Scientific plate as an instrument for science communication and learning

La lámina científica como facilitadora de la comunicación de la ciencia y el aprendizaje

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Abstract

This research aims to provide evidence regarding how the plates employed in scientific texts are capable of fostering interaction with specialized data by triggering positive emotions that emphasize content and make science attractive. This was a qualitative study based on ethnographic techniques with volunteer students from the *Instituto Tecnológico de Zacapoaxtla* in Puebla, Mexico. In order to accomplish the stated objective, a scientific plate was produced using a design model that highlights the principles of information design. The plate was subjected to an ethnographic study where it was observed that, when reading a scientific article, users favored visual information to contextualize and interiorize knowledge. Thus, interacting with the plate made accessing scientific information a pleasant experience due to the diversity of emotions and feelings detected. During the tests, the contact between participants and plates was notorious, leading to emotions and sensorial reactions that made an impact on the perception of participants, making scientific content more interesting.

Keywords: science communication, scientific plate, Scientific Illustration, playful experience, information design

Resumen

El objetivo de esta investigación es aportar evidencia sobre cómo las láminas que aparecen en textos científicos son capaces de facilitar la interacción con información especializada al provocar emociones agradables que permiten enfatizar los contenidos, haciendo que la ciencia sea más atractiva. Este fue un estudio cualitativo apoyado en técnicas etnográficas, con un grupo de estudiantes del Instituto Tecnológico de Zacapoaxtla, en Puebla, México. Para ello, se produjo una lámina científica usando un modelo de diseño que enfatiza los principios del diseño de información. La lámina se sometió a un estudio etnográfico, en el que se observó que, al leer un artículo científico, los usuarios se vieron favorecidos por la información visual para contextualizar y retener el conocimiento. Durante las pruebas fue notorio cómo el contacto de los participantes con la lámina producía una experiencia visual, la cual se concretaba en una emoción y reacción sensorial que generaba un impacto en la percepción de que el contenido científico era más interesante, por lo que el interactuar con la lámina hizo más placentero su acceso a la información científica.

Palabras clave: divulgación científica, lámina científica, ilustración científica, experiencia lúdica, diseño de información

Introduction

Scientific topics are difficult to grasp for non-specialized audiences, leading to their rejection because of being complex, or plainly boring. However, when presenting information in a more attractive way, it was observed that its reception improved due to its higher accessibility (Sánchez Mora & Macías Nestor, 2019).

According to the Reading Module survey, conducted by the *Instituto Nacional de Estadística y Geografía* (INEGI) in Mexico, 69.6% of the population does have the habit of reading, while the remaining 30.4%, representing almost a third part of population, does not (INEGI, 2024). Among the preferred materials for reading are those dedicated to entertainment, work/study and general culture. The same survey asserts that the most preferred topics are literary novels from varied genres, followed by self-help, personal development and religion, it is only after them that texts focused on a specialized subject, profession or university level content can be found, finally trending towards general culture.

Further widening the panorama, a survey related to Public Perception of Science and Technology in Mexico, also conducted by INEGI (2017), discovered that people were more knowledgeable about sports with a 12.8% rate, while science merely yielded 6.3%, besides, it was discovered that 51.3% of people do not read science articles. Looking at the population's low interest rates, science communication proves to be a difficult task, which is why creating a scientific culture where people can be in contact with scientific information in their daily lives is of vital importance, to face such challenge it is necessary to implement strategies and tools that serve towards this purpose. One example of this is the use of images within scientific texts which not only help to communicate knowledge, but also provide emotional links with the information, facilitating its acquisition.

Scientific plates have a long history of helping science to register and share knowledge (Harris, 2023) when making a unique use of scientific illustration, which is a tool utilized to communicate science and contributing an attractive side to specialized text reading. Thus, plates can enhance the informative experience of the texts in which they are

presented, being an entity that goes beyond time and geography (Bleichmar, 2016). Nonetheless, a little-studied topic is the ability of scientific plates in Biology texts to generate playful-informative experiences; that is, while making knowledge perceptible, they also entertain and amuse us, generating an emotional link between the information and the reader.

This research aims to contribute insights on how the plates that appear in scientific texts on Biology can be developed, through the employment of an Information Design specialized model, by gathering evidence on its potential to trigger emotions and sensations in the user, making science more attractive.

It is sought to gather evidence that supports that plates, along with Scientific Illustration create sensations that offer a playful experience that allows to dive into scientific knowledge, fostering curiosity towards topics related to science (Torres, 2022), facilitating that users get in contact with scientific information, given that we are sensorial beings that develop empirical experiences through our senses (Eisner, 2020).

In order to realize this vision, a scientific plate was created in accordance with the Alicia model and following Information Design principles. Once finished, the plate was subjected to an ethnographic study, in which both the scientific plate and the article were shared with participants for reading purposes, conducting an interview with the user to know their experience afterwards.

Theoretical background

Science communication refers to making known the results of research carried out in universities or study centers, it also encompasses responsibility and commitment of those who researches so that information does not stagnate and continuously flows freely to make findings available to fellow researchers and society (Lazcano-Peña et al., 2019). Provided that the need of scientific knowledge in society is evident, researchers have to communicate their findings. Thus, the way of communicating data to non-specialized individuals is the most important premise, since scientific knowledge aids in daily life decision-making processes (Gaviria-Velásquez y Majia-Correa, 2021).

The image acts as a mediator agent between text and knowledge, it is a meaning booster and bearer of emotions. It is recognized as an efficient element to properly communicate information that can be easily processed by the brain, retaining information. This is why it is used to exemplify things that are not easy to explain, compare, grasp, transmit or debate on, among others, through words (Petterson, 2002).

Starting from the demands for representation that can be found in the production of images for its scientific use, plates with pedagogic

purposes took relevance to communicate information, and were historically developed along with technological advancements, witnessing the birth of several formats and laying the foundations to illustrate religion, geography and natural sciences (del Pozo, 2013), as well as history and ephemerides (Gonzáles, 2013), being an informative support by functioning as a complementary medium that communicates relevant contents (Feldman, 2004), while also bringing aspects of the outside world that would otherwise be inaccessible to the learning field (Linares, 2015).

Plates saw a considerable rise during the greater scientific expeditions carried out in the 18th and 19th centuries (Grilli et al., 2015). A long time after, thanks to educational trends and the eventually conceived modern education, these were employed in education centers, becoming a learning tool as well as a decorative element that carried out aesthetic functions, stimulating senses inside the classroom (González, 2013; del Pozo, 2013) and turning images into texts (Feldman, 2004), which means that by itself they are a form of reading that provide information in different cognitive and sensorial levels.

This can be explained by the fact that plates reached a specialization grade so high, that they became knowledge technologies that eased information access by emphasizing intuitive capabilities (del Pozo, 2013), provided that they synthesize reality, favoring teaching activities through organizing information and presenting an agile, ordered approach (Feldman, 2004). The aforementioned is key in science learning, which makes use of this resource to complement and widen oral and written communication, since it is true that science can also be learned by observing and producing images (Grilli et al., 2015).

In the context of science communication, a plate is a graphic product which, in its fundamental essence, is composed of one or more illustrations, and they are defined by the specialized topic being represented. These scientific illustrations, while functioning to visualize information, are also epistemological images that emphasize visual design and help to communicate scientific knowledge (Heekeren, 2021), it also shows the results of research and prepares them for its use as learning materials (Ortega Alonso, 2019). Planned by experts, based on artistic techniques, and designed to be experienced in multiple dimensions — physical, sensitive and multisensorial —, this type of image is qualified to be a cognitive material, since our brains process the information to transform it through our senses.

This is due to the fact that visual input trigger several mechanisms that form aesthetic experiences, and such phenomena has inspired plethora of studies (Sauer & Sonderegger, 2022; Wakabayashi et al., 2021).

It is possible to discuss, then, three specific events that take place during this event (Wakabayashi et al., 2021): The first one is perceptual processing, a phenomenon that does not reach consciousness and is based on proper visual stimuli. The second is cognitive processing, which functions based on our own judgement about what we see and depends on the specific contexts and situation where it happens, this is translated into high volatility. Lastly, there is emotional processing, a mechanism that relies on affective appearance and has a regulating effect of the visual experience, in a way that evidence suggests that this process strongly interacts with the perceptual and cognitive processes.

The aforementioned showcases the importance of creating scientific illustrations that contribute knowledge and can reinforce articles from any scientific domain (Caeiro & Muñiz, 2019), taking into account who it is designed for and managing to communicate what is required.

By containing scientific illustrations, plates are quite a valuable resource for contemporary learning in the biology area, this translates to the identifying process, since descriptions through texts are not enough to improve the perceptibility of a plant or animal and its morphology (Gómez-Ollé et al., 2021). On the other hand, an illustration does have the versatility to adapt when it comes to the presentation of specific zones, interior parts, the various layers of a texture, etc. Which is achieved by the constant perspective play, planes, framing and portraying to easily explain the study subject.

This explains why the elaboration of plates and its visual contents require observation skills, domain of illustration techniques, and dexterity to represent specimens, while taking into account the size, shape, proportion and all the necessary visual inputs that will make all elements constituting it identifiable, providing an understandable representation that will further clarify concepts that written text left behind or vaguely approached, following the previously mentioned principles will most certainly communicate scientific research effectively (Migoya, 2017).

Another aspect to bear in mind is the role of text in plates, since their major focus on the picture engages in a different logic when compared to the text-picture relations known through books and newspapers, this is because the plate's contents uses titles, tags and brief texts only (Linares, 2015). Which is mostly due to the informative weight of content expressed with scientific illustrations and graphic elements.

Considering the aforementioned, proper guidelines for design in image production would encompass color, light, shadow, planes, perspective, texture, scaling, proportion, composition, and representation techniques such as line, texture, pointillism, color pencils, digital and mixed illustration, among others. At the same time, they are expected to truthfully communicate scientific information, an objective that also

entails triggering emotions and playful experiences within the receiver of these images (Pettersson, 2002).

When communicating, data must be concise; therefore, information design works to select, filter, and retain only what is relevant to disseminate the intended message (Pettersson, 2002). This allows for shaping and guiding the creation of scientific plates that support the understanding of specialized topics, providing an opportunity to test new design models centered on the principles of information design.

Thus, Information Design, when applied in scientific plates, harmonizes with those pieces of data regarded as key to reinforce the image, so it can express a complete, coherent and easy to understand message. Besides, the use of rhetorics boost the playful capacities of the visual message.

An essential trait of human nature is the capacity to develop playful activities, this is to say, activities related to playing, however, this term goes beyond the amusement act, since it also contains features like being cultural, contextual, and open to more than one solution. The aforementioned includes significative tasks that lead people to cognitive states which allow reflection about our world and freely express one's identity; therefore, playfulness is a crucial ability for human beings, since it is a positive factor that contributes to mental health and individual wellbeing (Tonkin & Whitaker, 2021).

This idea is considered in education, where its execution seeks learning dynamics that favor understanding, construction and deconstruction of knowledge that goes hand-in-hand with reflexive processes (Vargas Garduño et al., 2021).

It is only through these principles that education, and specially in science, recognize the potential of creating formative experiences that incorporate the playful perspective in teaching and learning processes (Borjas et al., 2019), following the objective of inheriting abstract or particularly difficult knowledge at every step (Rocca Báez, 2021). Such philosophy constitutes the concept of playful experience, which is defined as an experience that allows for learning through pleasant activities, favoring motivation and students' development (Borjas et al., 2019), facilitating meaningful learning in the process (Rocca Báez, 2021).

Consequently, playful experiences are spaces created to foster imagination, in which it is possible for learners to build and rebuild knowledge without considerable effort by conducting emotion-rationality exchanges through high-level cognitive associations (Vargas Garduño et al., 2021).

It must be considered that there is a relationship between the one who sees and what is seen, which generates an interdependence of meanings that leads us to understand that, more than a phenomenon of

sight, visualizing information entails an experience that encompasses many levels, where the senses, knowledge, value judgments and our emotions intervene, intertwining in a dialogue (Peña-Casallas, 2020), and that this can be facilitated if we generate the conditions so that cognitively we can have a playful experience when coming into contact with visual information.

It can be said, then, that scientific plates possess a potential to evoke emotions and deliver it to those involved, through the didactic use of visual features in science and technology teaching and an emotion-triggering, aesthetic dimension that transforms learning activities into ground-breaking experiences (Goodman, et al., 2020).

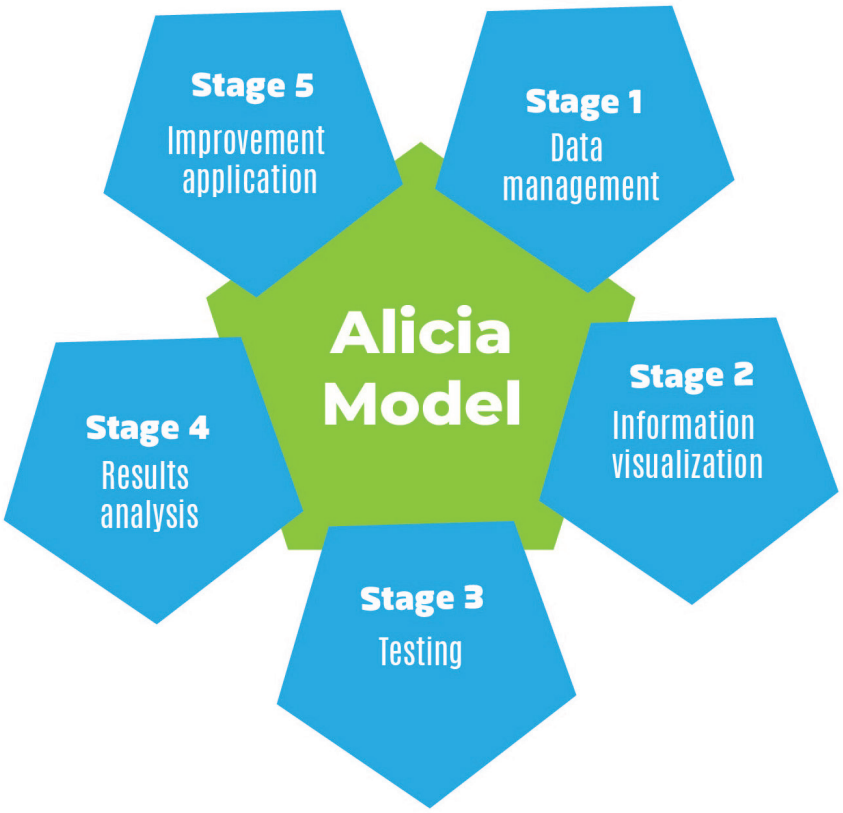
Methodology

A qualitative methodology was chosen for the development of this research, since the objective is identifying and assessing the presence of playful experiences of people when interacting with a scientific plate and its contained information. In terms of instruments, interviews were conducted to gather information, allowing a systematic process for data collection, and thus helping researchers to take a reflectional posture (Johansson, 2019; Mwita, 2022).

The interviews were conducted through a script, which employed questions related to: 1) The perception towards scientific information from students, 2) Previous knowledge of scientific illustrations as a visual tool in the communication of scientific subjects, 3) Perception of visual information within research articles, and 4) Their playful experience, this is to say, getting to know what and how did they feel by interacting with the visual support of the scientific plate when reading the scientific article.

To perform the applied part of the work, that is, creating a scientific plate, the Alicia model was followed (Luna-Gijón, 2022, 2023b, 2023a), which consists of five stages (figure 1) and has a specialized literature-sustained foundation on Information Design principles, seeking the creation of informative experiences that lead to understanding, while also promoting efficient communication and developing accessible documents through the establishment of connections among data, and placing people in the center of the process.

Figure 1
Alicia model stages, according to Luna-Gijón, 2023b



In order to make the qualitative process meticulous and grant the capability of analyzing gathered information, three categories were established following the theoretical framework to classify data: Experience with scientific information, Visual experience and Playful experience.

The first category is related to knowledge acquisition, ease of information access, the perceived quality of information, the value of the expressed knowledge, and information retention.

The second category deals with the sensations that can be verbally expressed with words related to the eyes and sight, the evocation and links that visual elements establish between previous knowledge and new information.

The third category considers the role of sensations and emotions in the interaction process between people and scientific information. Within this category, the surge of physical perceptions and expressions related to action performing are included.

According to these stablished points, the research process described below was conducted.

Stage 1. Information management

This stage began by searching for information sources, universities, research centers and researchers open to participate in the project. The selection process was performed considering the location of the principal author, prioritizing the nearest educational center that could offer a biology department, so the author can visit it as many times as necessary and be able to contact an expert directly. A research teacher from the biology area in the *Instituto Tecnológico Superior de Zacapoaxtla* (ITSZ) in Puebla, Mexico was identified. The project details and an invitation to participate were sent, mentioning the contribution requirement of providing information related to a project being carried out by her at the moment; it was possible to reach an agreement, and she provided material from an article about pseudoscorpions.

Once the topic was assigned, extensive data documentation was performed to identify useful information to properly know pseudoscorpions, so it could be represented on a scientific plate. At the same time, visual information was collected in relation to colors, textures, sizes and morphological features unique to each type, such as body segmentations, anything deemed as necessary to represent it visually.

After gathering all necessary data, an information management process was carried out, said process consisted of selecting, organizing and planning the collected data usage, in order to determine what pieces of information would be represented visually on the scientific plate, included as pure text, and which parts would be jointly distributed to express the desired knowledge.

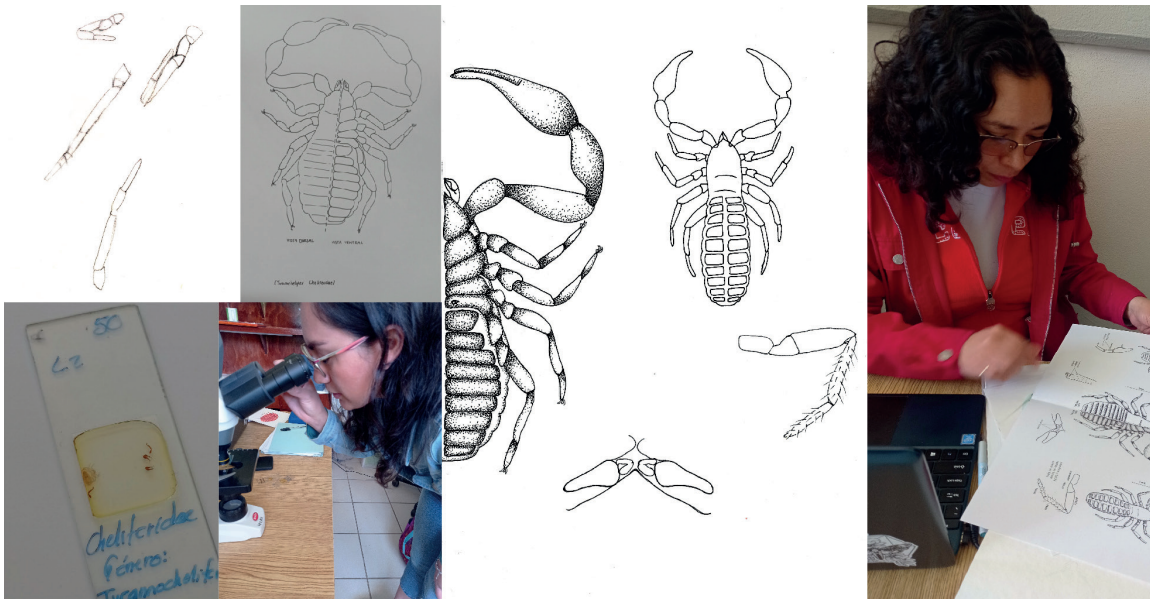
Stage 2. Information visualization

After the previously mentioned processes concluded, the scientific plate production stage began. The plate's composition was planned according to the guidelines for Information Design and implementation of graphic design rules. For illustrations, a specialized process to design scientific visuals was followed, drawing drafts to conceive the archetypes of each of the three pseudoscorpion variants, and only then employ illustration techniques such as pointillism and cross-hatching.

When carrying out Scientific Illustration, there were key points such as researching and being familiarized enough to grasp the best way to communicate the study subject. When producing accurate illustrations of the desired species, entomological understanding is required, in other words, being knowledgeable in regards of body structure, the sections composing it, number of extremities, sexual dimorphism, among other specimen data that allows an adequate illustration and prevents any confusion with other variants.

Simultaneously, the layout for the plate for data distribution was in the works. During this process, continued contact with the researcher was kept, and the illustration's progress advanced under her supervision and approval (figure 2).

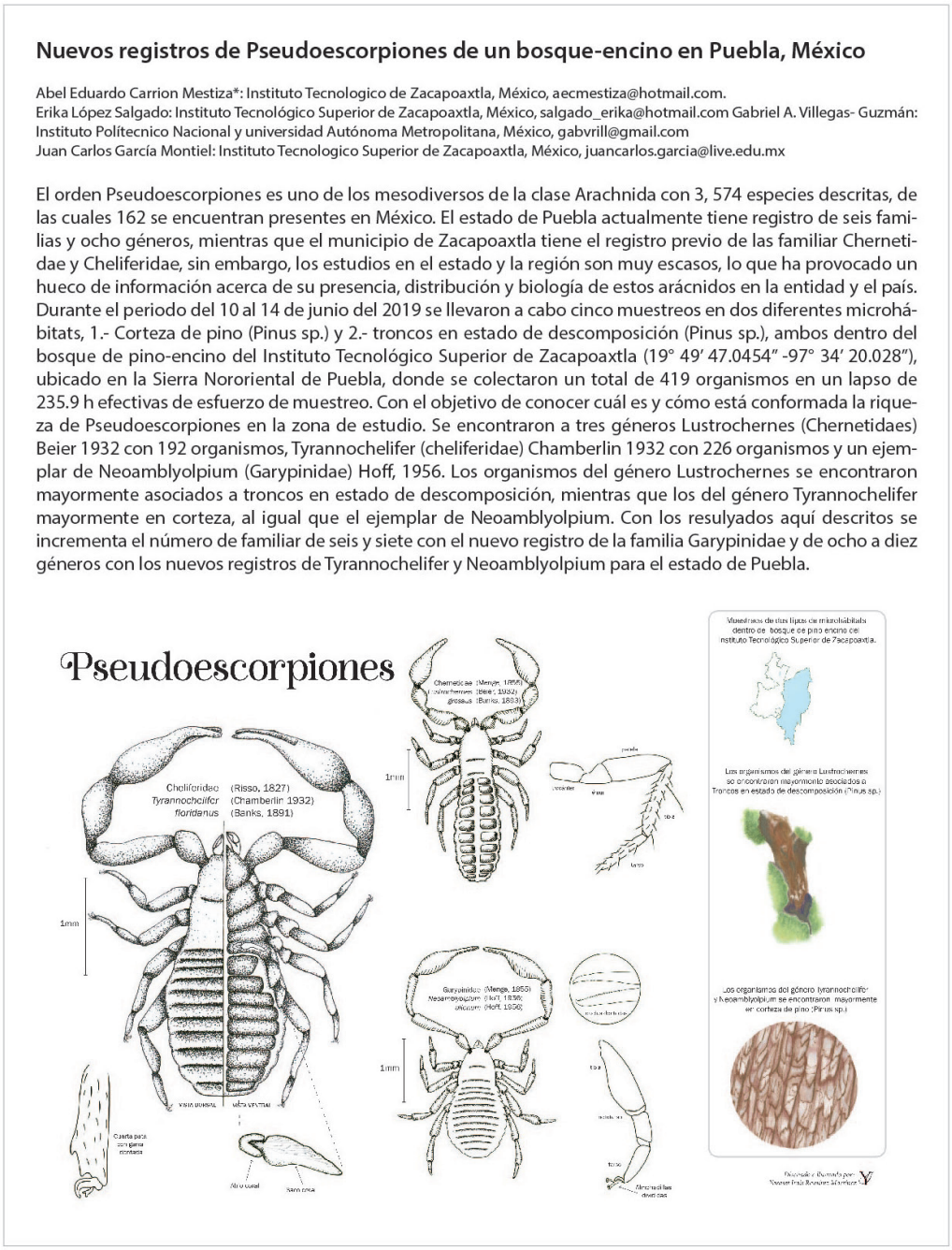
Figure 2
Production process of the scientific plate: archetype design, specimen observation to understand its morphology, element distribution within the format, and production under researcher's supervision



Stage 3. Informative material evaluation

Once the scientific plate was finished, testing procedures began. Figure 3 shows a prototype used during said tests, which included a text provided by the expert teacher and the plate developed for this research.

Figure 3
Prototype: Proposal of the plate and article bundle



The study was conducted with the participation of twelve students, four male and eight female, all of them being part of a fourth semester group from the biology bachelor's degree in ITSZ (figure 4).

Figure 4
Interview process in collaboration with students from the biology degree in ITSZ, reading the scientific plates

The test employed ethnographic techniques in a 4-hour timelapse, and each interview took approximately 10 minutes. During this time, students were exposed to the article among the scientific plate, providing enough time to read, and only after reading could the interview start. The results obtained from this stage will be later discussed.

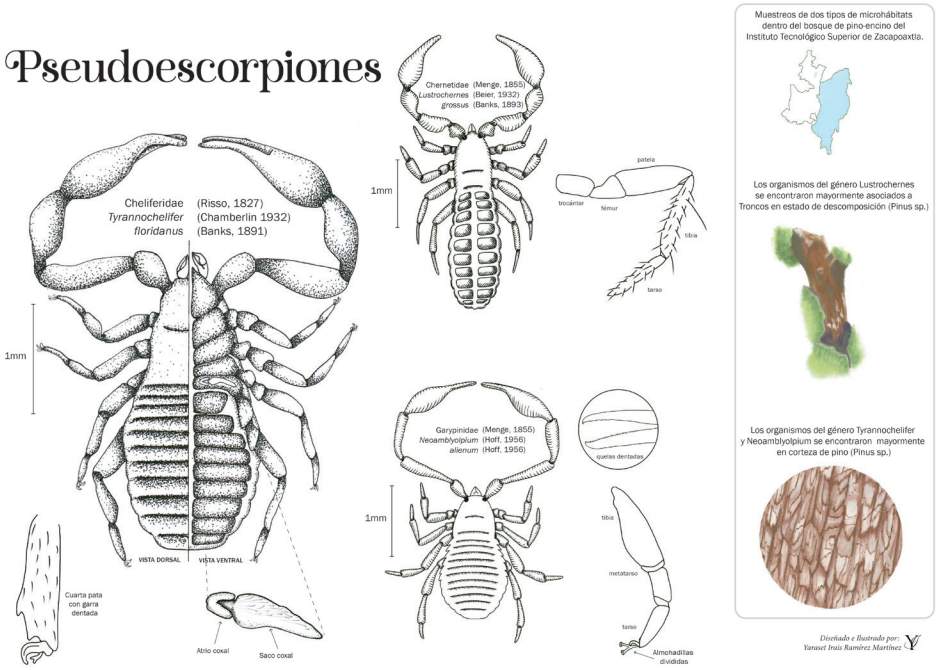
Stage 4. Results analysis

Regarding the results obtained from the case study, participants unanimously showed interest in the subject, declaring that content seemed attractive. Some of them had little knowledge of the topic, while others were completely unaware of its existence, probably because of being barely known type of species, and it being so small, many people from the region would let it go unnoticed. An extensive analysis of the results obtained during this stage is developed in the Discussion section.

Stage 5. Improvement implementation

Parting from the collected comments, an analysis to identify opportunity areas regarding the material was performed. Following user feedback, it was decided to expand the font size of a text box that showed microhabitat examples and a map dedicated to their respective geographic location, since some students could not distinguish said text. In figure 5, results after feedback-based improvements of the scientific plate are presented.

Figure 5
Final version of the Pseudoscorpion scientific plate



Now that the project development process has been explained, it is pertinent to show the results gathered from stage 3. To classify obtained data, the previously stablished categories within the methodology are being considered.

Results *Scientific information experience*

According to user's comments, the impressions towards the scientific information and its texts' contents focus on it being complex, since it includes difficult terminology or complex data, probably due to the author lacking enough clarity to better explain the employed terms. Despite being part of a science degree, students are still unfamiliar with many concepts, which is why they present difficulties understanding technical language and specialized ideas.

The interviews have proven themselves to be a unvaluable help to identify how the plate's inclusion aids them to interact with specialized subjects, for example: "... when trying to understand the topic, while reading, I was imagining things, but illustrations allow me not to, I could see what was in my mind" (Interviewee 4).

When asked about the nature of articles they would consult when information gathering was needed, some of the students shared the following:

> Most of the times we are expected to gather information and sometimes just information [in form of text] is not enough, but pictures do make them comprehensible, almost every time I look for articles with images, to understand them, because texts are a hassle to read and pictures makes one more interested, at least that is what interests me more, and how I learn more information (Interviewee 5).

"Yes, they use a lot of technicism and oversaturation of text, as a reader it can be tiring at some point" (Interviewee 11).

"They have a lot of reading; you just have to be very patient to comprehend them" (Interviewee 12).

Visual experience

Regarding visual elements, participants see the plate and Scientific Illustration as a powerful tool to clarify any doubt that may surge, thanks to the association of contents from the scientific article with visual elements from the material. As an example, the following comments were registered:

> I think it is an easier way to understand everything, in my opinion, drawings can be better understood in comparison to writing without drawings, for example, this drawing, it already shows you the parts and identifies even more, making certain topics easier to comprehend (Interviewee 1).

> They are really important because when you see a scientific article and see the text it catches your attention, but when you see illustrative references, you think "this is related to that", and it amplifies your knowledge about the topic you are reading (Interviewee 3).

Visual information is also regarded as useful for the scientific communication task, since it can attract a wider audience because of its easy way to present information. A statement that is reinforced with the interviewees' comments:

> It is a very important tool, because at the time of engaging in scientific communication it can be a method for people to have a better panorama to understand the topic, considerably softening the hardness of readings, while also making it very entertaining (Interviewee 3).

> I think it is very important, since some people do not learn in the same way, some learn viewing, others reading, others hearing, so, putting writing as well as drawings would be a good method (Interviewee 10).

Moving on to expert audiences, Scientific Illustration proves to be a very useful tool, its requirement to identify elements and image placing makes the task of communicating information about specimen morphology easier, and it is the same for its corresponding visual information that allows this process to occur, precisely as the interviewed expert teacher asserts:

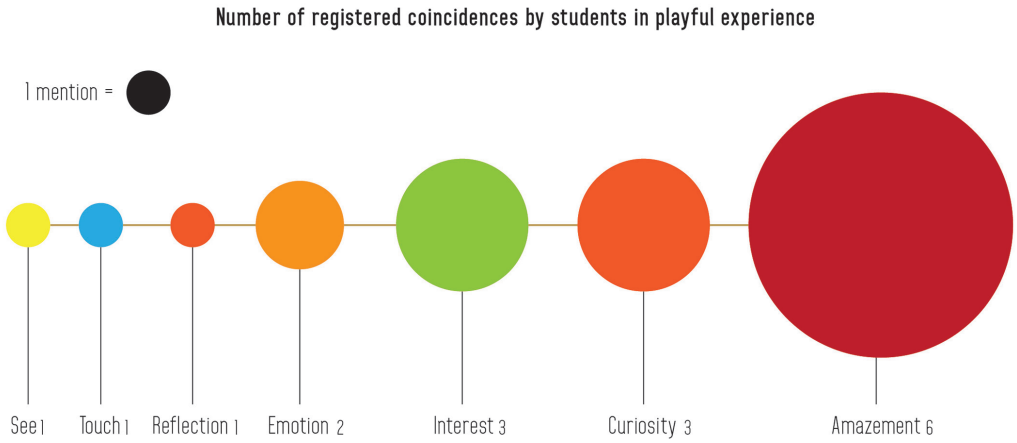
> Visual information is certainly indispensable for research, since you can realize what and which are the characteristics and features of a specimen (Expert teacher).

Playful experience

Scientific illustration undoubtedly has triggered plethora of sensations and even awakened feelings when seeing them, there is evidence about it provoking amazement, curiosity, interest, and it has even lead to reflection, creating a stimuli of being able to touch, and want to go out in search of the species shown in the places where the article assures they can be found, similar affirmations are present in the following comments: "*... now that I am watching this, well it is quite incredible how certain organisms can have these structures, it makes one curious to study and learn more about them*" (Interviewee 1). "*It made me want to go to the forest and find it*" (Interviewee 7).

Figure 6 shows the coincidences in terms of emotions and sensations experienced, being amazement the feeling with the most presence. The next places belong to curiosity and interest; some of them expressed feeling excited and others found a place to reflect when seeing the information. It is worth mentioning that some interviewees had an awakening in terms of feeling as if they could touch and see the specimen physically. It is also crucial to emphasize that every interviewee was able to feel, whether in a high or low degree, the aforementioned range of emotions.

Figure 6
Visualization of emotions and sensations experienced by students



The figure shows the generation of a pleasant experience within participants, who can associate what they see with relatable feelings, while also connecting said emotions with their senses like sight and touch, triggering the intention to physically verify what was graphically displayed.

The morphological features of a species, when shown in the illustration, allow the process of getting to know about it to be structured and simple, which was perceived as useful and attractive for users, some of their comments are cited below:

"Wow! I had not seen them, it is fun to see, their fluffy leggies make me curious and amazed" (Interviewee 2).

"Having three species from which I can compare similarities and differences is, like, wow!" (Interviewee 3).

They also expressed the morphological structure has complex attributes, allowing them to look at ecosystems through a different lens: *"It helps to see how complex are the beings that inhabit our surroundings, many times we ignore them despite being very important, there is the importance of ecosystem protection all over the world"* (Interviewee 8).

One of the advantages of illustrations is that they can show visual information that enhances experience: *"... it looked very well illustrated to me, it has the features of Pseudoscorpions, I liked the map, the trunk in decomposition and the pine bark"* (Interviewee 6), the same enhancement can be perceived when playing with sizes and showcasing small beings with a higher clarity, which provided the following comment: *"Yes, they are really, like, very small, here in the picture they can be seen with higher detail, I like everything, its morphology, structure and it made me feel like, an exciting feeling, and wanting to know more about them"* (Interviewee 9).

Some users commented not only about feelings, but also about the sensations they felt when interacting with the scientific plate:

> It is like, I want to take them with my hands and check how their pincers feel in the skin, its serrated claw in the fourth leg amazed me, just like its pincers, it made me curious about the strength they have to grab things, I feel happy and curious about if I will find them one day (Interviewee 12).

This is key, these sensations are triggered because of the emotions generated from the interaction with visual materials.

Next, an analysis and discussion of findings will be developed, based on the stablished theoretical framework for this research, in order to interpret and identify the contributions of the project.

Analysis and Discussion

One of the contributions of this research project is gathering evidence related to the utility of Alicia model, which indeed turned out to be efficient to manage specialized information. Such affirmation is confirmed by the documented case of the scientific plate on pseudoscorpions for the biology area tackled during the project, always striving for clear and accessible communication, if not for these qualities, it would be even more difficult for people to interact with plates in the way it was observed through interviews. Besides, adding ethnography allows for a better understanding of the user, opening the possibility to offer a proper and emotive product (Gallo, 2022).

Another contribution involves the reassessment of plates as knowledge triggers, especially through emotional processing, where the affective factor makes it easier to approach and acquire specialized information. The results certainly did yield the involvement of emotional experiences, which tend to generate pleasant and positive sensations.

At this point, it is imperative to understand students' profiles to comprehend the real value of the registered experiences during interviews, since these students are constantly exposed to several types of images and experiences born from the visual, and more specifically, because of their vocational profile, a considerable portion of their academic life so far has involved contact with visuals related to science. Von Zeipel (2015), dives into this phenomenon, and asserts that, the higher the level of scientific education we are in, the more complex, sophisticated and saturated the illustrations students can access will become, which is undoubtedly a key factor to consider since there are several cognitive processes that have to be performed to process said images.

In accordance with the aforementioned, it is remarked that, despite the students' background and capacities, the plate successfully created a wide range of emotions and sensations among interviewed students. Said event, as discussed in the previously reviewed theory section, signals the existence of potential to generate significative learning experiences.

Learning is developed and reinforced through experiences triggered from emotions and sensations, each contributes specific information that will be later interconnected and associated to open a path for new knowledge, which at the same time modifies behavior and the connection with previous experiences, tying new ones with the objective of amplifying the acquired knowledge (Velásquez Burgos et al., 2009).

It can be inferred that students have interiorized the fact that reading materials from their academic field tend to include heavy textual information (interviewees 4, 5, 11 and 12), resulting in tiredness and mental fatigue. And whenever a routine-breaking picture appears, and if it has a direct relation with the topic discussed along the text lines, an enhanced perception of what was read now is more interesting than before is created. This phenomenon is correlated with the visual culture

present in daily life, which prizes images as means to understand the world (Bratash & Galaktionova, 2021; Pauwels, 2008).

Within this process, experience guided by scientific knowledge is easier to comprehend because of images, since the visual information gained through recreation, imagination and emotions create neuronal connections that transform into knowledge and learning, thus, pleasant experiences transmitted thanks to playful methods will be favorable for specialized concept learning, since they promote positive emotions that stimulate memory (Velásquez Burgos et al., 2009).

It is due to the previously discussed facts that plates can turn into a visual experience, featuring two main functions: the first being tied to utility and the second to emotion, which is highlighted when analyzing comments from participants 1, 3 and 10, as well as the expert teacher, who remarked the value of illustrations as a tool to communicate and sharing, besides amplifying knowledge, as well as attracting *attention and being entertaining*.

The playful element becomes a mediator of the educational process, since it boosts information retention, triggering reflection capabilities, while also creating a restriction-free environment, turning this process into an enhancement of human experience, where meaning is built and provides formative elements in favor of specialized knowledge for people (Borjas et al., 2019).

This experience enhancement is appreciated in the wide range of viewpoints collected in the category of Playful Experience, where results yielded data ranging from sensorial evocation (interviewee 12) and varied emotions (interviewees 2, 6 and 9) to cognitive reactions that call to action in a specific way (interviewees 3, 7 and 8); which can be considered as the biggest finding from this study, since generally the process of reading science is associated to objectivity and rationality, however, by including images, the emotional effect amplifies the interaction with science, humanizing this process, creating a certain degree of empathy that impacts information acquisition and allows it to be retained in memory, facilitating the process of getting in contact with information, and developing scientific thinking, which reinforces the reported insights by Borjas et al (2019), and Rocca Baez (2021).

Yet another contribution of this research is, precisely, contributing evidence in regards of how visual products possess a triggering component for pleasant, sensorial perceptions (Sauer & Sonderegger, 2022), said evidence can be considered as playful experiences, and these experiences can be used to promote science teaching and learning through plates and scientific illustrations. Another aspect worth considering is that plates will present a higher impact if they are developed under the guidance of a design model that emphasizes the principles of Information Design, since proper content management reduces ambiguity and

paves a path for an innovative development that understands the performance requirements of users.

It was observed that users require visual information along with academic texts to clearly understand information which, by itself, is complex and hard to interpret, which is why scientific plates display a potential to become tools that link people with specialized knowledge.

Conclusions

A visual tool like the scientific plate, produced by following the Alicia model and emphasizing Information Design, is capable of establishing a connection with the user in a way that impacts their emotions and makes information memorable.

The scientific plate is highly valuable in the biology field, allowing knowledge to become tangible, identifying species and triggering curiosity, as well as the needed interest to keep researching and discovering, whether it is through academic texts or field exploration.

During tests, the visual experiences born from plates proved to be quite notorious, yielding sensorial reactions and a showcase of emotions, impacting the perception in regards of scientific content, becoming more interesting than before, and allowing people to link it with significative learning.

The scientific illustrations available within specialized texts employed for the plates, are of considerable utility for the biology scientific community, whether it is in terms of communication among colleagues or sharing their research to everyone, alleviating the learning process of a rather complex topic. Granting this method a playful factor adds even more value to plates, going beyond monotonous concepts to approach science, and instead providing pleasant and attractive activities meant to be enjoyed and entertaining, while learning something new and interesting at the same time.

Qualitative research served to widen the perceptions regarding playful effects of scientific plates in academic texts belonging to the Biology area. As for the limitations, it is true that participants were reduced to a group within a specific geospatial region. On the other hand, new research paths have been identified, such as analysis of scientific plates on different areas of knowledge like physics, chemistry, engineering and social sciences, as well as studying with deeper detail the breadth and specificity of emotions experienced by people when interacting with science plates.

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