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Developing EFL students' multimodal literacy with the use of infographics

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Abstract

Multimodal literacy has been advocated as an essential twenty-first century skill due to the increasing access to digital media. Although there have been pedagogical interventions aimed at developing multimodal literacy, few studies have done so in EFL contexts. The present study explores the effectiveness of infographics in improving reading comprehension skills of a final sample of 46 EFL Spanish speaking university students. A pre-test and post-test approach was employed with an intervention and a control group. Comprehension was assessed following previous proposals that considered image and text-image questions. The results indicate a statistically significant enhancement in reading comprehension for students exposed to infographics-based teaching. Additionally, teachers' perception, which was examined through teachers' logs, indicate the material was effective although it might benefit from additional L1 support. These findings underscore the potential of infographics as an educational tool for EFL classrooms and contribute to innovative approaches for educators seeking to boost reading comprehension in EFL contexts.

Keywords: EFL instruction, Infographics, Multimodality, University

Introduction

The growing availability of digital media production technologies has significantly increased people's access to cultural artifacts such as videos, visuals, and AI digital products that have shaped the landscape of the last decade (Lim & Tan-Chia, 2023; Lim & Toh, 2020; Lim et al., 2022a). Suffice it to say, the COVID-19 pandemic intensified people's reliance on technology, which has led to significant transformations within both the educational domain and our daily lives (Zhao & Watterson, 2021). If students as well as teachers have access to both producing and processing multimodal digital artifacts now more than ever, it is natural to wonder how this impacts the teaching and learning processes (Lim, 2021; Mayer, 2021). An important case is that of English as a Foreign Language (EFL) since educators and researchers are increasingly exploring how the new technologies can enhance teaching practices in this area (Gao et al., 2024; Pellicer-Sánchez et al., 2020; Pellicer-Sánchez, 2022; Wang et al., 2024; Zapata, 2022).

Regarding teaching students to process and comprehend multimodal, digitally produced texts, the literature has been favorable. Research has shown that young people today are reading more than ever thanks to habitual exposure to multimodal texts in

online contexts (Potter & McDougall, 2017). In fact, it appears that recognizing the multimodal nature of texts can help educators exploit the simultaneous presentation of different modes (Pellicer-Sánchez et al., 2020; Webb & Chang, 2015). Two potential benefits of multimodal texts are of interest for the present research: improving reading comprehension and developing critical thinking. Regarding reading comprehension, research has shown that using both pictures and text near each other may improve domain learning and its application (Johnson & Mayer, 2012; Mason et al., 2015). Additionally, empirical studies have indicated that young and adult readers tend to dedicate more reading time to processing text rather than pictures (Serrano & Pellicer-Sánchez, 2019; Tragant & Pellicer-Sánchez, 2019). On the other hand, studies linking the use of multimodal texts with critical thinking skills have shown that transformative practices are enabled by meaning-making practices through multimodal composition (Karatza, 2022; Lim et al., 2021). A qualitative study by Zhang (2018) described how the use of online resources informed by systemic functional linguistic (SFL) can help EFL students demonstrate critical thinking skills in academic writing. As Lim and Tan (2017) noticed critical viewing is a fundamental competence for people to be able to support their interpretation of multimodal artifacts. Even though both skills are independent, it is undeniable that they both are crucial to achieving information literacy (IL), which has been defined as the capacity to identify information needs, find the appropriate information, and think critically to evaluate and use the information found (Wu, 2018).

Considering that not all digital natives are alike due to the different access to technology people may have (Brown & Czerniewicz, 2010; Selwyn, 2009), developing multimodal literacy has become a matter of empowerment and equity (Cope & Kalantzis, 2015; Zapata, 2022). Different approaches to doing so have been proposed to incorporate multiliteracies in the classroom. Among these approaches we have the pedagogical moves of the New London Group (NLG) (1996), the principles for multimedia learning (Mayer, 2021), the Learning by Design Framework (L-by-D) (Cope & Kalantzis, 2015; Kalantzis et al., 2005), the FAMILY framework (Lim & Tan, 2017), and the Systemic approach (Lim & Tan, 2017, 2018). FAMILY is an acronym that teachers can remember to organize their units, ensuring to address different important aspects necessary to raise awareness of multimodal texts. F refers to the form (features and functions) related to the genre being taught, A refers to the awareness of the strategies that can be used to shape the text to a particular Audience. M stands for message and it emphasizes the importance of understanding how texts can persuade the audience and the literal and inferential meanings. I stands for integration, and it is a phase in which the teacher can help students recognize relationships across semiotic modes. L refers to the word Link, and it underscores how the teacher is expected to connect multimodality to both language learning and subject matter. Finally, Y alludes to the word *why*, and it is the opportunity for teachers to prompt students to question the text using what was learned as evidence.

Even though there have been positive findings from the implementation of these frameworks, the review of the literature has not revealed much work concerning EFL. As Pellicer-Sánchez (2022) indicates, it is still necessary to gather evidence that helps build a model of L2 multimodal and multimedia learning.

The present study evaluates the impact of an intervention following a combination of the L-by-D and FAMILY frameworks on students' multimodal critical reading comprehension of infographics. We believe that the results from this research can guide EFL educators on possible ways to incorporate not only multimodal text as reading material, but approaches that may positively impact students' reading comprehension and critical thinking while making use of said material. The main contribution of this study is the application of specific frameworks to develop multimodal literacy within an EFL context, with an emphasis on the critical thinking component that these frameworks promote. First, we explore the importance of multimodality in education, then we proceed to discuss the role of critical thinking in connection with multimodality. Lastly, we discuss the method we implemented for the study including the participants, research design, intervention, instruments, and data collection and analysis procedures.

Literature review

Approaches to teaching multimodality

Literacy has undergone a remarkable evolution in the last twenty years, which has expanded the understanding people have of communication. Experts tend to agree that an important landmark that propelled this development is the work of the New London Group (NLG) (NLG, 1996; Zapata, 2022). The NLG consisted of a group of ten educators who were concerned about the changing landscape in social, technological, and economic aspects, which, in their opinion, demanded a reformulation of literacy pedagogy. Some of the examples that the authors mentioned as symptoms of this need include the rise of new modes and technologies of communication as well as the varied texts appearing in the workplaces. As a result, the NLG proposed a new approach for literacy pedagogy called multiliteracies which was conceptually founded in Halliday's SFL (Halliday & Matthiessen, 2014). This approach recognized that in those years literacy already involved much more than reading printed texts and, in fact, the approach recognized six design elements: Linguistic Meaning, Visual Meaning, Audio Meaning, Gestural meaning, Spatial Meaning, and Multimodal patterns of meaning (what connects the first five modes).

Two arguments were presented by the NLG that sustained their multiliteracies approach. First, the modal dimension indicates that meaning-making occurs in the increasing variety and integration of modes. Second, the term multiliteracies was used to address the fact that there is an increasing local diversity and, at the same time, global connectedness. To implement the approach offered, the NLG states that the 'what' and the 'how' must be clear. As for the 'what', the NLG proposes the concept of design be understood as organized forms of meaning. Three concepts are of importance in relation to designs. Available designs which are resources for meaning, Designing understood as the work performed on and with Available Designs in the semiotic process, and the Redesigning which are the resources reproduced and transformed through Designing. Regarding the 'how', the NLG advances four flexible pedagogical angles (New London Group, 1996; Zapata, 2022):

- a) Situated Practice: This can be understood as making connections between curricular outcomes and students' identities and needs. Available Designs from students' life-

worlds and simulations of multimodal texts found in future workplaces as well as public spaces can be used to bring the familiar into the classroom as well as introduce the new.

- b) Overt Instruction: This move involves the introduction of explicit metalanguages that help students describe and interpret how meaning is conveyed through the different modes of communication. This should lead to students understanding the motivated aspects that factor in the process of Designing.
- c) Critical Framing: Through this angle, teachers can help students gain distance from the multimodal text as well as the knowledge gained in order to critically interpret its design in light of its relation to its context.
- d) Transformed Practice: In this move, the teacher gives students the opportunity to apply what they have learned in editing Available Designs or in engaging themselves in the Designing process.

The proposal by the NLG has become an important antecedent for more recent frameworks that have sought to guide educators in developing students' as multimodal readers and text users. One of the main continuations of the effort of the NLG has been assembled by two of its members, Mary Kalantzis and Bill Cope. These academics developed the NLG approach as to make it more accessible to instructors and students: this proposal is known as the Learning by Design (L-by-D) Framework (Kalantzis et al., 2005).

The L-by-D Framework acknowledges the students' context has continued evolving thanks to the access to different technologies that shape the way in which people produce and consume texts. Due to the ubiquitousness of digital aspects in students' contexts, the creators of this proposal advocate for the mixing of both informal and formal learning to encourage students to see the way in which multimodality is not only part of their realities but also of the schooling. By doing so, the L-by-D framework allows for the opportunity of promoting two dimensions in the learning process so that it is equitable: (1) the sense of belonging that permits students to connect at a personal level with both the content and the context; and (2) transformation, which refers to changes in students' lives that can make them engage meaningfully with their learning process (Zapata, 2022). Regarding the 'how', the L-by-D framework reformulates the pedagogical angles with the concept of *knowledge processes* or *epistemic moves*, which are terms used to refer to foundational types of thinking in action (Zapata, 2022): experiencing, conceptualizing, analyzing, and applying (Cope & Kalantzis, 2015; Zapata, 2022).

In Singapore, the work of Lim and Tan has been important in putting forward an understanding of teaching and learning as multimodal experiences, highlighting texts as inherently multimodal and the relevance of multimodal learning design (Lim & Tan-Chia, 2017, 2023; Lim & Toh, 2020; Lim & Tan, 2018, 2021). At the core of the proposals Lim and Tan have worked on is the concept of semiotic awareness, which was first proposed by Towndrow et al. (2013). Semiotic awareness can be defined as the skill that allows learners to critically analyze multimodal texts by paying attention to design aspects. This ability can be expressed through two skills: viewing and representing.

Lim and Tan (2017) proposed The Systemic Approach to develop multimodal literacy in students, having as objective to turn students into critical viewers of

multimodal texts. This approach consists of three levels of viewing a visual text: encountering, comprehending, and critically viewing the multimodal text.

- a) Encountering the text: It involves engaging with the text at an emotional, personal level. Responses from the students at this level involve reactions such as finding the text interesting or creative while articulating the reasons why they feel a certain way towards the text. The teacher may expand on certain aspects the students heighten and in this way students' awareness of certain textual (linguistic and/or visual) elements of the texts.
- b) Comprehending the text: It consists of providing students with the necessary meta-language for them to comment on the multimodal text, scaffolding students' understanding of the system choices that realize SFL's metafunctions. For example, the teacher can focus on students exploring the importance of the audience as to develop a deeper understanding of the interpersonal metafunction. Lim and Tan (2017) suggest doing this through the FAMILY framework.
- c) Critically viewing the text: This pedagogical move involves encouraging students to evaluate how effective the semiotic resources were employed in the multimodal text. Questions that ask how the author or text achieve certain effects become important as well as how the visual text can be improved.

The systemic approach has been an influential pedagogical proposal for learners' successful engagement with multimodal artefacts as well as in advancing multimodal reading as intertwined with critical thinking. However, while the FAMILY framework is expected to equip learners with the affordances required for questioning these artefacts, the critical thinking construct does not seem to be strongly operationalized and, hence, amenable to support unquestionable research findings. To shed light on how critical thinking has been addressed in relation to multimodal literacy, the following literature review presents an overview of relevant studies and their findings.

The approaches offered by the NLG and in the L-by-D framework can be seen as part of a continuous evolution of the concept of literacy over the past two decades. While these frameworks have been instrumental in the development of multimodal literacy along with critical thinking, there is still lack of clarity regarding the development of this skill in the context of English as a foreign language.

Critical thinking in the context of multimodal literacy

Different authors have shown that the cultivation of critical thinking is positively related to an improvement in both multimodal literacy (Lim & Tan, 2018; O'Halloran et al., 2015) and English language skills (Liang & Fung, 2021; Lu & Xie, 2019). Moreover, researchers interested in multimodality (e.g., Tseronis, 2015) are sometimes explicit that multimodal meaning can be transformed into arguments in favor of a certain point of view. Given the growing need for multimodal literacy in educational settings, researchers have offered pedagogical approaches that include the development of critical thinking skills to effectively interpret the meanings conveyed by different channels that intertwine in the same multimodal text. For example, O'Halloran et al. (2015) report on a socio-semiotic approach that emphasizes the acquisition of certain analytical

metalanguage suitable for the interpretation and production of multimodal texts known as *multimodal approach analysis for critical thinking* (MACT).

For MACT proponents, a multimodal text is the result of a particular combination of semiotic choices expressed in the way authors organize and adapt the information they communicate to their readers. This constitutes the meanings of the text, capable of being effectively analyzed by students and teachers harnessing the appropriate skills. In practice, the approach translates into the application of an IT-assisted method to identify and analyze the structural characteristics and central ideas of different types of textual genres (e.g., advertisement, movie posters, news reports, etc.), managing the relevant information in a guided way (e.g., summarizing or synthesizing information) and, finally, critically assessing the communicative impact of a particular composition of verbal and non-verbal elements.

Along the same lines, the systemic approach to critical viewing advanced by Lim and Tan (2017) provides a framework for the teaching and interpretation of visual texts, where critical thinking and discourse analysis skills are combined to discern and evaluate the use of multimodal strategies. In the didactic translation of this approach, the development of critical thinking draws eclectically from different sources, including a version of the three types of persuasion from Aristotle's Rhetoric: *Logos* (or appeal to reason), *Ethos* (or appeal to credibility), and *Pathos* (or appeal to emotion). Thus, for example, to evaluate the persuasive power of multimodal texts, the proposed framework includes a component aimed at scrutinizing the way in which verbal and visual elements demonstrate the use of factual information (Logos), professional knowledge (Ethos), or emotional influence on the audience (Pathos).

Several studies provide grounds for the pedagogical affordances enabled by critical thinking skills both within and beyond EFL teaching. For example, Holdren (2012) studied the creation of visual arts to assess high school students' higher level reading comprehension performance and critical thinking. The use of a visual art project as assessment demonstrated higher-level thinking skills such as metaphoric connections, and manipulation of detail and problem solving. These findings served to provide recommendations for a rubric-based assessment. Similarly, in a higher education setting, Pereira (2017) investigated the persuasive aspects of multimodal arguments through a digital literacy exercise and found that a digital device can influence the audience at a cognitive level by means of orchestrated modes the authors call *multimodal phrases* or *sequences*. According to this author, "the careful design applied to attention traps, centripetal gazes, audience inspiration, and focal objects for multimodal argumentation compares well with the traditional rhetorical concerns of logos, ethos, and pathos." (p. 15). In the context of EFL education, Huang (2017) examines critical multimodal literacy pedagogy with a focus on learners' media text comprehension. In his study, the researcher showed that by paying attention to images, sounds, words, and their organization, students were able to develop critical thinking skills in relation to moving-image texts. Zhang (2018), in turn, reports on how EFL students' critical thinking in academic writing is enhanced using internet materials informed by SFL. Karatza (2022) presents a design for learning based on both O'Halloran et al.'s (2017) MACT approach and Lim and Tan's (2017) Systemic Approach to teaching critical viewing. The study took the form of a four-week workshop in a virtual setting aimed

at introducing pre-service EFL teachers to multimodal literacy. Results from multimodal analysis and subsequent reflection on workshop syllabus and implementation yielded evidence of meta-awareness regarding the use of relevant metalanguage, as well as MACT-based teaching of critical thinking as a successful transformative process. In a similar vein, Lim et al.'s (2021) case study of two primary teachers' multimodal pedagogies found that there was an unbalance between teachers' ability to create appropriate instances for multimodal literacy and students' opportunities for critically exploring meaning-making practices through multimodal composition. Overall, the literature suggests that recurrent affordances such as an appropriate metalanguage and a focus on processes and products are deemed worthy of attention for pedagogical purposes.

Cultivating critical thinking skills has been shown to have an impact on critical thinking. From a theoretical standpoint, pedagogical frameworks such as the MACT and the systemic approach offer opportunities for teachers to develop critical thinking using multimodal texts in the classroom. However, multimodality research in the EFL/ESL classroom with a focus on critical thinking is still limited. This indicates the need to fill an important gap as it is now well established that multimodal communication is increasingly important and has the power to wield significant influence over us. All in all, multimodal literacy is fundamentally about being able to engage with multimodal representations critically and the studies presented thus far provide evidence that critical thinking skills are crucial for students to assess and create multimodal content successfully.

Method

Participants

The initial participants of the study ($n=72$) were university students enrolled in a compulsory pre-intermediate, blended learning EFL course which was offered in several sections for different study programs. This course is the second compulsory EFL course offered at this institution and is aligned to an A2 level of English following the standards of the Common European framework of reference (CEFR). In Chile, it is common that English is a compulsory course offered across study programs in higher education. This requirement aims to enhance the employability of future professionals by equipping them with the English language proficiency necessary to thrive in an increasingly globalized workforce.

Four complete sections were used for the study: Two of the sections were used as control groups and the other two sections worked as intervention groups. Our inclusion criteria for the students in the classes included three factors: (1) being native Spanish speakers, (2) taking the course for the first time, and (3) not having a diagnosis or neurodivergence (e.g. ASD, dyslexia, etc.). Table 1 displays the distribution of the participants for the intervention. We opted to incorporate this number of sections due to the common problem of attrition due to participants not completing both the pre and post-tests in this type of study. Seventy-two participants completed the pre-test, forty-six out of the initial number completed the post-test. Table 1 displays the distribution in terms of condition and sex of the final sample.

Table 1 Participants in the study

			Control	Experimental	Total
Sex	Female	Count	14	12	26
		% of Total	30.4%	26.1%	56.5%
	Male	Count	8	12	20
		% of Total	17.4%	26.1%	43.5%
Total	Count		22	24	46
	% of Total		47.8%	52.2%	100%

Table 2 Mixed-methods research design

Phase of the study	Data collection techniques	Purpose of the phase
First – Quantitative (pre- and post- study design)	Multimodal infographics reading comprehension test (pre and post)	Measure the impact of the intervention by comparing the results obtained with two equivalent multimodal reading comprehension tests
Second – Qualitative	Teacher logs	Analyze the perception EFL teachers had of the intervention conducted

All participants signed informed consents that complied with the requirements of the ethics committee of the institution in which the study was conducted. The study was approved by the ethics committee of the participants' institution.

Research design

The study follows an explanatory mixed-method design (Creswell & Creswell, 2018). According to Creswell and Creswell (2018) this study design consists in a two-phase project. The first phase involves gathering and analyzing quantitative data which offers preliminary findings. Subsequently, during the second phase the researcher purposefully select participants that can offer further insights on the results of the project by means of qualitative data collection techniques, such as interviews and focus group interviews. In Table 2, we explain how the research design was implemented in the present study.

With regards to the instruments used before and after the intervention to measure the impact of the intervention, we created two equivalent reading comprehension tests. First, for reading material we selected infographics from two prestigious health related organizations: World Health Organization (WHO) and Centers for Disease Control (CDC). The final test consisted of five infographics, each of them followed by four questions. For each of the five texts, the first question was designed to capture the meaning conveyed by the verbal system while the second question needed of the image to be answered successful. This distinction between text questions and image questions has been put forward in previous seminal studies (Pellicer-Sánchez et al., 2020; Unsworth, 2017; Unsworth et al., 2019). Three distractors were designed for each question.

The third question was the same for all the infographics, and it was “*Taking into account both text and image, what is the main message of the infographic?*” This question aimed at assessing the textbase level understood in this study as the ability to make an inference that connect discourse segments at the surface level thus creating a semantic mental representation (van Dijk & Kintsch, 1978). With our formulation of the question,

we emphasized our multimodal approach that considered that these discourse segment could come from different semiotic modes, giving it a multimodal twist to the classic formulation. Krippendorff's Alpha was calculated for interrater agreement in the scoring of the open-ended answers. For pre-test open-ended answers, we obtained 0.705, and for post-test open-ended answers 0.887. That is, for the pre-test there was moderate interrater agreement and for the post-test high interrater agreement. The increase was probably due to the discussion held after the pre-test was corrected. All differences were resolved through discussion.

Finally, the fourth question evaluated students' critical thinking skills by asking them to determine the credibility indicators and emotional triggers used in the infographic. Both test forms were validated by means of two processes that can be used in conjunction piloting the instrument with students of a similar profile not part of the sample and validating the questions and alternatives with a panel of experts (Carcamo, 2023). Panels of experts are essential to gather informed opinions about the instrument (Escobar-Pérez & Cuervo-Martínez, 2008; Garrote & Rojas, 2015) while piloting usually helps identify potential problems with wording as well as the way in which answers might be provided by the future participants as well as confirm the time students will take answering the instrument (Brooks et al., 2016).

To gather teachers' perceptions about the material they implemented and students' learning, all teachers had to complete teacher logs. The teacher log consisted in three sections. First, they had to complete the students' attendance, so that the researchers knew how many students had participated in class. Second, the teacher had to provide information about how they felt students dealt with the handouts used for the intervention. Finally, teachers were supposed to reflect on the effectiveness of the material and, in case they thought it could be improved, they had the opportunity to make suggestions. For the analysis of qualitative data, we followed an inductive approach following the principles of thematic analysis (Braun & Clarke, 2006). The steps followed were suggested originally by Elliot et al. (1999).

1. Getting familiar with the data and generate draft codes.
2. Generate initial codes.
3. Collating initial codes into themes.
4. Reviewing themes.
5. Validating themes across the data set.
6. Defining and naming themes and sub-themes.
7. Revising themes through data extracts.

Teaching intervention

Lim and Tan-Chia (2023) have advocated for using a sequence for teaching related to the learning process of multimodal literacy (encountering, exploring, evaluating, and expressing). To complement and strengthen this proposal for teaching English as a Foreign Language (EFL), we opted for using an Engage-Study-Activate lesson sequence following Harmer's (2007) proposal. The main reason we did this was to facilitate the use of common EFL jargon with the EFL teachers who implemented these lessons in their

Table 3 Summary of the intervention considering the FAMILY framework

Lesson	FAMILY framework	Purpose
1	Introduction and pre-test	Introduce project Share informed consents Administer pre-test
2	F: Form A: Audience	Focus on helping students gain awareness of the features of infographics and their relation to the intended audience
3	F: Form A: Audience M: Message	Review elements of infographics (e.g. use of logos, types of semiotic modes used) Focus on types of graphic representations that can be used in the graphic mode and their respective effects as well as the communicative purposes infographics may have
4	F: Form A: Audience M: Message I: Integration	Focus on image-text relations and intersemiotic effects Analysis of infographics in terms of Form, Audience, Message, and Integration
5	Y: Why	Focus on semiotic awareness and its relation to persuasion
6	F: Form A: Audience M: Message L: Link Y: Why?	Design and creation of infographics considering form, audience, communicative purpose, and modes of persuasion
7	Conclusion and post-test	Review of the intervention Administration of the post-test

Table 4 Comprehension and critical thinking scores

	Condition	N	Mean Compr. scores	SD	Mean Critical Thinking scores	Std. Deviation
Pre-total	Control	22	10.727	2.55	2.046	1.13
	Experimental	24	12.21	2.54	2.13	.9
Post-total	Control	22	11.137	4.13	1.6	.91
	Experimental	24	16.75	2.17	1.88	2.17

classrooms during the training sessions. We thought that by presenting the lessons as E-S-A, it would be easier for them to understand the logic underlying each intervention handout. In the handout, the Engage phase was introduced by the heading ‘let’s play’, the Study phase was introduced by the heading ‘let’s learn’, and the activate phase by ‘let’s do it’. The complete intervention lasted 7 sessions, which is similar in length to some of the case studies shared in Lim and Tan-Chia (2023). Table 3 shows an overview of the intervention.

Before implementing the material for the intervention, all teachers were informed about its design and given time to examine the material as well as make suggestions to improve it.

Findings

Descriptive statistics were used to measure the performance of the control and intervention group in the pre- as well as the post- test (Table 4).

Tests of normality were calculated to establish whether the total scores (adding up comprehension and critical thinking scores) in the pre- and post- tests obtained by

Table 5 Shapiro–Wilk test

	Condition	Statistic	Df	Sig
Pre-test total score	Control	.947	22	.271
	Experimental	.956	24	.368
Post-test total score	Control	.919	22	.072
	Experimental	.969	24	.643

Table 6 Total scores

	Condition	N	Mean	SD
Pre-total	Control	22	12.77	3.01
	Experimental	24	14.33	2.94
Post-total	Control	22	12.73	4.35
	Experimental	24	18.63	2.63

the experimental and control groups met the assumption of normality required for conducting parametric tests. Table 5 displays the results.

The Shapiro–Wilk test was used since the literature indicates that it is the best option for samples smaller than 50 (Rodrigues de Souza et al., 2023). The results of the Shapiro–Wilk test, as shown in Table 5, indicate that the four measures comply with normality; thus, parametric statistical tests can be used.

Table 6 shows the results of the descriptive statistics for both the pre-test and the post-test scores, considering the scores obtained in multimodal reading comprehension questions, critical thinking questions, and the total scores (addition of the two).

Independent T-tests were run to compare the scores in the pre-test. The results showed that both groups' results were not statistically different from each other ($t(44) = 1.778$, $p = 0.082$). After the intervention, the experimental group increased its average while the control group's remained similar. An independent-samples t-test was conducted to compare the post-test scores, revealing that the final total scores between both groups were statistically different ($t(44) = 5.611$, $p = 0.00$). However, when comparing only the results from the critical thinking question scores, this difference was not observed ($t(44) = 0.932$, $p = 0.39$). This finding suggests that students in the intervention only increased in multimodal text meaning related questions.

A paired-samples t-test was conducted to evaluate the impact of the intervention considering the pre- and post- test scores of the experimental group. There was a statistical significant increase in scores from pre-test ($M = 14.33$, $SD = 2.94$) to post-test ($M = 18.63$; $SD = 2.63$), $t(23) = 6.148$, $p = 0.00$. The software G*Power was then used to calculate effect size, which was large (d of 1.26). In the case of the control group, the difference was not statistically significant ($p = 0.943$).

Additionally, we examined the teacher logs to analyze the teachers' perceptions of the material used in the intervention using thematic analysis (Braun & Clarke, 2006). The teachers' logs included teachers' reflections written after the lessons given. These reflections varied in length but tended to focus on the role multimodal material

played in the classroom. Through the thematic analysis conducted, we were able to identify three themes: Engagement, L1 use, and General opinions.

Teachers agreed that the material was effective in engaging students with multimodality. They emphasized the importance of the Engage activity in the overall success of the class, the class discussions during the lesson as to monitor misunderstanding, and the submission of their answers after class. Teachers did not make any specific suggestion to modify the material for the future, but they indicated that occasionally it was necessary for them to use the students' L1 as to explain certain concepts related to multimodality, such as *modes* and *status*.

Discussion

The primary objective of this study was to investigate the impact of a multimodal materials-based intervention on EFL students' critical reading comprehension performance, with a focus on infographics. The findings in the previous section show that the intervention improved students' reading comprehension scores significantly, supporting evidence from previous research on multimodal instruction and meaning-making skills (Lim & Tan-Chia, 2023; Pellicer-Sánchez et al., 2020). What follows provides a more detailed analysis to contextualize these results and address their implications.

The improvement in reading comprehension scores is in line with the observation that multimodal texts facilitate learning by integrating various modes of representation (Mayer, 2021; Serrano & Pellicer-Sánchez, 2019). Specifically, infographics appear to aid EFL students' understanding of complex ideas through the combination of text and visuals, as suggested by authors such as Johnson and Mayer (2012). This observation echoes the work of other studies in this area linking multimodal tasks and critical reading comprehension (Stankić & Jakovljević, 2022; Varaporn & Sitthitikul, 2019).

However, a note of caution is due here since there is no evidence to conclude that there is also a statistically significant difference between the control group and the experimental group regarding the scores on the specific question used to assess critical thinking. This inconsistency with previous research results can be explained by the way we chose to operationalize critical thinking in this study, exclusively focused on *Ethos* and *Pathos*, following Lim and Tan's (2017) systemic approach. The choice was made due to the need to ensure construct validity by means of clearly aligning test questions with the relevant constructs (e.g., text-based meaning interpretation, image-based meaning interpretation, critical thinking), but it may have limited the operationalized notion in its scope to capture broader aspects such as argumentation (or *Logos*). This resonates with evidence from Öz and Memiş (2018), who stress the importance of comprehensive, standardized tests to assess critical thinking, and the related consideration that critical thinking requires sustained instructional efforts with an explicit focus on analytical and evaluative reasoning (Huang, 2017; Zhang, 2018). A further study with more focus on holistic instruments as well as extending the intervention timeframe to help students to develop critical engagement with multimodal artefacts is therefore suggested.

Looked at pedagogically, the findings corroborate the capability of frameworks like FAMILY and L-by-D in dealing with the challenges of multimodal instruction in EFL contexts (Cope & Kalantzis, 2015; Lim & Tan, 2017). Teachers' reflections, which emphasize the role of the material in engaging students and fostering multimodal literacy,

accord with earlier research on the transformative potential of multimodal pedagogy in similar higher education contexts (Farías & Véliz, 2019; Romero & Bóbkina, 2021). This is, in turn, consistent with other studies showing that, given the opportunity, teachers will integrate multimodality in their lessons effectively and with a positive attitude (Julinar, 2019; Ryu & Boggs, 2016). However, the teachers' positive attitudes were somewhat noteworthy as they contrast with certain studies reporting educators' hesitation to integrate multimodality into the classroom due to curricular constraints (Lim et al., 2022b). This difference may be explained by the professional autonomy allowed in this study, which presented the intervention as an opportunity for innovation in teaching practices rather than a compulsory curriculum change.

The consolidated outcomes of the present study are in accord with previous observations related to the appropriate conditions for multimodal assignments both in tertiary and secondary education. For example, Takaya (2019) supports the extended claim that university EFL students lack appropriate visual literacy skills and Romero and Bóbkina (2021) show that tertiary EFL learners tend to overlook certain specific pragmatic and critical aspects within multimodal texts due to these limitations. The analysis of the teachers' logs as well as the results of the test lead us to believe that the proposal designed has helped both teachers and student overcome some of the typical factors hindering systematic use of multimodal texts in the EFL classroom such as limited access to relevant materials, poor teacher preparation, and traditional conceptions of literacy (Farías & Véliz, 2019).

While the findings emphasize the potential of multimodal instruction, the study is limited by a high attrition rate which reduced the sample size, impacting generalizability. The short duration of the intervention appears to have constrained the development of critical thinking skills. Moreover, students' perspective, which may have likely strengthened the findings, was not systematically considered.

Despite its limitations, the study contributes to the increasing body of evidence supporting multimodal literacy as a valuable supplement to EFL pedagogy. It underscores the potential of multimodal artefacts, such as infographics, to improve reading comprehension. The findings also align with calls to enhance the EFL curriculum by encouraging educators to incorporate teaching practices to meet 21st-century literacy demands (Lim & Tan-Chia, 2023; Pellicer-Sánchez, 2022).

Conclusion

In the present study, we sought to explore and adapt Lim and Tan's (2017) FAMILY approach to the teaching of visual texts to develop multimodal reading comprehension from a critical perspective with EFL students. The findings of the study revealed that the approach designed to combine the L-by-D and FAMILY frameworks with an ESA lesson sequence effectively tackles the challenge of developing multimodal literacy in an EFL university classroom. This suggests the capability of infographics-based instructions to enhance multimodal reading comprehension in similar educational settings.

However, the generalizability of these results is subject to certain limitations. The main weakness of the study was the high participant attrition which contributed to the reduced sample size. Only forty-two out of the initial seventy-two participants completed the post-test. Another limitation was the lack of systematic exploration of the

students' perspective on how the intervention went. A direct implication of this is that the participants' insights on the experienced intervention, which remain unexplored, could have enriched the interpretation of the findings. Additionally, as previously noted, there was limited evidence to conclude a statistically significant difference between the control and intervention groups regarding critical thinking scores. A possible explanation for this might be the short timeframe of the intervention or the intricacies of critical thinking instruction with multimodal texts. It seems likely that this type of instruction requires a more extensive approach.

Although a limited sample size is among the usual standards of educational interventions in EFL contexts (Carcamo & Carmona, 2024; Sato, 2020), we expect that future research delve deeper into teaching methods such as the FAMILY approach with specific types of multimodal texts, to raise awareness in the educational field of the importance of developing multimodal critical reading comprehension. Further study should also explore longer interventions and enhance participant retention, while incorporating student perspectives through interviews or surveys for a better understanding of the effectiveness of the intervention. As Lim and Tan-Chia (2023) signal it, is important not to advance prescriptive models to approach multimodal literacy, but to inspire other educators to reflect and incorporate multimodality into their lessons. Both the broadening of the curriculum and the exploration of new teaching practices need to occur simultaneously and nurture each other to rejuvenate the concept of literacy within EFL contexts.

Acknowledgements

We gratefully acknowledge the support provided by the IDI Research Group throughout the execution of our research project

Author contributions

BC drafted the introduction, methods, results, and conclusions sections. BP drafted the literature review and discussion sections. BC and BP revised the manuscript. BC analyzed the data. All authors read and agreed with the manuscript submitted for publication.

Funding

This work received funding for the Teaching Innovation Project PID 202301 from UDLA Chile.

Availability of data and materials

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests

The authors declare no competing interests.

Received: 25 February 2024 Accepted: 22 January 2025

Published online: 09 June 2025

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