learning in a more dynamic way. Rodriguez et al. (2021) point out that "technological tools have brought changes to the educational landscape, creating innovative teaching methods that can be used inside and outside the classroom to improve educational knowledge" (p. 2). During the pandemic, technological resources enabled virtual learning, however, not all students had the necessary resources. Therefore, without adequate technological resources, students did not have proper access to education, impairing their academic performance.

On the other hand, the problem is exacerbated when technological devices consume too much of the user's time. A student in class spends more time interacting with their technological devices than with their classmates or the teacher, ignoring the activities they should be doing. Carrillo and Valencia (2020) state that "around more than 50% of students have a technological device, so they are always in constant communication" (p. 17). Currently, most children have access to at least one technological device, so they are always in constant interaction with them. Technological devices become distracters that can ultimately affect academic performance.

2.7 Procrastination and social networks

Nowadays, social networks play an important role in society; however, due to the 2020 pandemic, social networks became more relevant thanks to the ease of communication. In turn, in the educational field, students and teachers obtained educational information. However, the problem lies in its misuse. Muñoz et al. (2023) argue that "adolescents create certain dependence compatible with patterns of addiction to different platforms or applications such as social networks, which can lead to a somewhat dangerous situation" (p. 3). Nowadays, students spend more time on social networks interacting with mobile devices than with the people around them.

On the other hand, in the educational environment, the excessive use of social networks causes students to present scattered attention or low concentration, affecting their academic performance. The learning process is interrupted by the excessive use of social networks. Valencia (2019) argues that "currently these networks have managed to attract the attention of young people by taking their use to the extreme, as they capture more of their attention than any other activity" (p.2). In classrooms, students pay more attention to social networks than to teacher-led classes. Young people and even children participate in

them to the point of staying in permanent contact not only with friends but also with strangers. Even the inappropriate use of digital platforms can become a distractor rather than an educational resource.

2.8 Procrastination and social networks

There are models of procrastination that help define the personality or characteristics of the person who procrastinates or delays academic activities.

2.8.1 Psychodynamic model

People are driven by the fear of failure despite having enough opportunities, thinking they are not capable and analyzing the motivations around them. This model connects people's behavior with the reasons for academic procrastination. Atalaya-Laureano and García-Ampudia (2019) argue that "procrastination comes from childhood; since, at this stage a very important role is played in the development of adult personality and the influence of unconscious mental processes and internal conflicts on behavior" (p. 8). Personality is formed in childhood; childhood traumas persist into adulthood. Therefore, since there is a fear of failure from an early age, students tend to consecutively postpone their social and educational activities. Emotions are also involved in the psychodynamic model. Fear of failure causes students to constantly procrastinate.

2.8.2 Motivational model

The person is motivated and committed to carrying out activities and achieving success in a way that avoids procrastination. For this reason, Atalaya and Garcia (2019) mention that:

> The motivational model indicates that procrastinating students are unmotivated, and are prone to adopt a position of dissatisfaction in relation to the objectives they intend to accomplish or become discouraged when obtaining an achievement involves effort and dedication; therefore, they are more likely to choose to suspend or postpone the start or progress in their tasks. (p. 9)

An unmotivated student is more likely to procrastinate, delaying their educational activities. Thus, by not completing their schoolwork on time, their academic performance decreases. Students who are always motivated and determined are less likely to procrastinate.

2.8.3 Cognitive Model

Students in this model represent intrusive thoughts for the actions they need to take. Carrasco (2022), states that "procrastinators tend to think in terms of procrastination, so they are especially susceptible to exhibiting obsessive thought patterns when they cannot complete a task or are close to a deadline" (p. 10). Fear of failure and social isolation cause people to delay learning. In addition, these individuals analyze whether or not to fulfill their roles.

2.9 Types of Procrastination

It is assumed that the types and models of procrastinators are the same due to the characteristics, however, they are different aspects. Ayala et al. (2020) mention that there are the following types of procrastinators:

> Passive procrastinators: They delay the completion of tasks or decisions, they delay until the end of the established deadlines, and they cannot make decisions quickly.
>
> Active procrastinators: This type of procrastinators work better under pressure, their tasks are always left until the end of the established deadline.
>
> Decisional procrastinators: They make the decision not to carry out academic activities until the end of the established deadlines (p. 8).

Each student is a different world, so there are different types of procrastination that define each student's behavior. However, this does not prevent students from procrastinating. Not completing assignments or not turning in assignments on time is detrimental to academic performance.

2.10 Academic Performance in the Subject of Chemistry

In education, academic performance allows assessing the student's progress within the development of the teaching-learning process. The activity that the teacher performs in this area is paramount, in this regard Estrada (2018) indicates that "it is the reflection of the learning coming from the didactic and pedagogical interaction between the teacher and student" (p. 224). Student learning is the result of the way in which the teacher teaches, the same that makes use of a methodology and didactic resources to achieve that end.

The academic performance of students in the subject of chemistry is determined through formative and summative activities. Sometimes the performance in the subject is obstructed by various factors that distract the student. The subject of Chemistry is a science that requires adequate concentration on the part of the student to avoid procrastination. The factors mentioned in the theoretical reference such as technological devices and social networks are elements of distraction during classes. When there is constant distraction, the student does not understand and is not able to relate the topics presented in class, so that their academic performance is impaired.

3. Methods and instruments

The research was correlational, the relationship between the variable of procrastination and academic performance in the subject of chemistry was identified, resulting in an inverse correlation, i.e., the higher the level of procrastination, the lower the academic performance. On the other hand, the research presented a socio-educational approach, since it was in charge of investigating the different social and academic problems that directly or indirectly affect academic procrastination.

The type of research was bibliographic, a search for information was conducted in theses and scientific articles, which served as theoretical support to substantiate that procrastination influences academic performance in the subject of chemistry. The instruments used were a survey and an interview. The survey was directed to 120 students of the "Abdón Calderón" Educational Unit corresponding to the first year of General Unified High School. The design of the questionnaire was based on the indicators of the research variables, which allowed a correct approach to the established problem. The instrument consisted of 8 structured questions of the independent variable and 8 structured questions of the dependent variable. The answers to verify the causes of procrastination ranged from 1=Always to 5=Never, the answers to determine academic performance ranged from

1=Excellent to 5=Unsatisfactory. Likewise, the interview was conducted with the teacher in charge of Chemistry in the first year of high school. The interview guide consisted of 6 open questions corresponding to the dimensions of the independent variable and 6 open questions responding to the dimensions of the dependent variable.

As for the selected sample, the students in this period presented the necessary characteristics for the research. Students at this level are approximately 15 to 16 years old, they are going through a transition stage from childhood to adolescence, this process alters their concentration during classes and increases procrastination.

The academic performance of the first term of the subject was analyzed. The topics addressed in this period constitute the basis of Inorganic Chemistry such as: atomic models, periodic table, electronic configuration and formation of chemical compounds. Therefore, the academic performance in this period is fundamental since it constitutes the basis for more complex topics such as stoichiometry, solutions and chemical equilibrium. In relation to the temporality, the research was transversal, so it was carried out in a determined period of time. The depth of the research was explanatory, in such a way that the causes and consequences of procrastination were analyzed in order to create a critical thinking with respect to the subject.

3.1 Data processing and analysis techniques

The processing and analysis of the surveys were carried out using Microsoft Excel 2021. The information collected from the respondents was used to create statistical tables, tabulate data and create figures for analysis. In addition, the SPSS 2022 program was used to perform the correlational analysis between academic performance and the types of procrastination derived from the applied survey. The results were obtained through Pearson's correlation using a significance level of 0.01 and box and whiskers figures that allowed analyzing the relationship between procrastination and academic performance in the subject of chemistry.

4. Results

From the results obtained in the survey, the causes that students mention as important factors in procrastination are emotional stability and the use of technological devices along with social networks. 88.33% mention that emotional stability is important in the teaching and learning process. Motivation, and feeling cheerful contribute to their concentration in schoolwork. In relation to the use of social networks, 65.01% of students affirm that they spend 7 to 10 hours during the course of the day on platforms such as Facebook, WhatsApp and Tik Tok, for the same group investigated, the social and economic context do not represent important factors in procrastination. Only 25.83% of students affirm that these aspects interfere in the performance of their activities. During the research, passive and decisional procrastination obtained greater relevance in the students.

4.1 Passive procrastination

Passive procrastinators delay the completion of their academic activities; for the normality test, the Kolmogorov-Smirnova test is applied, due to the fact that the sample is larger than 30 students. Table 1 shows the normal values for applying Pearson's correlation.

Normality tests				
Passive Procrastination		**Kolmogorov-Smirnov[a]**		
		Statistician	**gl**	**Sig.**
Academic Performance	1	0.138	25	.200*
	2	0.105	55	.200*
	3	0.064	40	.200*

Table 1. Normality tests of passive procrastination.

In the three levels of procrastination the Sig value is .200, that is, the data are normal. The existence of high levels of procrastination or delay in activities is detrimental to students' academic performance. In the second level there is a high number of students who affirm that they perform passive procrastination, it should be mentioned that it is not intentional, normally students at this point postpone their activities for causes such as social and even economic context.

According to Figure 1, the levels of passive procrastination do have an impact on academic performance (See Figure 1).

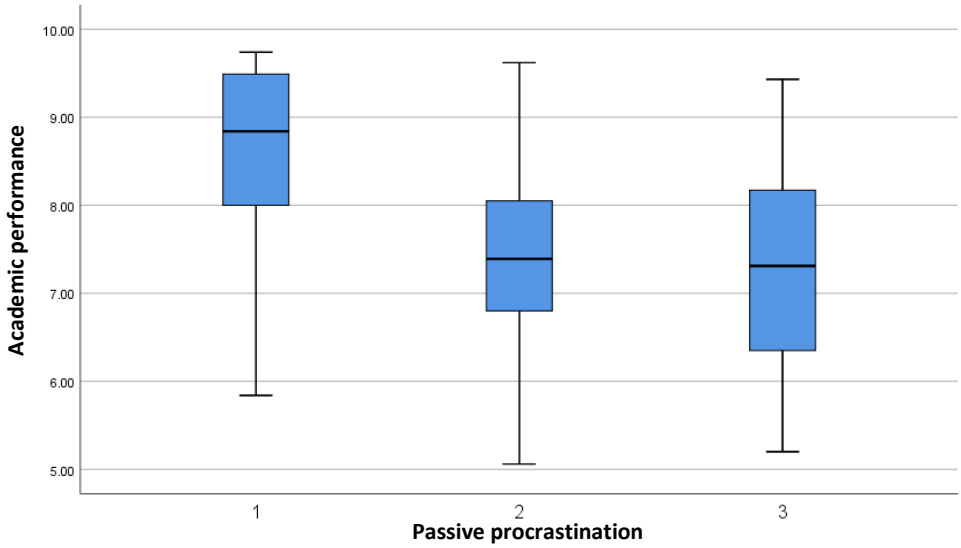


Figure 1. Box and whisker plot: Passive procrastination and academic performance.

In the first level of procrastination it is observed that students normally obtain grades of 8 to 9, therefore, the lower the procrastination, the higher the academic performance. In levels 2 and 3 of procrastination the grades that students obtain are 7 to 8, in exceptional cases the grades range from 5 to 6, in this part it is evident that the higher the procrastination, the lower the academic performance. The students' procrastination frequently affects their academic performance in the subject of chemistry.

Table 2 shows the Pearson correlation on passive procrastination.

Correlations			
		Academic Performance	**Passive Procrastination**
Academic Performance	Pearson correlation	1	-.344**
	Sig. (bilateral)		0,000
	N	120	120
Passive Procrastination	Pearson correlation	-.344**	1
	Sig. (bilateral)	0,000	
	N	120	120

**. Correlation is significant at the 0.01 level (bilateral).

Table 2. Correlation of passive procrastination.

The Pearson's r statistic value is -.344, that is, there is an inverse correlation, moreover, this correlation is highly significant. Therefore, it can be affirmed with 99% confidence that in the field of study there is a negative correlation between the variable procrastination and the variable academic performance, because the value of Sig, bilateral is 0.000 which is below the required 0.01.

Since there is an inverse correlation, it is argued that passive procrastination does affect academic performance. Students tend to postpone academic activities until the end of the established deadline. In passive procrastination, the fear of failure prevents students from performing their activities correctly.

4.2 Decisional procrastination

Decisional procrastinators make the decision to postpone their academic activities. In the normality test, the Kolmogorov-Smirnova test is applied, due to the fact that the sample is larger than 30 students. Table 3 shows the normal values for applying Pearson's correlation.

Normality tests				
Decisional Procrastination		**Kolmogorov-Smirnov[a]**		
		Statistician	**gl**	**Sig.**
Academic Performance	1	0.065	63	.200*
	2	0.122	38	0.169
	3	0.090	19	.200*

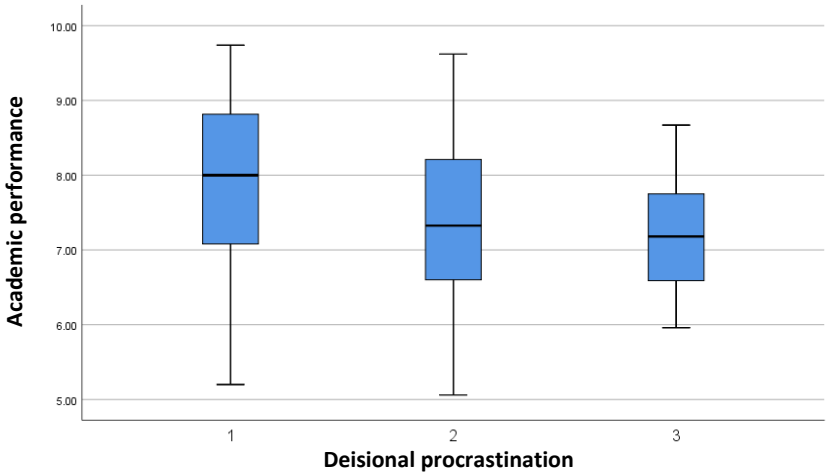
*. This is a lower limit of true significance.

a. Lilliefors significance correction

Table 3. Normality tests of decisional procrastination.

In the first and third levels of procrastination the Sig is .200 and in the second level 0.169, that is, the three are normal data because their value is greater than 0.05. Thus, being normal values allows us to affirm that decisional procrastination does affect the student's academic performance. Students sometimes decide not to perform academic activities of their own free will. This is due to different factors such as emotional stability, family context or economic context that prevent them from performing the activities and even lack of interest in the subject.

According to Figure 2, the levels of decisional procrastination do have an impact on academic performance (See Figure 2).



Box-and-whisker plot: Decisional procrastination and academic performance.

Taking into account the average levels in the first level of procrastination, it is observed that students normally obtain grades of 8, therefore, the lower the procrastination, the higher the academic performance. In levels 2 and 3 of procrastination the grades obtained by the students are from 7 to 8. In exceptional cases the grades reach 6, in this part it is evident that the higher the procrastination, the lower the academic performance. However, it should be noted that in level three there are few students who practice decisional procrastination.

Table 4 shows the Pearson correlation on decisional procrastination.

Correlations

		Academic Performance	Decisional Procrastination
Academic Performance	Pearson correlation	1	-.221*
	Sig. (bilateral)		0.015
	N	120	120
Decisional Procrastination	Pearson correlation	-.221*	1
	Sig. (bilateral)	0.015	
	N	120	120

*. The correlation is significant at the 0.05 level (bilateral).

Table 4. Correlation of decisional Procrastination

The Pearson's r statistic value is -.221, that is, there is an inverse correlation. Furthermore, this correlation is significant, so it can be affirmed with 95% confidence that in the study area there is a negative correlation between the procrastination variable and the academic performance variable, because the bilateral Sig value is 0.015, which is below the 0.05 required.

Since there is an inverse correlation between decisional procrastination and academic performance, it can be affirmed that the greater the procrastination, the lower the academic performance. Although it should be mentioned that sometimes procrastination is involuntary and over time it can become a habit. Procrastination is detrimental to the student's academic performance.

5. Discussion

Procrastination is a social and academic problem that has become normalized over time. Students postpone their academic activities for those that have less relevance or importance, thus affecting their academic performance. One of the causes is the use of technological devices and the use of social networks. This is what Guamán and Ticsalema (2022) state in their research, where they mention that:

> Internet addiction is a maladaptive behavior characterized by the deterioration in the control of Internet use, manifested through a set of cognitive, behavioral and physiological symptoms, generating negative consequences whose impact is mainly in the personal, family, social and school context (p. 102).

In the educational environment, the excessive use of technological tools predisposes students to academic procrastination. The student is easily distracted and postpones his tasks, putting at risk his teaching-learning process. Likewise another cause in procrastination are the emotional factors presented by the student, for this reason Camacho (2018) in his research argues that the "emotional conflicts that the student perceives generate negative moods, decreasing their concentration and increasing academic procrastination" (p. 123). Emotional stability is important in academic performance. The

student when presenting a negative attitude limits his abilities and skills, easily postpones his academic activities in a way that decreases his academic performance.

With respect to the relationship between procrastination and academic performance, Zumárraga and Cevallos (2022) affirm that:

> Academic procrastination produces a negative and significant effect on academic performance (β = -.22; p <.001). Implying that students who procrastinate more frequently, in relation to their academic tasks and activities, tend in turn to report worse academic performance (p. 8).

The results obtained in the research related to passive procrastination are -.344 in Pearson's r and the Bilateral sig. a value of 0.000, likewise in decisional procrastination in Pearson's r it has a value of -.221 and in the Bilateral sig. a value of 0.015, the values agree with the results shown by Zumárraga and Cevallos when demonstrating that procrastination affects academic performance.

Likewise, Paucar (2021) in his research states that "in students there are high and medium levels of procrastination, the same levels that affect academic performance, determining that there is a negative correlation between these indicators" (p. 90). The above findings allow reinforcing and verifying the results obtained in the present research, the incidence of procrastination on academic performance. The higher the level of procrastination, the lower the academic performance or vice versa; the lower the level of procrastination, the higher the academic performance.

Procrastination is the delay of academic activities, currently students procrastinate their activities normally. However, procrastination is an involuntary act that over time becomes a habit that is considered normal by students. To support this theory, there are different models and types of procrastination that define each person. On the other hand, academic performance in the subject of chemistry is determined by quantitative and qualitative activities. Each student learns differently, so the teacher must implement different strategies to evaluate academic performance. It should be taken into account that chemistry is an experimental subject, which allows the teacher to explain the contents through laboratory practices or experimental demonstrations. In addition, students acquire specific skills and abilities by performing experiments.

The relationship between procrastination and academic performance in the subject of chemistry arises when the student postpones or postpones his academic activities, impairing his academic performance. Among the causes of procrastination, the family context, the economic context, technological devices, social networks and emotional stability are evident. These elements turn out to be distractors for the student during the learning of chemistry.

Regarding social networks and technological devices Valencia (2019) in his research argues that.:

> Approximately 25% of the students who spend more than 5 hours a day using social networks have low academic performance, that is, more than 2 areas with low performance, and these hours spent using this technology include the school day. The33% of students who spend between 1 and 2 hours a day studying at home do not have any area with

> low performance, while the remaining 67% have lost some area, of which 23.6% have more than 2 areas with low performance (p.11).

Similarly, in the educational institution where the research was conducted, the factors that are most relevant in procrastination are the use of technological devices and social networks. 72.52 % of the students use a technological device during the learning of the subject of Chemistry. The student when concentrating on other activities that are not related to the subject of chemistry tends to delay their academic activities because they do not understand the topics covered. This affects their academic performance.

6. Conclusions

The research determined the incidence of procrastination and its effect on academic performance in the subject of chemistry, obtaining as a result an inverse correlation, i.e., the higher the procrastination, the lower the academic performance. Procrastination arises from different causes, however, the research highlighted the use of social networks and technological devices as they are relevant for students. Nowadays, these tools are important, however, as highlighted by other authors in research related to procrastination and technological devices, young people spend too much time on technological devices, which become distractors. In this way, students at the educational institution where the research was carried out, when they are pending on social networks or cell phones, their concentration decreases, and this eventually affects their academic performance.

The motivation that the student experiences during the course of the class is essential to avoid procrastination. Motivation also comes from their personal perspective, i.e., goals or dreams they set out to accomplish. A student who is unmotivated or sad tends to procrastinate more, not finding the need to perform or fulfill their schoolwork. Based on the present research, it is intended to project alternative solutions to reduce the level and types of procrastination. One of these alternatives may be the use of a digital academic agenda. The objective of the digital academic agenda is that the student organizes his activities in a timely manner, establishing priorities in a dynamic and fun way. This alternative, together with other strategies and resources, could become a basis for qualitative studies related to the reduction of procrastination rates in middle and high school students.

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