THE EFFECT OF A BLENDED LEARNING COURSE OF VISUAL LITERACY FOR IN-SERVICE TEACHERS

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ABSTRACT

Aim/Purpose	The purpose of this study was to examine the effects of a 20-hour blended learning visual literacy course applied to in-service teachers. For this purpose, we designed the course to train the educators and the instrument to measure the level of visual literacy of participants before and after the intervention. Then, we found the differences.
Background	Visual literacy is essential for improving visual communication skills on in-service teachers because they use and construct visual material permanently. Hence, they need to be trained for developing visual literacy taking into account their pace of life and specific needs.
Methodology	We employed a quasi-experimental one-group pretest-posttest design. The area of study is Social Science, specifically Education. The population was in-service teachers who work in private schools in the north zone of Quito, Ecuador. The convenience sampling method was used to conduct this pilot study of 51 teachers at one private school. The visual literacy course was designed based on the ACRL Visual Literacy Competency Standards. The differences in the level of visual literacy were measured through a visual literacy test of 45 items made for this specific purpose. Differences between pretest and posttest were found after performing paired samples t-test on collected data.

Contribution	This research contributes to visual literacy research focused on in-service teacher's instruction. This practical study was based on a complete proposal for training and evaluated the visual literacy level of in-service teachers.
Findings	Findings show that there are statistically significant differences in pretest and posttest scores, so teachers improved their level of visual literacy after the 20-hour blended learning visual literacy course.
Recommendations for Practitioners	Practitioners should adapt the length of the training course to the teachers' schedules. They should review the course themes and the items in the visual literacy test to know about the specific content to be taught along the course.
Recommendations for Researchers	Researchers who want to replicate a similar study should have a bigger group of participants and, if possible, they should have a control group.
Impact on Society	This study indicates that teachers could improve their level of visual literacy after attending a well-structured training course. Thus, it is crucial to offer in-service teachers the opportunity to improve their visual communication skills through a concrete learning process adapted to their schedules and life.
Future Research	Future research should focus on evaluating before and after the treatment, through practical projects, the previous and acquired knowledge of in-service teachers.
Keywords	visual literacy, teacher training, blended learning, in-service teachers

INTRODUCTION

Visuals are incorporated in all printed and digital teaching and learning material, so students perceive visual messages constantly, even when they are not conscious about this fact. This requires teachers to be aware of the visuals' impact on learning because they permanently elaborate instructional material with a myriad of images, and "it is important to design visuals that do not mislead or confuse" (Yeh & Cheng, 2010, p. 244) students. However, the lack of teachers' abilities to communicate through visual language could derive from a bad selection of images and a poor design on visual instructional material. This happens because teachers did not develop skills for effective visual communication when they were pre-service teachers (Aberšek, 2008), despite the fact that visual literacy "improves the teaching and learning process"(Box & Cochenour, 1995, p. 32), is "the most crucial for education"(Kędra, 2018, p. 69) and "it must be learned"(Avgerinou & Pettersson, 2011, p. 8) for learners of the twenty-first century (Avgerinou, 2009; Brumberger, 2011; Hattwig et al., 2013; Kędra, 2018). Thus, it is necessary to develop visual literacy abilities for in-service teachers because they are facing multiple educational contexts where they have to know how to communicate effectively with students through visual language.

Through the years, research on visual literacy has been widely focused on issues of teaching and learning for students (Brumberger, 2019; Sánchez et al., 2019), but there is a need of research about visual literacy interventions for in-service teachers. Indeed, from an international perspective, one of the main gaps in knowledge about visual literacy is precisely the instruction and testing integral intervention for practicing educators. This need for pedagogical research is extended to the local context of this pilot study, where there were no interventions in this field for training pre-service or in-service teachers. This area of research was identified by Brumberger (2019) in her mapping about visual literacy research. Here, the author states that pedagogical research has to focus on new learners, so this study focuses on in-service teachers. As it was mentioned, the most essential members of the educational community have to become visually literate (Aberšek, 2008; Begoray, 2002; Lundy & Stephens, 2015) in order to enhance their teaching practice. However, an intervention requires clear learning

objectives and methods for assessing (Kędra, 2018). What will be the best content to design a visual literacy course in order to develop visual competences for in-service teachers?

The Association of College and Research Libraries (ACRL, 2011) presents the "ACRL Visual Literacy Competency Standards for Higher Education" that "provide a comprehensive framework for teaching visual literacy skills" (Hattwig et al., 2013, p. 68) on tertiary education. Clearly, the *Standards* develop the set of abilities described in the ACRL visual literacy definition:

> Visual literacy is a set of abilities that enables an individual to effectively find, interpret, evaluate, use, and create images and visual media. Visual literacy skills equip a learner to understand and analyze the contextual, cultural, ethical, aesthetic, intellectual, and technical components involved in the production and use of visual materials. (Association of Research and College Libraries, 2011)

Scholars acknowledge ACRL *Standards* as the foundation (Matusiak et al., 2019) and "the most extensive and tangible set of visual literacy abilities" (Brumberger, 2019, p. 12) to develop a proposal of a well-structured and effective visual literacy instruction. Thus, in this research, the blended learning course of visual literacy for in-service teachers was designed following ACRL *Standards*. In addition, a visual literacy test was created to assess in-service teachers' visual literacy competency before and after the course. The purpose of this pilot study was to examine the effects of the intervention applied to in-service teachers. Consequently, this paper reports the differences between the visual literacy pretest and posttest scores through quantitative analysis. The authors want to contribute to the visual literacy pedagogical research focused on in-service teachers' instruction. The blended learning course and the test of visual literacy stand as a concrete proposal for this purpose.

LITERATURE REVIEW

VISUAL LITERACY TRAINING FOR IN-SERVICE TEACHERS

Specific literature about in-service teachers' training and evaluation of visual literacy shows that authors recognize the need for visual education, but there is not a clear and well-structured proposal of how they should be trained.

Box and Cochenour (1995) found in their pilot study that visual literacy was acknowledged as a need for teachers. Their research showed that there were no specifics courses in visual literacy for teachers, and it is a field not appreciated or included in teacher professional education. However, visual literacy is deemed as an important skill for improving the teaching and learning process (Box & Cochenour, 1995). At that time, authors offered insight about the situation. Some years later, Betty Noad (2005) investigated the way "teachers were teaching about visual images and texts" (p. 343). She concluded that teachers' understanding of the functioning of visual texts and the teaching of visual literacy helps them to shift from written text-based teaching to visual and multimodal text-based teaching. While this study did not have a structured training in visual literacy, it is evident that teachers are aware that they need to learn how to teach about visual and multimodal texts. This study exposes that teachers face problems teaching in a contemporary context because they have neither visual literacy nor multi-literacies training (Noad, 2005). Similarly, Billie Eilam (2012) found that research about visual literacy has focused very little on teachers' role in learning with visual representations. In fact, teachers have a lack of ability in using visuals, so they cannot take advantage of them in the teaching and learning process. The author points out that visual literacy expertise must be acquired through a well-organized training based on theoretical foundations, and teachers' preparation for visuals tasks is an essential part of the complex teaching profession (Eilam, 2012). Up to this point, in different periods, it ratifies the need for visual literacy programs in teachers' education, and the need for teachers' training when they are already in-service.

Harrison Yang (2013) presented a proposal in which he adapted and implemented an integrated approach named STEP (scaffolding, transaction, evaluation, and presentation) into a graduate course

for developing visual literacy skills for students who attended the program. The STEP approach conducted students through four stages in order that they achieve a learning goal, which was a group project that could be a poster or a presentation. By making one of these, students showed the visual literacy skills that were acquired. In this research, "standards of visual literacy were deliberated and introduced" (Yang, 2013, p. 222) to help them to have a foundation about visual literacy. The assessment of this intervention was made through a survey about the seven standards and ninety learning outcomes of ACRL's (2011) Visual Literacy Competency Standards for Higher Education. This study shows a self-perception about the participants learning; the participants were aware of their own learning during the visual literacy instructional approach, but this approach did not offer a concrete set of themes for which to design a visual literacy course, and it did not show the level of visual literacy.

Finally, Prisca Rodríguez Cruz (2014) observed teachers' choices, as resources and methods, when they incorporate visuals in technology-enhanced environments. She detected the teaching practices for fostering visual thinking, learning, and communicating with students. As a result, the author indicates that visual literacy has not been taught and teachers apply previous experiences for their teaching practice. She presents the Visual Spiral Framework (VSF) that supports teachers to teach explicit visual literacy to students (Rodriguez Cruz, 2014). This study reveals the imperative need for visual literacy training for in-service teachers. The VFS framework has been taken from teachers' practices, but once again, it is not a proposal of visual literacy in-service teachers' training.

Previous research uncovered and ratified the need for a concrete and clear visual literacy proposal to help in-service teachers to develop visual literacy skills, which have to be evaluated through a visual literacy test that shows a clear measurement of their acquired competences.

VISUAL LITERACY APPROACH

Visual communication is maybe the most essential for human beings because it includes facial expressions, body language, and all visuals (Velders et al., 2007). From birth, most people understand and learn the world around them with the assistance of vision, and it is easier to communicate through graphics before learning how to write and read. In particular, visuals say something instant, like a flash (Díaz Jiménez, 1993), and they have a different meaning for each person. This fact awakened scholars through the years, because it seemed vital to learn how to read images and to develop abilities for visual communication. Hence, visual literacy is not a new idea (Pettersson, 2015).

Visual literacy, as a concept, might go back to Plato or Comenius's time (Velders et al., 2007), and as a description is 50 years old since Debes (Fransecky & Debes, 1972) presented his first definition, which is also presented by the International Visual Literacy Association (IVLA). "Visual Literacy refers to a group of vision-competencies a human being can develop by seeing and at the same time having and integrating other sensory experiences. The development of these competencies is fundamental to normal human learning" (Fransecky & Debes, 1972, p. 6). Starting with Debes' original definition, several researchers from different disciplines built their own based on their experiences and personal perception. However, all the theoretical pieces were not useful to build a single and big definition, even though each carries substantial knowledge to the concept (Avgerinou & Pettersson, 2011). Thus, there is no consensus to visual literacy definition in published literature, and it is considered a competence (Encabo Fernández & Jerez Martínez, 2013; Fransecky & Debes, 1972), a set of skills (Ausburn & Ausburn, 1978; Hattwig et al., 2013; Kędra, 2018) and an ability (Braden & Hortin, 1982; Felten, 2008).

All of these terms "are used invariably and interchangeably" (Avgerinou, 2009, p. 29). Kędra (2018) argues that there will not be any agreement with respect to visual literacy definitions because it is a multidisciplinary field. Meanwhile, Pettersson (2015) thinks it is hard to describe verbally a nonverbal concept, and Avgerinou and Ericson (1997) point out that there are as many definitions as scholars who researched about visual literacy. Indeed, over the years visual literacy definitions incorporated

new language and indicated transformations about what does it mean to be visually literate (Hattwig et al., 2013). Technological changes, the increase of interdisciplinary image usage and the importance of visual media as a communication tool in contemporary culture (Hattwig et al., 2013) were decisive.

In this perspective, Anne Morgan Spalter and Andries van Dam (2008) mentioned the requirement of digital visual literacy for individuals because they need skills to create and understand types of visual information made by computers. The reason was clear, visuals saturate people not exclusively from printed material or television, but from screens on web sites, digital signage, and digital devices. Additionally, scholars were worried because people had to face a myriad of digital information on media and they did not have enough skills to interpret them. Unconscious perception effects had to be minimized through a visual literacy intervention that helps people to make an analytical and critical judgment of visual content (Ortega Carrillo & Fernández de Haro, 1996).

In the field of education, researchers and scholars pointed out that teachers and learners should know how to produce visual material. Extreme caution about the use of copyrighted visual material available on the Internet (Bleed, 2005) was undoubtedly a concern of that time and a reason to argue that visual literacy is an essential competence for 21st century (Aberšek, 2008; Avgerinou, 2009; Brumberger, 2011; Hattwig et al., 2013). On this line, it was imperative to educate young people — and also adults— about the proper use of visual content with copyright law restrictions because they need to know how to operate legally in the digital sphere and how to create content using the work of others (Palfrey et al., 2009).

These give us insight about "the close link of visual literacy with the techno-cultural phenomenon" (Ausburn & Ausburn, 1978, p. 292) statement formulated since this field started to be investigated. Visual literacy has evolved along with information and communication technology because "visual images become the predominant form of communication" (Lundy & Stephens, 2015, p. 1057), "news modes of communication use much more than written text" (Emery & Flood, 2019, p. 11), and modern communication technology is still highly and strongly visually oriented (Ausburn & Ausburn, 1978; Hattwig et al., 2013).

While arguments and definitions continued to increase, Pettersson (2015) compiled a list from 1969 to 2013, of more than a hundred authors who have presented some visual literacy definition. It was clear that the need for promoting visual literacy in the education field was the origin of many definitions and, thus, constant research. Thus, Kędra (2018) suggests "to close the debate over the concept and to do something about its implementation in education" (p. 71). A not new statement, Fransecky and Debes (1972) have already suggested performing concrete actions to achieve an understanding of visual literacy.

The ACRL (2011) responded to scholars suggestions with the Visual Literacy Standards for Higher Education, a complete proposal to define a visually literate person as someone who is able to "effectively find, interpret, evaluate, use and create images and visual media" (p. 1). The ACRL standards are a set of abilities that define performance indicators and learning outcomes (Hattwig et al., 2013) to implement a visual literacy teaching and assessing intervention. The seven standards complement the Information Literacy Standards for Higher Education, and it is a clear scheme to help students to become visually literate. Hence, ACRL standards were used in this study to build the blended learning visual literacy course.

BLENDED LEARNING COURSE OF VISUAL LITERACY

According to ACRL, use and implementation of standards is flexible and does not follow a linear structure, so it is possible to choose standards depending on discipline, "curricular needs and overall learning goals of a program or institution" (Association of Research and College Libraries, 2011, p. 2). Thus, ACRL standards 1 to 5 were selected and the instructor of the course chose only the performance indicators and learning outcomes considered suitable to promote a level of visual literacy

measurable in a short period. In order to make explicit competency-based learning, learning competencies were set for each standard. The themes proposed were based on design principles and conceptual topics for education of graphic designers, and were chosen according to the learning outcomes (See Appendix A).

The schedule and time to develop the visual literacy course were established by the school's authorities taking into consideration the teachers' work schedule. Hence, the intervention was structured as a blended learning course because it is one of the most suitable practices for training them. In fact, this format is more flexible (Sommer & Ritzhaupt, 2018) in terms of timetables and periods for carrying out activities outside the classroom. Moreover, blended learning instruction preserves the richness of the face-to-face class and it offers asynchronous support and tutoring on-line. Thereby, this proposal was a blended learning course of 20 hours in 4 days (14 hours face-to-face and 6 hours online). The two face-to-face classes lasted 7 hours each day and the two on-line classes lasted 3 hours each time.

The instructor selected carefully the activities for the blended learning course of visual literacy in order to achieve a fusion of the best and most appropriate face-to-face and on-line activities, and to respond to the educational needs of the course (Vaughan et al., 2013). Thus, face-to-face classes were addressed by combining the presentation of the themes with practical activities such as case studies and individual and collaborative tasks, which were to be carried out at that time. On-line sessions were conducted via Blackboard Collaborate. The instructor assisted participants via email, Messenger, and Whatsapp. The guidelines about the course were given through the local educational platform Idukay. Several resources were used during the course: the teaching in real-time with the support of slides on each topic, the *Visual* mobile app (Huilcapi-Collantes et al., 2019), some mobile apps for image editing, and some websites such as Unsplash and Pixabay. A variety of useful web content was accessed from different browsers via the participants' mobile devices and laptops. Themes were not presented to teachers in the linear order that shows in Appendix A. See the schedule of the course in Appendix B.

METHOD

This quasi-experimental one-group pretest-posttest design studies the effects of a training course on visual literacy for in-service teachers who were involved in it. The study area of this research is Social Science, specifically Education, so the population is in-service teachers that have finished their tertiary education. They work in private schools that offer all levels of education in the north zone of Quito Metropolitan District. Researchers used a convenience sampling method for conducting this pilot study. Hence, the sample was all of the 51 in-service teachers who worked in one private school. The institution offered this blended learning instruction as part of their professional teachers' training program, so no teacher could be excluded from the process. Researchers had to give the treatment to all teachers (Knapp, 2016), so a control group by random assignment was not possible to establish (Shadish & Luellen, 2006) due to the formative nature of the study.

RESEARCH QUESTION

The research question investigated in this study is:

- Do in-service teachers improve their visual literacy level after attending a 20-hour blended learning visual literacy course?

SAMPLE

The 51 participants were teachers of Mathematics, Nature Science, Social Science, Language, etc. from Early Education to Unified General Baccalaureate level. According to the local educational system, there are 3 levels of education, Early Education for children from 3 to 5 years of age, Basic

General Education for students from 5 to 15 years of age, and Unified General Baccalaureate for students from 15 to 18 years of age. It was essential that in the sample there were not pre-service teachers. Throughout the treatment, three participants did not attend all of the sessions. Just 43 teachers took the posttest. Thus, participants who took the pretest but not the posttest were not included in the data analysis. None of the participants had taken a visual literacy course before. From valid responses (n=43), nine (21%) are male and 34 (79%) female. Figure 1 shows participants age and percent.

Age group		n
25 - 29 years old		6
30 - 39 years old		23
40 - 49 years old		7
50 - 59 years old		7
Total		**43**
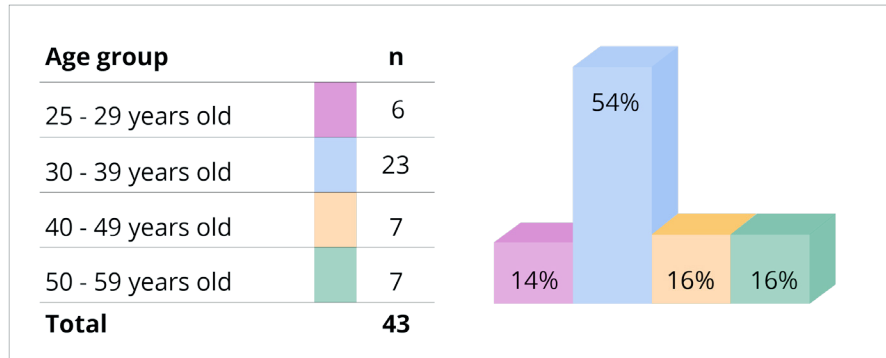
Figure 1. Participants' age

VISUAL LITERACY TEST AND DATA COLLECTION

A visual literacy test was designed to measure the differences in the level of visual literacy of in-service teachers after the treatment, so it served as a pretest and posttest. Teachers took the pretest the first day during the face-to-face class, and they took the posttest 5 days after, when the on-line activities were finished. The questions are in line with the different themes that were presented to teachers, so the test evaluates the different learning outcomes. There is a set of questions for each learning competency. Test questions were multiple choice and most of the questions required that participants analyze or make an evaluation of an image, a poster, or a slide depending on what learning outcome was being evaluated. See test items examples in Figure 2.

13. Do you agree that this symbol can be used with students of any school level?

○ Yes, because students of any age can understand an image.
○ Yes, because it is a worldwide symbol and any student knows its meaning.
○ No because students learn the meaning of symbols according to age.
○ No because this image does not represent a reality and nobody can understand it.

23. Sharpness of a digital image is determined by the amount of _____ per_____.

○ pixels - inch
○ picas - inch
○ bites - centimeter
○ points - inch

Figure 2. Example of test items

The visual literacy test had 45 items and each question was worth 1-point (correct) or 0-point (incorrect), so the test was worth 45 points. The participant's total score was the sum of the number of correct selected-response items. The visual literacy test was validated by five judges under three criteria: validity, clarity, and relevance (Hernández Ramos, 2014). The authors chose two profiles of judges: some that were visual communication university teachers or related educational fields, and others that were senior graphic designers. Criteria, in both cases, was that they excel in knowledge about the content taught in the visual literacy course. Once judges' suggestions were applied on the test, we asked 34 volunteers who were pre-service teachers, in-service teachers, and graphic designers to answer it. After collecting all responses, a validity test based on item difficulty was performed. P-values were between 0.21 and 0.97, so items below 0.25 and above 0.70 were reviewed and reconstructed in order to have an optimum difficulty level. Items above 0.85 were left to verify. Once the test was re-structured, it was created on-line in Google Forms. Responses were automatically collected and were downloaded to analyze with SPSS software version 25. Processing data was anonymous. See the whole visual literacy test in Appendix C.

DATA ANALYSIS AND RESULTS

First, we performed descriptive statistics of pretest and posttest scores. Table 1 shows that the posttest mean (21.8) is higher than the pretest mean (18.5), and the median value also increases on the posttest. On pretest the distribution is slight right-skewed, while on posttest is slight left-skewed, and both distributions are platykurtic.

Table 1. Distribution of pretest and posttest results

	n	$\overline{X}$	Mdn	Sx	As	Curt
Pretest	43	18.5	18	4.28	0.27	-0.99
Posttest	43	21.8	21	6.47	-0.03	-0.79

Then, we performed the Kolmogorov-Smirnov normality test on difference and applied parametric hypothesis test because p-value indicates that difference comes from a normal distribution (Z=0.075; p-value=0.200). We used paired samples t-test and the significance level was set to 5%. The p-value (0.001) of the test is inferior to 0.05, so we reject the null hypothesis of no difference between the means (H_0: $\mu_{Postest} = \mu_{Pretest}$). There are differences between pretest and posttest scores (See Table 2).

Table 2. Kolmogorov-Smirnov normality test and t-test results

Normality test (K-S)	t-test
Z=0.075; p-value=0.200	t=-3.657; p=0.001

The box plot in Figure 3 displays the visual literacy course effects on participants. The pretest box plot is comparatively shorter than the posttest. It means that pretest scores are slightly more concentrated around the mean (18.5) with scores ranging from 12 to 27 (15-point range), while the posttest scores spread from the mean (21.8) with scores ranging from 9 to 35 (26-point range). The long whiskers on the posttest shows that there are lower and higher scores after treatment. In fact, the posttest minimum score is 3 points lower than the pretest, and the posttest maximum score is 8 points higher than the pretest. In addition, results show that in the posttest 25% of in-service teachers are above the maximum score of pretest (27 points). Inter-quartile range of posttest is almost at the same level of pretest median; it suggests that more than 50% of in-service teachers hold better scores on the posttest. There are not outliers.
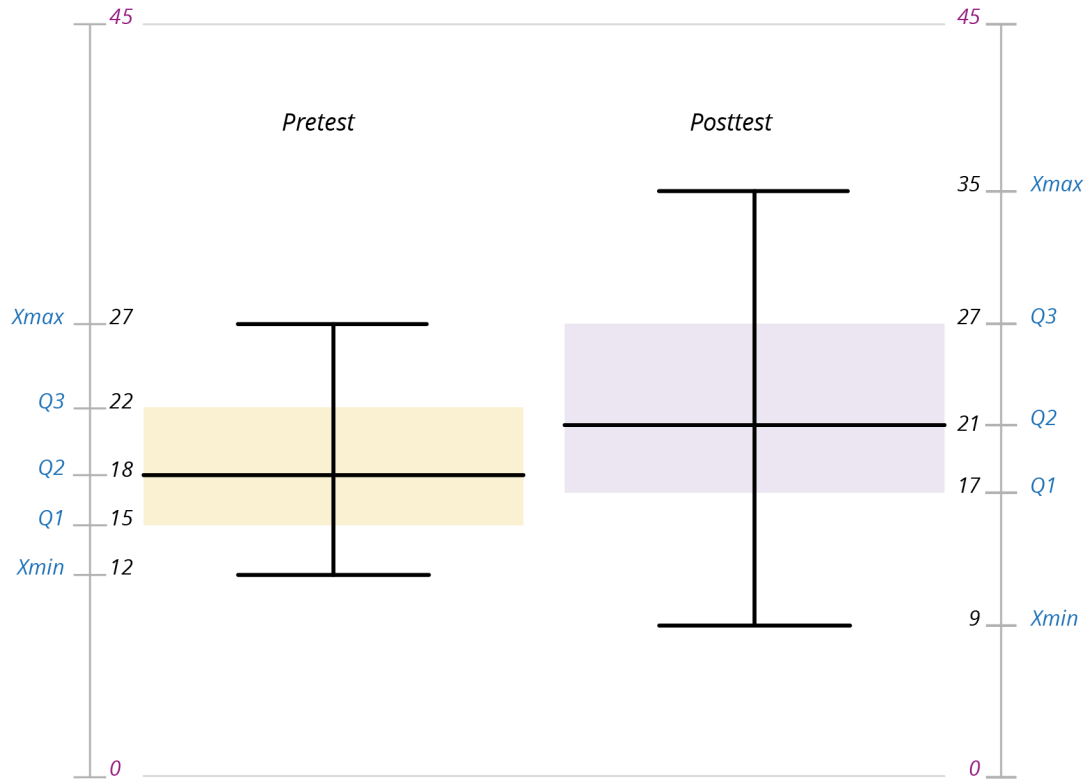
Figure 3. Visual literacy effects on participants.

The results show that there are statistically significant differences in the pretest and posttest scores which indicate some improvement in the level of visual literacy of the educators, considering the length of the course. This improvement reveals that the intervention is suitable and it has a potential as a visual literacy training course. However, there is not enough information to value the blended learning visual literacy course as an absolutely successful intervention where participants mastered all themes. Figure 3 makes evident an unexpected effect of the treatment on some participants, there are low scores in the posttest.

DISCUSSION

The blended learning course of visual literacy was designed based on ACRL Visual Literacy Competency Standards to train in-service teachers and to help them to develop visual literacy abilities. The proposed structure of the course focused on helping in-service teachers become visually literate persons who are able to "find, interpret, evaluate, use and create images and visual media" (Association of Research and College Libraries, 2011). The intervention was adapted to in-service teachers' schedule and the school calendar set by the school's authorities. Thus, this pilot study investigated whether in-service teachers could improve their visual literacy level after attending the 20-hour blended learning visual literacy course. We emphasized designing a well-structured course and an instrument in order to measure the differences in the level of visual literacy of participants before and after the treatment. However, we did not know how different the pretest and postest scores would be because this is the first intervention of this kind.

The findings show that pretest and posttest scores are different, so the research question is affirmative. On the posttest there is a better maximum score and from the third quartile to maximum there are the same or higher scores than the pretest maximum (27 points). Additionally, after treatment,

scores from Q2 to Q3 are higher than the pretest median. It allows us to affirm that at least 50% of in-service teachers showed a better level of visual literacy. However, findings make us cautious in stating that our proposal was absolutely successful because findings showed that some teachers had a lower score in the posttest. Possibly, the acquired knowledge, which comes from a field that in-service teachers are not used to, made them doubt their empirical knowledge. Furthermore, it is remarkable that any in-service teacher did not reach the highest score. Kędra (2018) says that learners can perceive visual literacy as too complex to acquire. The scores could be related to the length, and the intensity of the course. Hence, these variables could be influencing the result, so these require more attention for future studies and replications.

The results uncovered that teachers had an empirical knowledge about visual communication and digital images because no one had the minimum test score (0 points). It could happen, because, in the digital age and visual world, teachers consume and produce visual communication (Matusiak et al., 2019) in their personal and professional context by using tools that facilitate building visual products. Unquestionably, it helps them to feel familiar with terms and content related to digital images. Moreover, it is important to remember that six test items that have a p-value above 0.85 were left to verify. Thus, in order to complement this study, previous and acquired knowledge of in-service teachers could be evaluated in practical projects before the pretest and after the posttest respectively. "Creating effective posters and presentations require developers to have solid visual literacy skills" (Yang, 2013, p. 221).

Through this pilot study, the authors respond to the gap in knowledge about visual literacy research focused on in-service teachers. Indeed, this implementation in education could be a new starting point to study new learners, and different learning and delivery methods, scheduling and levels of guidance (Oficina Internacional de Educación, 2016) in teaching visual literacy.

Finally, it was not possible to have a control group by random assignment, and the sample size was small for generalization of results. We suggest that future studies take into account these limitations.

CONCLUSION

The main interest of this study was to design a research project that offered a concrete proposal for visual literacy training for in-service teachers and a tool for evaluating their level. Undoubtedly, ACRL Visual Literacy Standards were the most significant guide and "starting points" (Brumberger, 2019, p. 12) to implement this visual literacy intervention. Moreover, the visual literacy test was a valuable tool to measure the understanding of the themes of visual literacy course which are in line with the learning outcomes and standards. As Brumberger (2019) suggests, it is necessary to offer pedagogical research through a complete proposal for teaching and evaluating visual literacy abilities. In addition, this study has focused on contributing to a practical study, from which it is clear to recognize what a visually literate person is able to do. In fact, results suggest that participants could improve their level of visual literacy in a short period of time. Finally, it contributes to visual literacy research focusing on teaching in-service teachers, whose need for visual literacy development has been highlighted by researchers through the years.

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APPENDIX A. USE OF ACRL STANDARDS IN THE VISUAL LITERACY COURSE.

ACRL Standard		Competencies	Performance Indicators	Learning Outcomes	Themes
1	1	Define and articulate the need for an image to a project.	1.The visually literate student defines and articulates the need for an image.	a. Defines the purpose of the image within the project (e.g., illustration, evidence, primary source, focus of analysis, critique, commentary).	The role of visual images in digital age.
2	2	Find and access the needed images and visual media for a project effectively and efficiently.	1. The visually literate student selects the most appropriate sources and retrieval systems for finding and accessing needed images and visual media.	a. Identifies interdisciplinary and discipline-specific image sources.	Search visual images, database visual images and reliable sources. Advanced search for images in Google.
				c. Recognizes how the image search process is affected by image rights and use restrictions.	
				e. Selects the most appropriate image sources for the current project.	
3	3	Interpret and analyze the meaning of images and visual media for developing learning material.	2. The visually literate student situates an image in its cultural, social, and historical contexts.	b. Examines the purposes and meanings of an image in its original context.	Perception of visual images.
			3. The visually literate student identifies the physical, technical, and design components of an image.	d. Examines an image for signs of editing, alteration, or manipulation (e.g., cropping, color correction, image enhancements).	
4	4	Evaluate the effectiveness and reliability of images as visual communications.	1. The visually literate student evaluates the effectiveness and reliability of images as visual communications.	a. Evaluates how effectively an image achieves a specific purpose.	Meaning, analysis and interpretation of visual messages.
				b. Assesses the appropriateness and impact of the visual message for the intended audience.	The cognitive impact of the visual message.
				c. Critiques persuasive or manipulative strategies that may have been used in image production to influence interpretation.	Rhetorical strategies to communicate with visual language. Persuasion through visual images.
				d. Evaluates the use of visual signs, symbols, and conventions to convey meaning.	*Repeated theme:* Meaning, analysis and interpretation of visual messages.
				e. Analyzes the effect of image editing or manipulation on the meaning and reliability of the image.	*Repeated theme:* Meaning, analysis and interpretation of visual messages. *Additional theme:* Image editing and manipulation to alter meaning.
	5	Evaluate the aesthetic and technical characteristics of images.	2. The visually literate student evaluates the aesthetic and technical characteristics of images.	a. Evaluates the aesthetic and design characteristics of images (e.g., use of color, composition, line, shape, contrast, repetition, style).	Design principles to elaborate instructional material with image-text integration. Typefaces and type contrasts.
				b. Evaluates the technical characteristics of images (e.g., resolution, size, clarity, file format).	Technical characteristics of images (e.g., resolution, size, clarity, file format.
5	6	Use images and visual media effectively to elaborate learning material.	1. The visually literate student uses images effectively for different purposes.	a. Plans for strategic use of images and visual media within a project.	Construction of a message with image-text integration.
				b. Selects appropriate images and visual media aligned with a project's purpose.	
				c. Integrates images into projects purposefully, considering meaning, aesthetic criteria, visual impact, and audience.	
				d. Uses images for a variety of purposes (e.g., as illustrations, evidence, visual models, primary sources, focus of analysis).	
				e. Uses images for subject-specific and interdisciplinary research, communication, and learning.	
			2. The visually literate student uses technology effectively to work with images.	a. Uses appropriate editing, presentation, communication, storage, and media tools and applications to prepare and work with images.	Image editing by using mobile apps and a free software photo editor.
				b. Determines image file format, size, and resolution requirements for a project, and converts images accordingly.	
			4. The visually literate student communicates effectively with and about images.	d. Includes textual information as needed to convey an image's meaning (e.g., using captions, referencing figures in a text, incorporating keys or legends).	*Repeated theme:* Construction of a message with image-text integration.
				e. Reflects on the effectiveness of own visual communications and use of images.	

APPENDIX B. SCHEDULE OF THE VISUAL LITERACY BLENDED LEARNING COURSE.

Day	Hours/Format	Theme
Day 1	1 hour/ Face-to-face	Course presentation and pretest.
	1 hour/ Face-to-face	The role of visual images in digital age.
	2 hours/ Face-to-face	Search visual images, database visual images and reliable sources. Advanced search for images in Google.
	1 hour/ Face-to-face	Technical characteristics of images (e.g., resolution, size, clarity, file format.
	2 hours/ Face-to-face	Image editing by using mobile apps and a free software photo editor.
Day 2	1 hour/ Face-to-face	Perception of visual images.
	1 hour/ Face-to-face	Meaning, analysis and interpretation of visual messages.
	1 hour/ Face-to-face	The cognitive impact of the visual message.
	1 hour/ Face-to-face	Rhetorical strategies to communicate with visual language. Persuasion through visual images.
	3 hours/ Face-to-face	Design principles to elaborate instructional material with image-text integration. Typefaces characteristics and type contrasts.
Day 3	3 hours/On-line	Construction of a message with image-text integration.
Day 4	3 hours/On-line	Construction of a message with image-text integration.
Day 5	On-line	Posttest.

APPENDIX C. TEST OF VISUAL LITERACY.

Note: The original language of this test was Spanish. It was translated into English for this manuscript.

Competence 1. Define and articulate the need for an image to a project.

Questions 1 and 2.

1. Reading is a _____ process that involves different languages and media, for this reason, an image could replace the text.
    o   Multiple
    o   Social
    o   Educational
    o   **Multimodal**

2. Within an educational project, what is the following image?
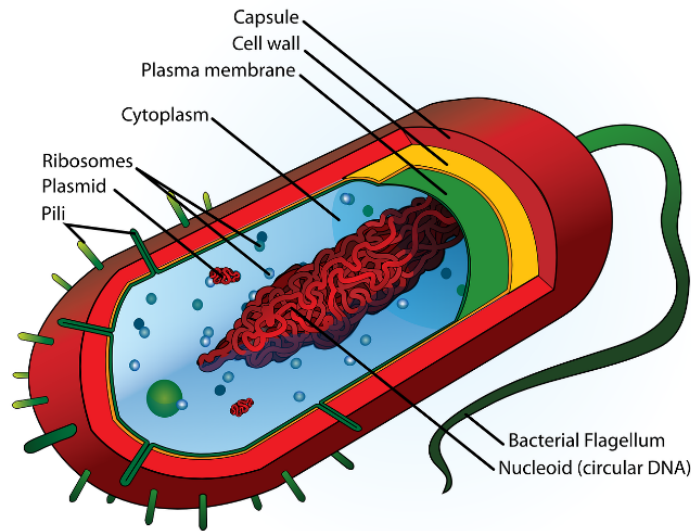
Source: Pixabay

    o   It is the focus of analysis about a fact that is not possible to observe with visual human.
    o   It is used to evidence a biological process.
    o   It is used to replace the text.
    o   **It is the primary source to know a reality that is invisible to the human eye.**

Competence 2. Find and access the needed images and visual media for a project effectively and efficiently.

Question 3

3. When can you say that free images searching for an educational project is effective?
    o   When searching on the Internet for images with Copyleft license.
    o   Only when looking for images that do not have Copyright in printed books or magazines.
    o   **When the ideal image is found with a Creative Commons Zero (CC0) license.**
    o   Only when buying images in interdisciplinary databases.

Competence 3: Interpret and analyze the meaning of images and visual media for developing learning material.

Questions 4, 5 and 6.

4. Why it is important to examine if an image was edited, altered or manipulated?

- o   Because you should not use edited, altered or manipulated images in teaching material.
- o   Because the signifier must not be altered.
- o   **Because it produces effects on the meaning.**
- o   Because an edited image hardly transmits an effective visual message.

5. What is the main analysis to be done on this image before using it for an educational project?

Source: Oladimeji Odunsi on Unsplash

- o   The image degree of iconicity.
- o   The image level of abstraction
- o   Sources of lightness and levels of shadows.
- o   **Purpose and meaning in its original context.**

6. It is vital to first analyze the _____ of an image that will be used in the teaching material because students _____ the images according to their _____ and _____.

- o   color - perceive- level of abstraction - details.
- o   degree of iconicity –understand– contrast – color harmony
- o   **significance – interpret – educational level - age**
- o   referent - interpret – interest – motivation

Competence 4: Evaluate the effectiveness and reliability of images as visual communications.

From question 7 to 13.

7. Do you agree that the following image is suitable for use in teaching material for school-age children to address any issue related to women?

Source: Maria Badasian on Unsplash

- o   Yes because you can use images with a low level of iconicity with school-age children.
- o   No because it is difficult to identify if the silhouette is feminine or masculine.
- o   **No because the visual message can have multiple interpretations.**
- o   Yes because images with a high level of abstraction are suitable for use with school-age children.

8. Do you think that the following image can be used to work in class with teenagers on topics such as teamwork and tolerance?

Source: Nathaniel Tetteh on Unsplash

- o **Yes because image has symbols that can be analyzed by teenagers.**
- o No because it is an image with too much abstraction and it is very complex to analyze it.
- o No because teenagers perceive better images with a high degree of iconicity.
- o Yes, because it is an image with a very low degree of iconicity, therefore it is easily understood.

9. An image is understood when _____

- o **its connotative meaning is discovered.**
- o the degree of iconicity is determined.
- o it is identified the type of visual sign it is.
- o its signifier is analyzed.

10. The image is a _____ that _____ the student to _____ the information.

- o abstract referent – discourages – memorize
- o visual element – induces - dissociate
- o **pedagogical resource – helps - remember**
- o icon element – incites – disaggregate

11. Do you think the following image is effective in transmitting a message about access to education?

Source: School London College of Communication. Client Pencils of Promise

- o No because a concrete reality is perceived only if the images are real.
- o Yes because the modified images always persuade about reality.
- o **Yes because it persuades the viewer about a concrete reality.**
- o No because a fictional image fails to persuade the viewer.

12. What visual rhetorical figure has been used in this image to persuade the viewer?

Source: Pixabay

- o Pun
- o Metonymy
- o **Ellipsis**
- o Anaphora

13. Do you agree that the following symbol can be used with students of any school level?

Source: Stoica Ionela on Unsplash

- o **No because students learn the meaning of symbols according to age.**
- o No because it is an image that does not represent reality and nobody can understand it.
- o Yes because students of any age can understand an image.
- o Yes because it is a worldwide symbol and any student knows its meaning.

Competence 5: Evaluate the aesthetic and technical characteristics of images.

From question 14 to 26.

14. Identify the type contrasts of typefaces in the following image.
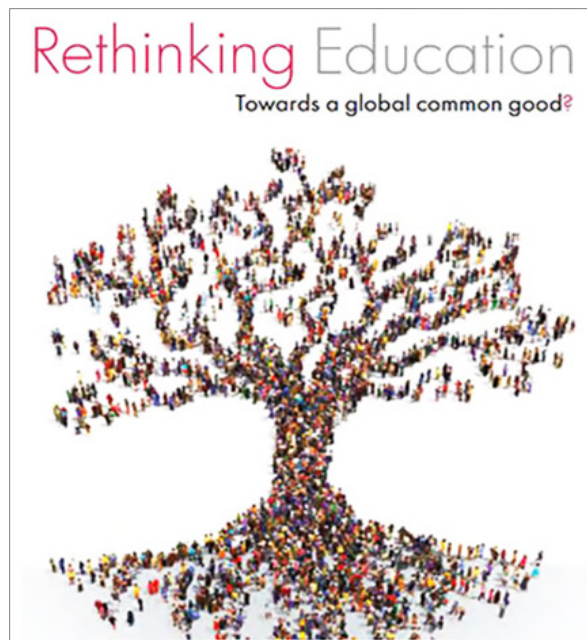
Source: UNESCO Credits of image cover page: © Shutterstock / Arthimedes

o   The contrasts of size and weight.
o   The contrasts of texture and color.
o   **The contrasts of color and size.**
o   The contrasts of weight and texture.

15. Evaluate the contrast of size of typefaces in the following image:
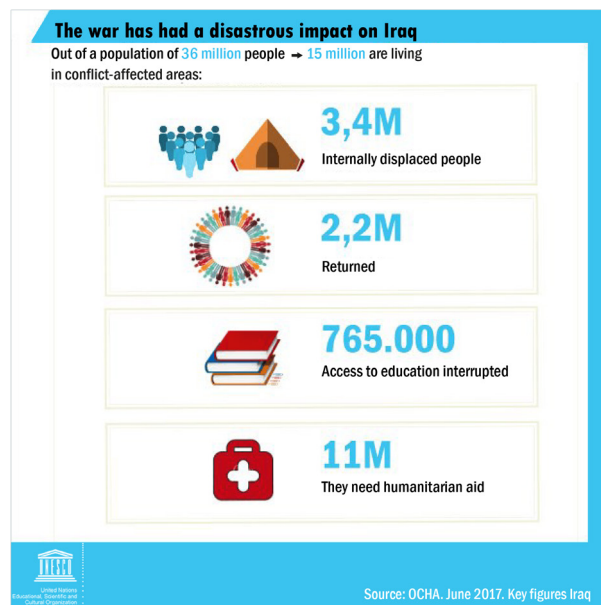
Source: Translated into English and adapted from a screenshot of the UNESCO twitter account.

- o It is poor because the blue and black contrast is not perceived.
- o **It is beneficial because it marks a hierarchy between different texts.**
- o It is irrelevant because the contrast of size is not perceived.
- o It is poor because the contrast should not be made when there are numbers.

16. What is the most important aspect to consider when choosing a typeface for making any digital teaching material?

- o Typography should have serifs and contrast of form.
- o Typeface should have bold to contrast of size.
- o **Typeface should be readable on the device.**
- o Typeface should be different from those used in printed books.

17. Identify the category of type of these typefaces:

Bodoni **Times Bold** **Onyx**
Fenice, Ultra **Walbaum**

Source: The non-designers design book by Robin Williams.

- o Sans serif
- o Slab Serif
- o **Modern**
- o Oldstyle

18. Identify the categories of type used in the title and paragraph of this slide.

**PROMOTE THE
DEPTH OF
THOUGHT AND
IMAGINATION**

"People lose the ability to engage
with reality; that is a process of
dehumanization that may be
gradual and silent, but very real."

Adolfo Nicolás, SJ.
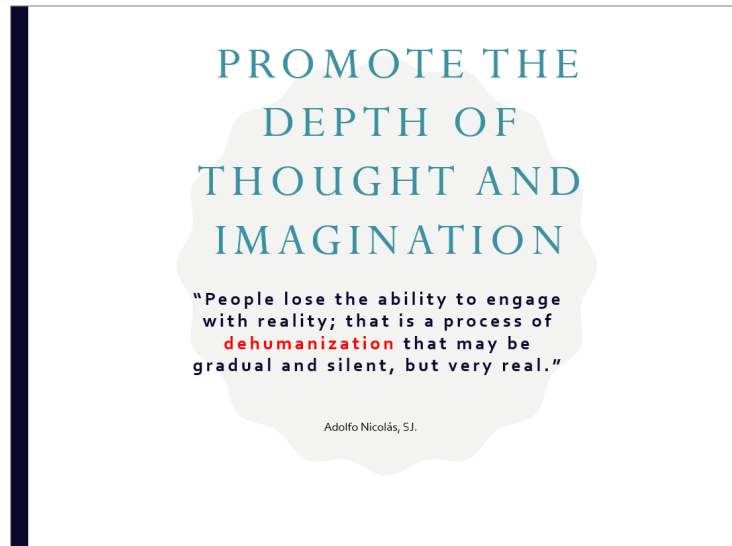
Source: Own elaboration.

- o **Modern and San Serif.**
- o Oldstyle and Modern.
- o San Serif and Oldstyle.
- o Slab Serif and Modern.

19. In the following composition, identify the category of type and type contrast used.
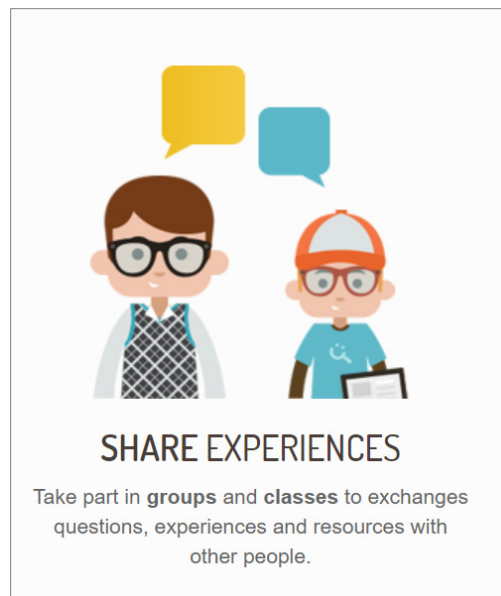
Source: Screenshot of "Tiching" website.

o   Category is Modern and there are contrast of structure, size and form.
o   Category is Sans Serif and there are contrast of weight, form and structure.
o   **Category is Sans Serif and there are contrast of size, form and weight.**
o   Category is Modern and there are contrast of size, structure and form.

20. In the following composition, identify the category of type.
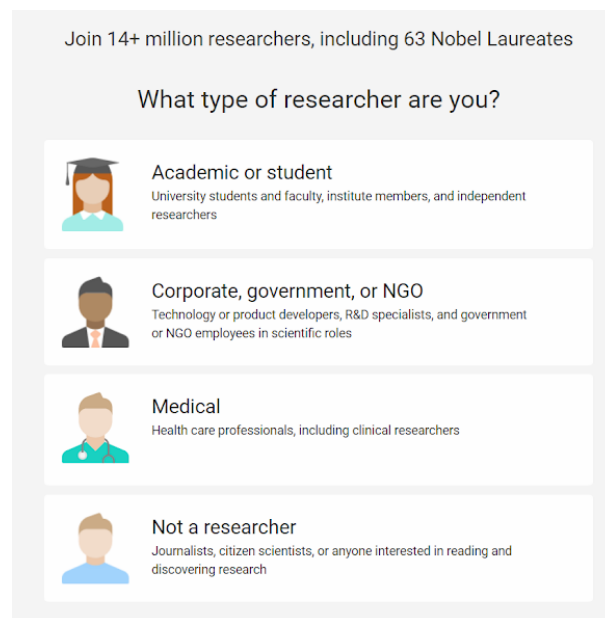
Source: Screenshot of the "Researchgate" website.

o   **Sans serif**
o   Modern
o   Oldstyle
o   Script

21. What are the features of the following typefaces:

Source: Own elaboration

- o Typefaces without serifs are perceived as the only formal and are the most readable.
- o Typefaces with serifs are perceived as modern, varied and dynamic.
- o Typefaces without serifs are perceived as classic, old and institutional.
- o **Typefaces with serifs are perceived as traditional, serious and formal.**

22. What is the extension of the image file you choose to find simple and static images with flat colors?

- o TIFF
- o **PNG**
- o PSD
- o JPG

23. The sharpness of a digital image is determined by the amount of _____ per____.

- o **pixels - inch**
- o picas - inch
- o points - inch
- o bites – centimeter

24. In a raster image, its weight depends on the amount of _____per_____.

- o points - centimeter
- o picas - inch
- o **pixels - inch**
- o bites – centimeter

25. Which extensions of image file support transparency?

- o PNG and JPG
- o JPG and BMP
- o **GIF** and **PNG**
- o PSD and JPG

26. When would you search for a vector image for an educational project?

- o When it will be used in subjects related to Sciences.
- o When an illustration with many details, textures, shadows, and colors is required.
- o When I need a smaller file size image with real details, such as a photograph.
- o **When I need a simple image with few details and flat colors.**

Competence 6: Use images and visual media effectively to elaborate learning material.

From question 27 to 45.

27. How does the alignment of each item influence the composition of the poster below?
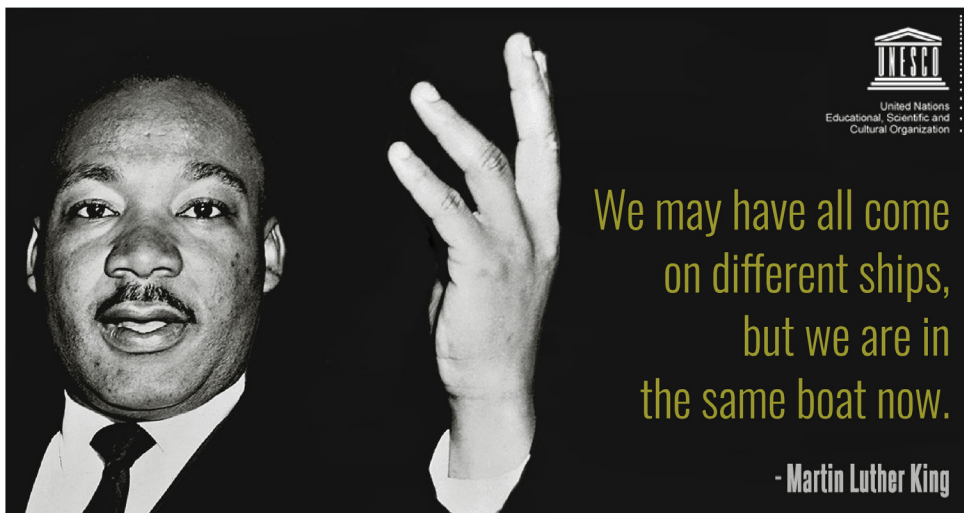
Source: Translated into English and adapted from a screenshot of the UNESCO twitter account.

- o   The left alignment is not suitable because it contrasts with the English/Spanish left-to-right system of writing and reading.
- o   Alignment generates readability problems on textual items.
- o   **Alignment creates a visual connection between items and thus creates unity.**
- o   The alignment catches the viewers' attention, so this avoids viewers to focus their attention on Martin Luther King image.

28. What design principle should be applied to relate the ideas on this slide?

Source: Own elaboration.

- o   Alignment
- o   **Repetition**
- o   Proximity
- o   Contrast

29. We want to emphasize the main idea in this slide. What design principle makes no sense to apply?

Source: Own elaboration.

- o Repetition
- o **Proximity**
- o Alignment
- o Contrast

30. How can the principle of proximity influence the visualization of information on this slide?

Source: Own elaboration.

- o It does away with the contrast between text blocks.
- o **It helps to organize the information in groups to visualize it better.**
- o It reduces the hierarchy between the title and the paragraphs.
- o It improves the readability of texts.

31. What is the problem with the font used in the paragraph of this slide?

Source: Own elaboration.

o It is unreadable because tracking has been adjusted.
o **It is unreadable because it is very heavy.**
o It is unreadable because the spacing is small.
o It is unreadable because the font is very small.

32. Evaluate the use of type on the following slide.
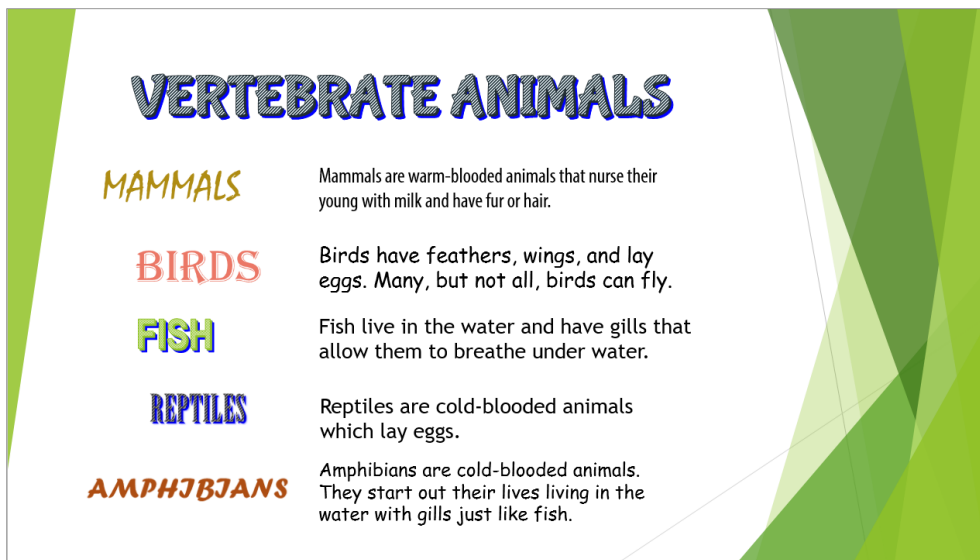
Source: Own elaboration. Information source: https://www.ducksters.com/animals/vertebrates.php

o It is unfavorable because there is no contrast or hierarchy.
o It is favorable because the use of different typefaces helps to capture the viewer's attention.
o It is favorable because the different typefaces provokes alternation in the content.
o **It is unfavorable because the use of different typefaces can be perceived as an error.**

33. What is the main problem of the image used on this slide?

Source: Own elaboration.

o   The image is pixelated.
o   The image has very little iconicity.
o   **The image lost proportions when it was scaled.**
o   The image has little contrast.

34. Analyze the next slide and choose the correct statement.

Source: Own elaboration. Images of slide were taken from Web to academic purposes.

o   Each image has a style that relates to a cultural context.
o   The images have the same connotation.
o   **Each image can have a different meaning for each viewer.**
o   The message is incomplete due to the absence of references for each activity.

35. Evaluate the text-image integration of the next slide taking into account the principles of design.

Source: Own elaboration.

o   It is misguided because there is no contrast of typefaces and the image has high iconicity.
o   It is misguided because there is a lack of contrast of typefaces, proximity, and details on the image are not perceived.
o   It is misguided because there is no proximity or repetition, and the image is not proportioned.
o   **It is misguided because there is a lack of contrast, alignment and the original image has been deformed.**

36. Analyze the typeface used in the paragraphs of this magazine and choose the correct statement.

Source: Downloaded from the UNESDOC Digital Library. https://unesdoc.unesco.org/ark:/48223/pf0000261279

- o Slab serif typeface helps readability because it generates space between characters.
- o Script typeface has simple strokes that help paragraph reading be smooth.
- o Modern typeface has no serifs, so it favors the readability of large paragraphs.
- o **Sans Serif typeface has no ornamental strokes, so it favors the readability of small size types and paragraphs.**

37. Analyze the typeface used in the title of this slide and choose the correct statement.
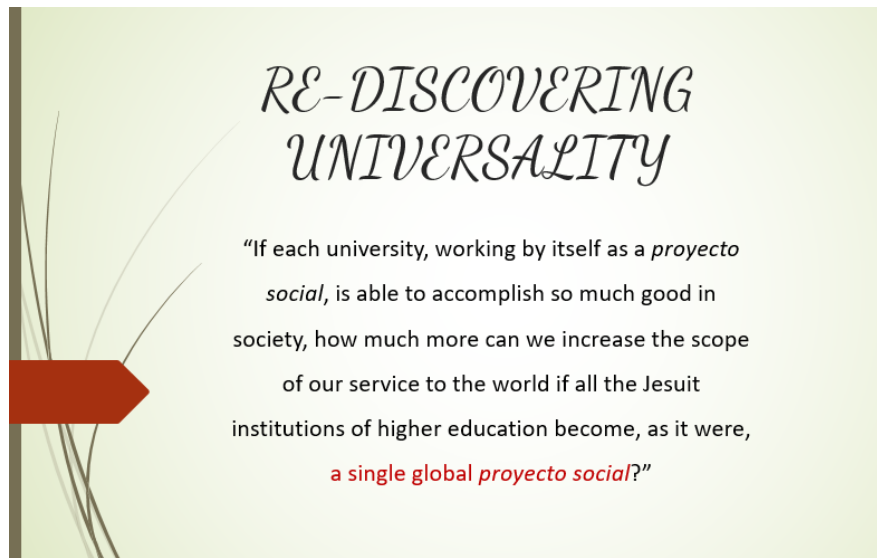
Source: Own elaboration.

- o   Script typeface is curvilinear and light, therefore it attracts attention in titles.
- o   Modern typeface is optimum for titles because of the similarity with handwriting contrasts with sans serif typefaces.
- o   **Script typeface should not be used in uppercase because it affects readability.**
- o   Modern typeface does not help the readability of titles because it has too many curve lines.

38. Analyze the typeface used in the title of the cover of this children's story and choose the correct statement.

Source: https://www.amazon.in/Ill-Always-Love-Hans-Wilhelm/dp/0517556480
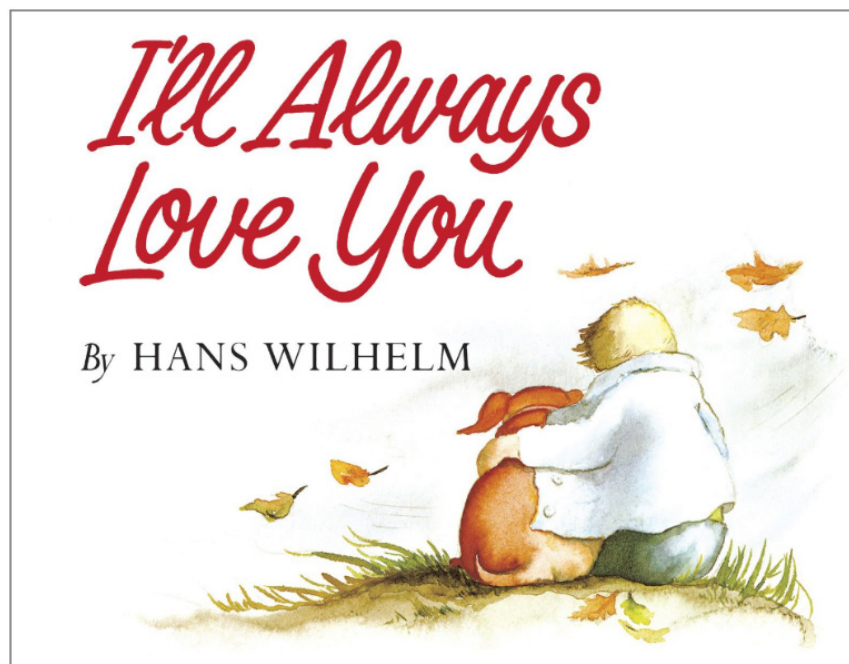
- o   Slab Serif typeface conveys tranquility and serenity.
- o   **Script typeface conveys affection and closeness.**
- o   Sans serif typeface conveys tranquility and affection.
- o   Modern style conveys personality and closeness.

39. The image shows a text which helps to convey a meaning, choose the appropriate statement.

Source: Volkan Olmez on Unsplash.

- o   **The lettering gives the image personality and creativity.**
- o   Modern typeface helps the image to convey joviality and youth.
- o   Decorative typeface gives the image originality and creativity.
- o   Calligraphy allows the image to convey personality and security.

40. It is desired to move people concerning street protests by developing a poster. What typeface do you consider most appropriate to join this image?

Source: Own elaboration.

- o **Slab serif typeface because it transmits strength and goes in accordance with the image message.**
- o Decorative typeface because it conveys uniqueness and complements the informality of the image.
- o Old Style typeface because it conveys closeness and complements the image message.
- o Modern typeface because it transmits actuality and is light.

41. Identify the type contrasts that have been applied in the following design.
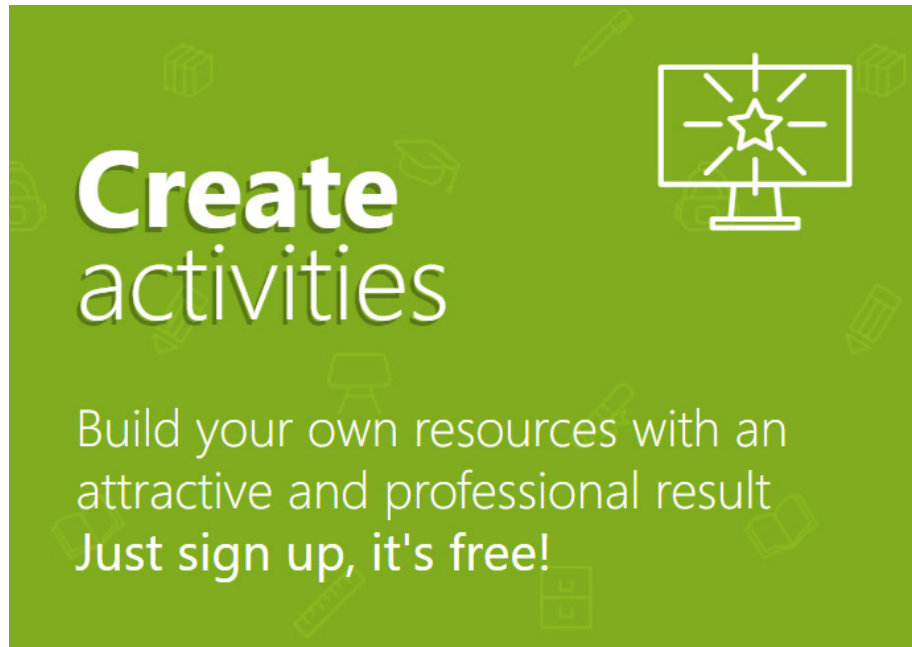
Source: Screenshot of the "Educaplay" website.

o   The contrasts of size and structure.
o   The contrasts of weight and structure.
o   The contrasts of form and size.
o   **The contrasts of weight and size.**

42. Identify the type contrasts that have been applied in the following news of a digital newspaper.

Source: Translated into English and adapted from a screenshot of the "El Universo" website.

o   The contrasts of direction, weight and structure.
o   The contrasts of weight, color and direction.
o   **The contrasts of structure, weight and size.**
o   The contrasts of form, weight and size.

43. What way of type contrasts is most appropriate to improve the readability of the paragraph on the next slide?
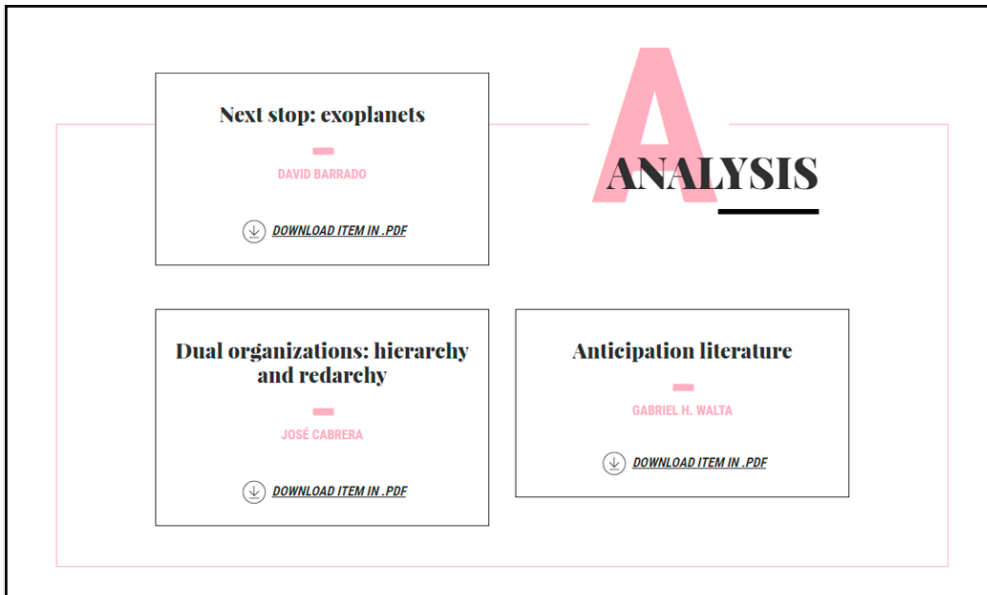
Source: Own elaboration.

- o **Contrast of form**
- o Contrast of weight
- o Contrast of color.
- o Contrast of direction.

44. There are six ways to type contrasts, which one has not been used in the following magazine?

Source: Translated into English and adapted from a screenshot of Telos magazine digital version.

- o Contrast of weight.
- o **Contrast of direction**.
- o Contrast of form.
- o Contrast of structure.

45. What contrasts of type are excessive in the following slide?
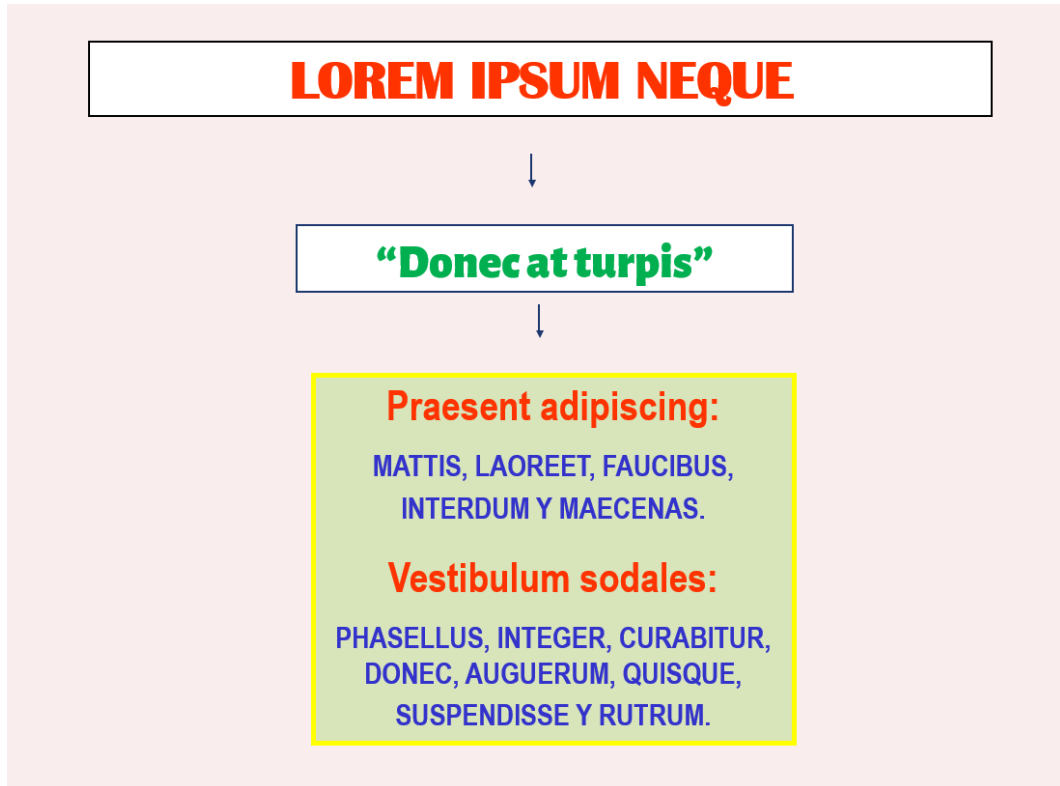
Source: Own elaboration.

- o **Excessive contrast of structure and form.**
- o Excessive contrast of weight and direction.
- o Excessive contrast of direction and size.
- o Excessive contrast of size and weight.

BIOGRAPHIES

Catalina Huilcapi-Collantes is a UI Designer and University Professor in Ecuador. Her educational background includes a Designer bachelor's degree and a Master of Education from the Pontifical Catholic University of Ecuador. She also holds a specialization in ICT and Education from the Simón Bolívar Andean University and a Master in Graphic Design and Interface from the Pontifical University of Salamanca. Nowadays is a doctoral candidate in Ph.D. Programme Education in the Knowledge Society at the University of Salamanca. Her research focuses on visual literacy, mobile learning, blended learning and UX for educational apps.

Azucena Hernández Martín is a Professor in the Faculty of Education at the University of Salamanca. She has a degree in Philosophy and Educational Sciences and a Ph.D. in Pedagogy since 1999. She is a member of the Research Group on Innovation and Educational Technology (GITE-USAL). Her research focuses on teacher training and professional development, educational innovation, the curricular integration of ICT, and digital competence for teachers and students. She has been a principal researcher and member of the research team in 20 regional, national and international research projects. She has published and collaborated in numerous articles, book chapters and books on mentioned topics.

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