

IMAGES AS A DIDACTIC RESOURCE

IMAGENS COMO RECURSO DIDÁTICO

IMÁGENES COMO RECURSO DIDÁCTICO



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ABSTRACT

This study addresses the use of digital images as a didactic resource in higher education, focusing on the Faculty of Accounting and Administration at the Autonomous University of Querétaro, San Juan del Río campus. Faculty data are analyzed, and a review of methodologies and results from related research is also conducted. The research is exploratory-descriptive in nature and is grounded in Mayer's cognitive theory of multimedia learning, as well as principles of visual design and media literacy. A tool based on Google Colab is proposed, which allows the extraction of color palettes from thematic images, the consideration of emotion-based color palettes, and the generation of new educational images through artificial intelligence. It can be concluded that the application of images—by extracting color palettes and incorporating emotions—enhances the semantic and emotional value of images, which can help improve students' cognitive attention skills, facilitate the emotional communication of content, and promote deeper image interpretation.

Keywords: Images. Didactic Resource. Education. Media Literacy. Color Palette.

RESUMO

O presente estudo trata do uso de imagens digitais como recurso didático no ensino superior, com foco na Faculdade de Contabilidade e Administração da Universidade Autônoma de Querétaro, campus San Juan del Río. São analisados dados da faculdade, bem como metodologias e resultados de pesquisas relacionadas. A pesquisa é de caráter exploratório-descritivo e fundamenta-se na teoria cognitiva da aprendizagem multimídia de Mayer, além de princípios de design visual e alfabetização midiática. Propõe-se uma ferramenta baseada no Google Colab que permite extrair paletas de cores de imagens temáticas, considerar paletas de cores associadas a emoções e gerar novas imagens educativas por meio de inteligência artificial. Conclui-se que a aplicação de imagens, ao extrair paletas de cores e incorporar emoções, potencializa o valor semântico e emocional das imagens, o que pode contribuir para melhorar a capacidade cognitiva de atenção dos estudantes, facilitar a

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comunicação emocional dos conteúdos e promover uma leitura mais aprofundada das imagens.

Palavras-chave: Imagens. Recurso Didático. Educação. Alfabetização Midiática. Paleta de Cores.

RESUMEN

El presente estudio se refiere al uso de imágenes digitales como recurso didáctico en educación superior, enfocándose en la facultad de contaduría y administración de la Universidad Autónoma de Querétaro campus San Juan del Río, se analizan datos de la facultad y también se hace un análisis de metodologías y resultados de investigaciones relacionadas. La investigación es de tipo exploratorio-descriptiva y se fundamenta en la teoría cognitiva del aprendizaje multimedia de Mayer y en principios de diseño visual y alfabetización mediática. Se propone una herramienta basada en Google Colab que permite extraer paletas de colores de imágenes temáticas, considerar paletas de colores de emociones y generar nuevas imágenes educativas mediante inteligencia artificial. Se puede concluir que la aplicación de imágenes al extraer paletas de colores y proponer emociones, potencia el valor semántico y emocional de la imagen, lo cual puede ayudar a mejorar la habilidad cognitiva de la atención en el estudiante, facilitar el mensaje emocional de contenidos y crear una lectura más profunda en las imágenes.

Palabras clave: Imágenes. Recurso Didáctico. Educación. Alfabetización Mediática. Paleta de Color.

1 INTRODUCTION

In the context of higher education, particularly in the Faculty of Accounting and Administration, didactic resources such as reading, the creation of exercises with numbers, as well as the use of images are used. Although the latter to a lesser extent.

The use of digital images as a teaching resource has great potential and importance, as well as a great impact on communication. Even though the impact on visual and emotional communication is very important, this resource is still not used as necessary. This research proposes to explore several aspects, such as the color palette, the emotions that are transmitted, the license of use, its integration into learning objects through artificial intelligence tools and even ethical aspects.

Despite the ease of access to didactic technological resources in education, the use of digital images is still limited or misused. In the Faculty of Accounting and Administration, images are used in presentations, but not necessarily with a clear pedagogical intention or based on design principles, cognitive or emotional principles.

The digital image has great potential to activate and improve cognitive processes, however, in teaching practice the use of color palettes, the emotional charge or the ethical impact of these images are almost not taken into account.

In a digital environment with so much visual information, it is important that learners are able to improve their media literacy knowledge and skills and have better critical thinking in each visual message.

Currently there is a lot of visual manipulation and fake news, which promote issues of politics, education, economics, etc., which are often based on ideologies or objectives of interest to a certain sector of the population. If these skills are improved, manipulation can be mitigated and over time can help students better interpret these messages and also have more meaningful learning.

2 THEORETICAL FRAMEWORK

2.1 BACKGROUND AND DEFINITIONS

In recent years, digital images in educational environments have become very important in improving content comprehension and retention. Studies have shown that visual design influences learning, especially when elements such as color palettes, composition, and symbolism are used to convey emotions. This makes it easier to interpret, understand, and retain information. A review of different research is made, with their results, methodologies, concepts and everything related to the digital image in the educational context.

2.1.1 Types of images

There are different types of images today, as well as different categories according to their use or purpose. Mainly there are images for free use and images with a license for use, in the educational field images for free use are sufficient. As for the format of images, jpg and png images are the most recommended for this study.

2.1.2 Psychology and use of color

The perception of color is influenced by the context and geographical place where a group of people is located and this can vary according to the culture, history and traditions of each place. Colors can trigger memories, emotions, and associations related to the same place of origin (Sánchez G., 2024).

Sánchez quotes (Bestley & Noble, 2018, p. 37) "the intelligent selection of color palettes and color combinations can be employed to create a design that is aesthetically pleasing to the viewer." When thinking about visual communication, it's worth choosing a color palette that's suitable. For example, creating an advertisement or PowerPoint presentation for a class session at school.

2.1.3 Color in education

The use of color is very important, remember that there are great theories about the use of color, both pedagogical and psychological. We may not always take it into account, but it is also important to consider it in the educational field.

Some research has found that 80% of the information that is processed by the user on the internet comes from sight, on the other hand, the excessive use of color can cause visual fatigue, the balance has to be found for the use of color (Canté, 2017). Canté quotes Embry (1984), "color accelerates learning from 55% to 78%".

2.1.4 Equity in didactic images

It is also necessary to carefully choose the images that are going to be used as a teaching resource, promoting diversity and inclusion.

2.1.5 Manipulative and non-manipulative teaching resources

A manipulative didactic material is that element used by teachers as a resource for learning based on obtaining knowledge through interaction with it, they are physical objects such as blocks or puzzles (Ruiz, 2019). Interactivity is very important, nowadays students have stopped being passive and tend to interact and manipulate didactic material. Non-

manipulative teaching resources are passive or abstract resources, such as texts, videos, audios or software. Various studies have shown positive effects when using manipulative and non-manipulative teaching resources (Reinoso, Córdova, Chillan, Méndez, & Bernal, 2024)

2.1.6 The Imaging Cognitive Tool

Visual organization is one of the best study techniques, the use of concept maps, diagrams, comparative charts and mind maps helps to structure the information and facilitates the review López, *et al.* (2018). This can be used in a face-to-face session, remotely or even in material such as homework and class complement.

One of the main cognitive skills we use when learning is attention. "Perceiving, memorizing and learning are actions that need attention" (Boujon & Quaireau, 2004). Many static or interactive resources such as various web-based applications or video games allow interaction and we can improve attention. A very famous website that helps improve cognitive skills and specifically attention.

2.1.7. Emotions in education according to the psychology of color

Choosing the right images is important in a teaching resource, but the color palette is also important. For example, in the design of a PowerPoint presentation or the main colors of a mind map. López, *et al.* (2018), state that emotions intensify the activity of neural networks and strengthen synaptic connections, which facilitates learning. Neurobiology shows that learning is better when content has emotional components.

If the wrong emotion is communicated, it can affect student performance, emotions such as anxiety, fear, or anger can sabotage attention span and affect working memory (Lopez, *et al.* 2018).

2.1.8 Data privacy

Platforms may use images of students or something else that may be part of an ethical and legal issue. Normally any institution manages several policies and some of them include a policy on their main website where personal data and images are secured, even so, it can be communicated to students.

Nissenbaum (2009) mentions the importance of contextualizing information and the need to establish guidelines on informed consent in educational settings. These precautions ensure that the use of images does not infringe on the integrity or rights of the participants.

2.1.9 Machine Vision

What is computer vision? "It is a scientific discipline made up of a set of techniques that allow the capture, processing, and analysis of images" (Domínguez, 2022).

2.1.10 Google colab

Google colab is a web-based tool that can help us to do statistical analysis, as well as practices based on artificial intelligence and artificial vision. This web-based application allows you to work with code instructions in Python, upload files in different data formats to manipulate them and without the need to use our computer resources, you can make calculations or obtain the results of various statistical tests. On the other hand, it also allows you to create artificial vision applications that in this case can analyze images and even generate new ones, by connecting to the "stable diffusion" library.

One of the main features is that cloud servers are used and the use of resources and response time depends on that. In comparison, if you use other applications such as "R studio", you would be using your own equipment and resources that usually increases the response time.

2.1.11 Media literacy

The existence of multimedia devices in our daily lives is undeniable, the younger generations have a special interest in new media and new ways of approaching information. (Gutierrez, Tyner, & Austin, 2012)

Fedorov (2011), refers to the definition of UNESCO documents, which refers to all types of media, texts and graphics, sounds, images of all kinds and through any technology. Contemporary media literacy can be defined according to Gutierrez, Tyner, & Austin, (2012) as:

The process of development of the personality influenced by the media and that occurs based on the material produced by them, which aims to modulate the culture of interaction with the media, the development of creative and communicative skills, critical thinking, the perception, interpretation, analysis and evaluation of media material and the teaching of different forms of personal expression with the use of media technology. Given the importance of media such as television, video games or the Internet in the informal education of children and young people, it would be unthinkable for schools to remain oblivious to the influence of the media.

There are formal and informal means of information and many of these are difficult to filter, at some point they reach a receiver. It is about understanding how the media works, how they influence society and how they can be used critically and responsibly.

2.1.12 The Science of Learning: Determining How Multimedia Learning Works

This article by Mayer (2009) reviews 15 principles of multimedia instructional design that are based on more than 200 experimental studies in the theory of text and graphic learning.

The author explains that learning is more effective when words and images go together in some teaching material, rather than separately. It has a theory based on 3 assumptions:

1. The dual-channel assumption: The human brain processes information through two separate cognitive channels. One is for visual and pictorial information, while the other is for auditory and verbal information. This means that graphics, animations, and on-screen text are processed differently than spoken narration or sounds.
2. The Limited Capacity Assumption: These cognitive channels have a limited ability to process information at a certain time. If too much information is presented at once, the student could experience cognitive overload, which would not allow them to be effective in learning.
3. The active processing assumption: Students must actively participate in cognitive activities rather than be passive, in order to construct new knowledge. These activities include:
 - Select: Pay attention to the most relevant words and images.
 - Organize: Mentally structure the selected words and images in verbal and pictorial models that are coherent.
 - Integrate: Connect these new models to each other and to the student's pre-existing knowledge in long-term memory.

Mayer (2009) clarifies that the use of visual elements in the PEA facilitates the construction of meanings.

Images not only fulfill a decorative objective, but also have a cognitive objective, favoring critical thinking.

The author also mentions that it is based on the CTML (Cognitive Theory of Multimedia Learning). Instructional material designers have developed principles to minimize irrelevant cognitive load, manage essential processing, and thus encourage generative processing.

Within these principles there are some very important ones such as:

The use of arrows, symbols, or headings to direct students' attention, the use of storytelling with images to take advantage of both communication channels, presenting the images with their description at the same time, breaking down long lessons into smaller parts, introducing concepts and keywords before the main lesson to reduce cognitive load, use a conversational tone that gives the feeling of social interaction.

2.1.13 Functions of the digital image in education: a methodological proposal for the writing and reading of the digital image on instructional screens

This research by Azzato (2011) is based on Richard Mayer's cognitive theory of multimedia learning, which proposes that humans learn best when words and images are combined, respecting certain design principles such as: multimedia (combining text and image to improve learning and that they are also synchronized), avoiding irrelevant elements and visual overload, Spoken narration is better than written text, and low-achieving students benefit more from good multimedia design.

In this study, a quasi-experimental design was made with control and post-test groups to pedagogy students of the University of Barcelona, creating 3 e-books with logic content, each with different characteristics, Lm (multimedia book):

- Lm1: with significant multimedia markings (following Mayer's principles).
- Lm2: with abstract multimedia markups (they do not follow the principles).
- Lm3: No media markups (text only).

In the results, there were actually no statistically significant differences in comprehension between the three groups, although abstract Lm2 was the least understood, while Lm1 did not have a clear advantage over Lm3. The students rated the books positively for their use and interactivity.

Assessment instruments were also created, such as prior knowledge about digital imagery, perception of the usefulness of the image in education, and willingness to apply the methodology in other contexts.

In this research, not all the hypotheses such as the advantages of Lm1 over Lm3 could be confirmed, but the importance and power of digital imaging as an educational tool is highlighted.

2.1.14 Effects of Adding Illustrations to Texts on Students' Science Achievement: A Meta-Analysis

This article by Lei, Chen, Chiu, Fang, & Ding, (2025), presents a meta-analysis of 63 studies conducted over five decades, with data from 7,621 students to evaluate the use of illustrations in scientific texts and how it influences students' academic performance.

The teaching material is diverse and a good part is of the textual type, which actually works quite well, especially for a person who has a better understanding of texts. Although there is also a lot of material that could need an illustration; teachers can improve science learning by carefully selecting appropriate illustrations to accompany texts (Lei, Chen, Chiu, Fang, & Ding, 2025).

Main findings found in the article:

1. Adding illustrations improves performance in science: The average effect was positive ($g = 0.232$), indicating that students learn better when illustrations are included in the text.
2. Factors that increase the positive effect:
 - Countries with higher national income.
 - Cultures that accept risk and have short-term orientation.
 - Students of higher grades.
 - Organizational illustrations (such as flowcharts or pictorials).
 - Black and white illustrations.
 - Texts that explain causes and effects or make comparisons.
 - Assessments that measure understanding and knowledge transfer.
3. Factors that do not influence: The means of evaluation (paper vs. computer) does not affect the result.

The authors recommend that teachers carefully select the illustrations that accompany texts, as they can facilitate learning, reduce cognitive load and improve students' memory.

2.1.15 Fake news: an opportunity for media literacy

The article by Fernández (2017) has as one of the central themes fake news, which is not a new phenomenon, but it does change the information landscape and represent a current social problem. Some social media platforms have become the main source of information and these have influenced policy issues. Facebook and Google have been criticized for allowing the spread of fake news, although they have already begun implementing measures to combat it.

Platforms have emerged in more than 50 countries to verify the veracity of this news, highlighting the importance of teaching citizens and especially young people to critically evaluate this information. Many of these fake news have the format of digital images and transmit emotions in addition to the false information itself.

3 METHODOLOGY

An exploratory-descriptive research was carried out and was based on Mayer's cognitive theory of multimedia learning and on principles of visual design and media literacy. A tool based on Google Colab is proposed that allows extracting color palettes from thematic images, considering color palettes of emotions and generating new educational images using artificial intelligence.

In the first part of the research, a questionnaire was applied to students of the Faculty of Accounting and Administration of the Autonomous University of Querétaro.

Type of research: Exploratory – descriptive.

Population and sample: According to the UAQ planning department (UAQ, 2024), the bachelor's degree in Public Accounting has a total of 287 students, in an age range mainly from 20 to 24 years old. The sample size is 164, with a confidence level of 95%.

Table 1

Students of the Bachelor's Degree in Public Accountant

Semester	Age Range					Total
	19-	20-24	25-29	30-34	35+	
1	41	5				46
2	9	9				18
3	27	19	5			51
4	1	14		1		16
5	2	33	1		1	37
6		12	1			13
7		33	3			36
8		21	1			22
9		35	11	2		48
Total	80	181	22	3	1	287

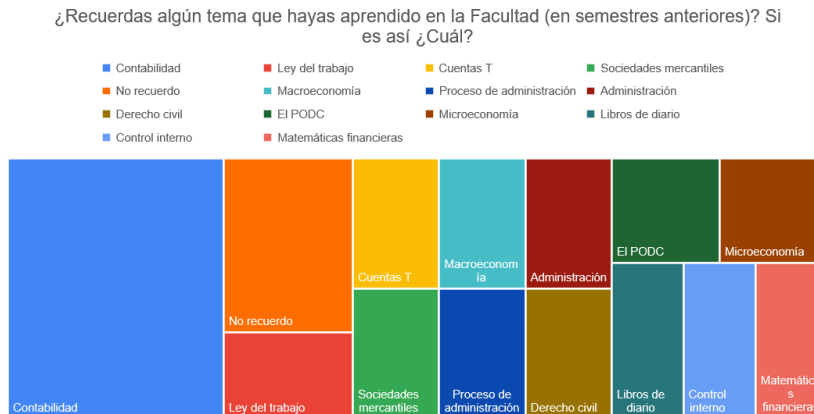
Source: UAQ-2024 Planning Department

3.1 FCA STUDENT QUESTIONNAIRE

A questionnaire was applied to students in the Public Accountant career in the Faculty of Accounting and Administration and these are some of the results obtained:

Figure 1

Do you remember any subject you learned in college?



Source: Questionnaire question no. 1

Figure 2

In the topics that you have remembered from the previous questions, were images included?

En los temas que hayas recordado de las preguntas anteriores ¿Se incluyeron imágenes?

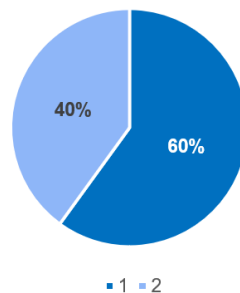
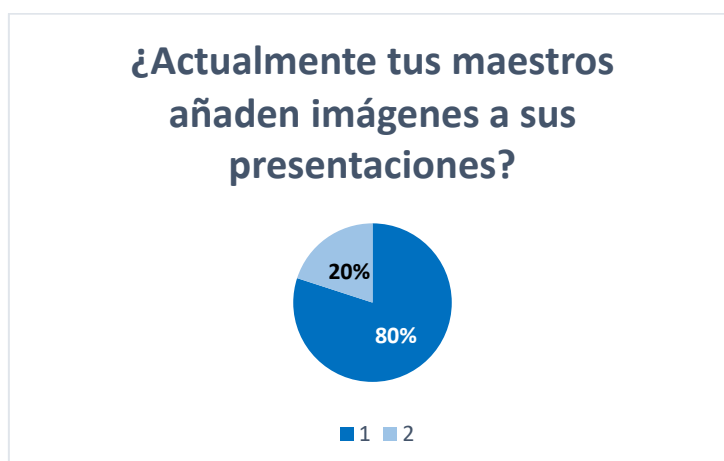


Figure 3

Do your teachers currently add images to their presentations?

**Figure 4**

Do you think you tend to remember a subject better when there are images?



In question 1, several possible answers were raised, while in questions 2, 3 and 4, the answer options were 1) Yes, 2) No.

4 RESULTS AND DISCUSSIONS

4.1 RESULTS OF APPLIED SURVEYS

According to the group of students from the Faculty of Accounting and Administration who formed the sample of this study, it was noted that images are actually used in presentations (PowerPoint), being one of the most used teaching resources. The students themselves consider that the use of images helps them to better remember a topic, however, the results show that it is not significant and this may be due to the profile of the students surveyed, but it may also be related to the fact that the teacher does not make use of the appropriate images that generate a notable impact on the students. Mayer (2009) states that

students achieve deeper learning when information is presented through images and words simultaneously, rather than just using words.

On the other hand, there are manipulative (physical) and non-manipulative (abstract) didactic resources, the latter being the ones to which the images referred to above belong. The quasi-experimental study by Reinoso et al (2024), suggests that manipulative resources have a significant positive impact at least on basic education students, this study is also based on the learning of mathematics. It might probably be good to combine them for the faculty of accounting and administration because of their nature in the use of numbers.

In question number 4, where they are asked if they tend to remember a topic better when images are used, the highest answer was NO, and surely this is due to the profile of students who are Accounting students and work much more with numbers

Following mainly the methodological proposal of Azzato (2011), where the author considers the digital image as an instructional message with educational intention, an application was developed in Google Colab that allows extracting color palettes from images (related to a theme) and reusing them in learning objects. This tool seeks to reinforce the visual and emotional coherence of the content, aligning with Mayer's (2001) principles of multimedia cognitive design.

The digital image, as Azzato proposes, must be read and written with functional criteria. This application proposes a form of visual writing based on color, where each palette communicates specific emotions in which it is possible to add new palettes of emotions manually. These can be used to reinforce concepts, motivate the student or facilitate understanding. The above, of course, taking care of the ethical aspect.

An application prototype with the following functionalities is proposed:

- Automatic image analysis using artificial vision techniques.
- Extracting color palettes from the same images
- Propose new color palettes, allowing you to select an emotion to convey
- Create new images based on all of the above

Here is the source code:

4.2 PROPOSAL FOR A PROTOTYPE OF IMAGE ANALYSIS

4.2.1 Part 1: Generating a Color Palette from a Group of Images

Figure 5

Generating a Color Palette from a Group of Images

```

Parte1 Generación de paleta de colores a partir
de un grupo de imágenes

• pip install colorthief
• # ✦ Paso 1: Importar librerías necesarias
• from PIL import Image
• import matplotlib.pyplot as plt
• import io
• import os
• import requests
• import base64
• from google.colab import files
• from colorthief import ColorThief # Added this line back
  
```

Source: The authors.

Figure 6

Step 2 in Color Palette Generation

```

# =====
# ✦ Paso 2: Subir imágenes y generar paleta base
# =====
•
•
• uploaded_files = files.upload()
• all_colors = []
  
```

Source: The authors.

4.1.2 Part2. Generation of emotional palettes

Figure 7

Generation of emotional palettes

```

Parte2. Generación de paletas emocionales

# =====
# ✦ Paso 2: Paletas emocionales
# =====
•
•
• paletas_emocionales = [
• "alegria": [(255,225,0),(255,105,97),(255,179,71),(144,238,144)],
• "tristeza": [(54,0,79),(3,138,180),(100,149,237),(174,196,222)],
• "enfermedad": [(34,139,36),(60,179,113),(132,251,152),(107,142,35)],
• "suena": [(255,0,127),(255,182,193),(199,21,133),(255,105,180)],
• "tristeza": [(25,25,112),(72,61,139),(123,104,238),(0,0,0)]
• ]
  
```

Source: The authors.

Figure 8

Mixing Both Paddles

```

• =====
• # ✦ Paso 4: Mezclar ambas paletas
• # =====
•
• paletamezclada = []
• for i in range(6):

```

Source: The authors.

4.1.3 Part 3. Generating a new image

Figure 9

Generating a New Image

```

Parte 3. Generación de una nueva imagen
• =====
• # ✦ Paso 5: Generar imagen con Stable Diffusion (modelo actualizado)
• # =====
•
• # Pide un tema
• tema = input("✎ Ingresar el tema a tratar: ")

```

Source: The authors.

5 CONCLUSION

The use of didactic material with images improves learning unless the student may have a greater sensory, auditory or kinesthetic inclination. Even so, it is proposed to use text and images at the same time, as proposed in other research. The didactic resource of the image analysis application that is proposed is manipulative, the student and the teachers will be able to interact.

On the teacher's side, these types of resources could be more difficult to prepare, but they are the most effective. Adding characteristics based on color theory also allows you to transmit some emotion in students and you will be able to get very complete learning instruments or objects.

On the other hand, several methods can also be combined, such as a WebQuest in which students are asked to send an image related to the topic to be studied and analyze these images to create other images based on those provided.

It is of utmost importance that the teacher carefully chooses the images to be used Lei, Chen (2025). The same is proposed within the procedure to create new images and color palettes.

When digital images are integrated into learning objects, apart from improving the experience, it also helps to strengthen media literacy.

The part of the prototype for analysing images that extracts colour palettes and proposes new colour palettes to convey an emotional impact, opens up the possibility of creating materials that go beyond informing, if it is proposed that learning objects can be created that transmit an emotion, but also that educate in the criticism of the visual part.

Teach students to identify how visuals can be used to manipulate emotions and create misinformation.

If we talk about teachers now, we could mention that it is important to be aware when designing educational images and contribute to forming citizens who are more critical and resistant to media manipulation. A culture of critical thinking can be fostered in the digital world.

The digital image not only accompanies the text, it also activates cognitive processes that in turn allow for more effective and meaningful learning.

The application of image analysis, by extracting color palettes and proposing emotions, enhances the semantic and emotional value of the image. This can help improve the cognitive ability of attention in the student, facilitate the emotional message of content and create a deeper reading in the images.

Work is currently being done on the application of the questionnaire to the other bachelor's degrees taught in the Faculty, Bachelor's Degree in Administration and Bachelor's Degree in Business and International Trade, in order to make a comparative table of the answers and thus obtain new results, considering new student profiles.

The software that is proposed for the generation of color palettes in the images, is of own elaboration (in the images presented, only the first part of each step is present), it is currently in the process of registration with indautor and would be made available to teachers to provide them with course presentations with images based on the generation of color palettes. It has currently been used by the research group and the students to whom it is taught.

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