The Influence of E-Comics on English Lexical Competence in Virtual Higher Education

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Abstract

The development of lexical competence in foreign languages is one of the skills that presents difficulties in the teaching-learning process, as it requires stimulation and retention on the part of the student and creativity from the teacher. In this sense, digital resources emerge as a conducive means to promote new knowledge and consolidate acquired vocabulary. In this context, the present research aimed to determine if digital comics influence the development of lexical competence in English in virtual environments at the higher education level. Methodologically, an experimental design divided into three phases (pre-treatment, treatment, and post-treatment) took place with a sample of 60 students during the autumn of 2023. The results demonstrated an association between digital comics and lexical competence development variables, influencing lexicon acquisition, experiencing creativity, dynamism, and language involvement. Besides, comics supported by Canva, Makebeliefscomix, and Pixton applications contributed to students' cultural, linguistic, and communicative repertoire. Concurrently, users' confidence increased through gradual and systematic recovery, use, and inventive writing activities. Supports such as images, dialogues, characters, and colors encouraged the retrieval of words for subsequent use. In this way, the cognitive process of recall ceased to be merely memorising to transition to a level of long-term significant comprehension. In conclusion, digital comics were plausible for encouraging practical, flexible, and playful vocabulary improvement in a virtual environment.

Keywords: lexical competence, e-comics, virtual learning, applications, foreign language

Learning a foreign language involves the development of various linguistic, cultural, and social skills related to the language, as it is the means through which a speaker interacts and connects with the outside world. Among the skills required for authentic communication is vocabulary acquisition because it allows access to a wide range of information and generates fluid dialogue. In this context, the Faculty of Languages from the Benemérita Universidad Autónoma de Puebla in the area of English aims for students to primarily develop communicative competence, as one of the most frequent limitations is the reduced lexical repertoire for expression, which limits the possibilities of effective oral interaction. Besides, after adding the virtual component, students' participation decreases due to a lack of word knowledge, contextual understanding, and confidence to speak in public. In these environments, the need to produce didactic resources and active environments leads to innovative and meaningful activities for the participants. Thus, facing various educational modalities, the aim is to address lexical weaknesses to benefit foreign language students.

From this context, the purpose of this paper is to identify whether the development of lexical competence is influenced by the use of e-comics in virtual environments in higher education. In foreign language didactics, the desire to innovate and address this educational issue gives rise to the design, development, and use of various strategies and resources that provide the necessary stimulus for students to understand and appropriate new knowledge. Therefore, digital resources emerge as a means to meet these teaching-learning needs of the target language. The use of digital comics with applications such as Canva, Makebeliefscomix, and Pixton is proposed to enable gamified learning with a communicative approach, allowing contact with the foreign language in an appealing, motivating, and flexible manner, generating contextualized language practice for the user. In this sense, such tools promote activities with a communicative focus to appropriate the lexicon. Along with this dynamic resource, the comic strip is incorporated as one of the educational supports with high stimulation and creativity. Indeed, it represents one of the cultural elements of contemporary society and Generation Z.

Considering the organization of this research, the sections include 1) Theoretical Framework, where the main conceptual foundations are presented. 2) Methodology, which analyzes lexical competence. 3) Results, which describe the evaluation of the proposed pedagogical intervention with data. 4) Discussion, 5) Recommendations, derived from the study, 6) Conclusions, and 7) References.

Theoretical Framework

Origins of lexical competence in the foreign language didactics, is found in the works of linguists such as Chomsky with his semantic analysis of corpus (Barón et al., 2013), and Hymes with his ethnographic studies of language, framing the lexicon from its context, usage, and intention (Roselló, 2021). However, it was not until the publication of Michael Lewis's book in 1993, *The Lexical Approach: The State of ELT and a Way Forward*, that importance was given to the study of the lexicon in foreign language didactics, as this work highlights it as an essential component in language learning, especially in the development of communicative competence. Following Lewis's contribution, studies have focused on viewing the lexicon not as a series or list of words learned randomly but rather as a competence, involving the speaker's

knowledge and skills that make them competent to interact effectively in oral or written communication (De la Maya & López-Pérez, 2021; Castillo et al., 2022; Marin-Marin & Hernández-Romero, 2022).

In more recent studies, the most researched topics are those that explain what linguistic competence is and how it develops, such as the works of Alejos (2017), Rodríguez-Montes (2020), and Pasuy & Agudelo (2022), which focus on analyzing the development of lexical competence through linguistic, semantic, and sociolinguistic approaches to understand the importance of word usage in authentic contexts. Other works, such as those by Onieva-Palomar (2019) and Robles (2018), highlight the importance of mastering the lexical factor as a didactic strategy for effective foreign language learning. However, there are also more specific studies, such as those by Cáceres et al. (2018), Valdés-León (2021), and Zambrano & García (2022), that explain how the effective development of lexical competence supports the enhancement of literacy skills. In the particular case of this research, the situation that prompted the study deals with a very recurrent problem in the development of communicative competence.

The knowledge of the lexicon has three dimensions: form, meaning, and use (Sanhueza et al., 2018). In the Common European Framework of Reference (CEFR), the lexical component associated in the first instance with linguistic competence links it to both pragmatic and sociolinguistic ones. It emphasizes the speaker's capacity in terms of two dimensions: richness and mastery of vocabulary. Richness is the size of vocabulary acquired in the language learning process through stimulus (input) and production (output) from daily interactions of each communicative activity. Besides, the mastery of the lexicon refers to the assimilation and association processes presented at each of the syntactic and semantic levels that occur when structuring words to form messages (Consejo de Europa, 2020). For his part, Robles (2018) mentions that the lexicon is an essential element for the mastery and linguistic development of a language since it allows the effective development of comprehension and oral expression skills.

Regarding its teaching, Torres & Aristu (2021) assert that beyond understanding cognitive processes, word dimensions, and strategies for learning and usage, it is essential to consider the speaker's identity, focusing specifically on the learner's areas of knowledge, interests, and personal relationships; thus, contextualized vocabulary learning is unavoidable. In his study, Beghadid (2022) classifies the vocabulary: 1. Technical vocabulary that deals with a particular disciplinary area, including its idioms and technical terms. 2. General vocabulary that consists of words used to name everyday activities commonly known by everyone. 3. Potential vocabulary is a set of words usually unknown to the student but whose meanings can be inferred or understood through their relationship with other known words or by context. 4. Passive vocabulary that is known but not frequently used in routine interactions. 5. Active or productive vocabulary is the lexicon a student constantly employs in their oral and written productions.

Strategies for Learning Vocabulary

Mastery of a language must adhere to both theoretical and practical aspects of vocabulary usage (Guerrero et al., 2022). For this reason, it is of utmost importance to have didactic strategies that are cognitive and socio-affective, including memorization, organizational, and motivational aspects (Gómez et al., 2021) to help learners acquire new vocabulary. Beghadid (2022) indicates that students often use three memorization skills to learn new vocabulary: visual, auditory, and kinesthetic. These strategies enhance the integration and recall of new words and their association (Berthely et al., 2023). Moreover, organizational and motivational strategies act as triggers for meaningful vocabulary learning. From a communicative-functional approach, reading comprehension tasks and academic and creative writing are used, as these contextual references stimulate the need to acquire vocabulary to interact correctly in a real communication task (García et al., 2020).

However, when discussing vocabulary learning strategies, it is impossible to overlook the classification by Levin & Pressley (cited in García-López, 2000) because most research dedicated to identifying strategy types has its basis in their studies. According to these authors, there are four groups of strategies: 1. Repetition Strategies are for students to repeat a list of words orally or in writing. 2. Sensory Strategies can be visual, tactile, or audiovisual, supported by materials such as vocabulary cards, images, and videos, to mention a few. 3. Semantic Strategies that focus on associating new vocabulary with previously learned words and analyzing their relationships for word memorization. Known semantic strategies include association, contextualization, imagery, and the morphosyntactic analysis of the word. 4. Mnemonic Strategies refer to all the resources or techniques students use to memorize a word.

García et al. (2020) classify vocabulary-learning strategies into three types: 1. Cognitive strategies. These are conscious activities to understand or learn vocabulary, such as repetition, reference materials, translation, grouping, note-taking, deduction, imagery, and keywords. 2. Communicative or compensatory strategies. These encompass all resources or techniques that aid in understanding the meaning of words, such as guessing, inference, association, exemplification, and questioning, among others. 3. Memorization strategies. These activities assist the student in remembering, understanding, and appropriating vocabulary, as well as comprehending meanings and recognizing new concepts within discourse to store them in their mental structure.

Technology-Mediated Vocabulary Learning

Technological advancements have opened a new way of interacting with knowledge, where images become a relevant element for knowledge transmission and communication within an educational context governed by telecommunications (Hernández et al., 2020; Flores, 2023). Furthermore, students are seen as digital natives who use mobile devices and digital applications for everything, meaning they see, know, and interact with their world through the web. Therefore, in teaching, it is fundamental to implement these digital tools to facilitate learning since cyberspace offers countless pedagogical and non-pedagogical resources in which any type of educational task can be developed significantly (Flores-González, 2020;

Ccoa & Alvites, 2021). Furthermore, Vargas-Murillo (2020) presents a classification that specifies educational strategies developed with digital technological tools used in virtual environments to work on the cognitive part of lexicon learning, which are:

- Conceptual-graphic-organizer strategies. They include concept maps for information retention and concept development. Mind maps for the construction and information management, creativity for taking notes and planning thoughts, and the semantic networks in which the meanings and interrelationships of words are for learning and enriching the lexicon. Some tools for this type of strategy are Draw.io, CmapTools, Microsoft Visio, Lucidchart, MindMeister, XMind, Creately, GitMind, ATLAS ti, and Inspiration.
- Visual-representation strategy. For example, infographics and illustrations that synthesize and encode information through texts, images, diagrams, and symbols. The information resources used for its design are Google Drawing, Piktochart, Canva Genially, Prezi, RealWorld Paint, and GIMP.
- Processing information strategies. They refer to three elements: (a) Interspersed questions, focused on feedback, resolution of doubts, and self-assessment; (b) summary, used in abstraction, synthesis, and reformulation to identify key ideas and concepts; and (c) narrative texts, whose function is the construction of mental and situational models through textual narrative, as well as literary creativity. Some digital tools for these strategies are Google Forms, Survery Monkey, Microsoft Forms, Resoomer, Text Summary, Google Docs, iA Writer, Penultimate, Celtx, Makebeliefscomix, and Pixton.

One of the disciplines that has most benefited from technology is foreign language didactics, as technological resources have been present in methodologies developed over time. In this sense, Borromeo et al. (2018) mention this in their study on the use and evolution of technology in foreign language teaching, stating that it was from the audio-lingual method onwards that technological resources and tools began to be exploited, even more so with the communicative method or approach, where the development of both communicative and digital competencies allows students to have experiences of ubiquitous, immersive, autonomous, and recreational learning (Trujillo et al., 2019).

The E-Comic Strip

The e-comic strip is a student-centered activity defined as a textual technique within the narrative genre, where stories are told through texts and images intentionally structured to evoke an aesthetic response in readers upon reading. This characteristic of combining text with images is one of the most outstanding features of comic strips, as it allows for the retention of information conveyed in each part of the narrative in a more substantial way (Mosquera & Rendón, 2021). For some authors, the origin of comic strips dates back to prehistory, with cave paintings, while others associate it with the invention of the printing press. However, it wasn't until 1894 that the comic strip as we know it today was born. The first comic strip was published in the New York World newspaper in 1876, featuring *The Yellow Kid*, where a narrative in panels depicting the life and actions of the characters, as well as descriptions of

their expressions, was presented (Maza, 2012). In 1920, comic strips transitioned from newspaper to formal publications. In 1938, the first standalone issue appeared featuring Superman. With this event, the true origin of comic strips, as we know them today, is established (Salinas, 2022).

The comic strip is considered a multimodal text where visually constructed experiences enable the understanding of culture (Pickel, 2018). Most authors agree that comic strips handle textual multimodality with elements such as panels, kinetic lines, visual metaphors, text, speech bubbles, images, perspectives, layout, and chromatic codes. Regarding the textual style, comic strips use satirical, lyrical, and aesthetic language to transmit the values and lifestyles of a particular society. They implement the structure of literary narrative where sequentiality in chapters or episodes is employed to give progression to the stories told (Cordero & Mejía, 2021). Besides, rhetorical figures predominate, enriching the texts with aesthetic resources to capture attention and interest (Vilches-Fuentes, 2019).

The e-comic strip can be employed as a didactic support tool in communication and culture. However, it is essential to develop narrative competence and reading ability in students based on the sociocultural elements of the language because its reading is not like any other. The decoding and interpreting process involves knowledge of the cultural-linguistic expressions and codes in which the comic strip was created (Flantrmsky, 2022). In foreign language teaching, the comic strip is considered a discursive technique that significantly enhances lexical learning and dynamizes the development of communicative competencies (Jiménez-Arriagada et al., 2020).

Moreover, in works such as those by Soto-Cano (2019) and Córdoba-Baldrich & Maturana (2022), the use of the comic strip is a resource for developing students' linguistic, pragmatic, and sociolinguistic competencies in a foreign language. They also see it as a mediator to encourage reading due to its attractive nature. Additionally, Huerta & Ortega (2021) emphasize its use to work on vocabulary and its retention through association and playful learning. Moreover, it aids in working on communicative activities of reception and production, both oral and written (Martínez, 2023). All these aspects together promote conscious vocabulary learning in an everyday context.

Methodology

To ascertain how the e-comics supported by the Canva, Makebeliefscomix, and Pixton applications influence the lexical competence development in a virtual environment at higher education, the present study uses an experimental design aimed at manipulating the independent variable (use of e-comics with three applications based on tasks) to observe its possible effect on the dependent variable [development of lexical competence (LC)] (Hernández-Sampieri & Mendoza, 2018). To this end, there is an experimental and a control group. To register how e-comics influence the LC, a techno-pedagogical model was applied in the experimental group to develop such LC using e-comics through Canva, Makebeliefscomix, and Pixton with three tasks. In contrast, the control group developed their LC with traditional methods, isolated from the proposed techno-pedagogical model. Finally, to test and verify the

plausibility of the proposal, pre-and post-treatment tests were administered to measure the effect of using e-comics with the applications for vocabulary learning. Therefore, the study is a cross-sectional quantitative study with an associative design based on the following hypothesis: The use of e-comics supported by Canva, Makebeliefscomix, and Pixton influences the development of LC in a foreign language in virtual environments.

Instruments: Pre-treatment, Treatment, and Post-treatment

The following instruments were used in the three phases:

- Pre and post-treatment. A standardized test was administered to measure the students' lexical repertoire, taking the CEFR levels as a reference to record the possible influence of e-comics after working with the techno-pedagogical design (treatment). It had a multiple-choice format, including filling in the blanks, unscrambling, and selecting the word that best fits a context.
- Treatment. A technology-mediated model was designed to teach vocabulary through e-comics using Canva, Makebeliefscomix, and Pixton according to three tasks based on the Technique Features Analysis (TFA) Model (see Table 3). It is hosted on the Moodle platform with hyperlinks to the Canva, Makebeliefscomix, and Pixton applications so that students can create comic strips based on three tasks and a set of 300 pre-specified words determined from the CEFR for Languages and according to the level corresponding to the critical path of the English Teaching Bachelor program. Table 1 shows the design of the techno-pedagogical model.

Table 1
Design of the Techno-Pedagogical Model

Tasks with applications	**Target words**	**Implementation**	**Instruments to evaluate this phase**	
Canva Makebeliefscomix Pixton	100 different words for each application (40 nouns, 40 verbs, and 20 adjectives)	25 words were worked per week in 3 two-hour sessions during a month for each application.	18 components from the TFA model to measure the lexical acquisition with apps based on tasks	Productive and receptive acquisition tests to measure students' LC with each application

Tasks for Each Application

Canva

1. Students carried out individual recreational activities for the presentation of keywords, their recovery, and memory (word search and crossword puzzles).

2. Subsequently, they used collaborative graphic organizers to categorize ideas, working on spaced recovery and the form-meaning union with the main ideas of the dialogues for the comic.
3. Finally, they elaborated the narrative outline individually, using the dialogues created in the previous classes to match them with the pre-designed images in Canva, allowing productive recovery and recognition of the mental representation of the concept. Thus, the students became aware of learning the new lexicon, stimulating their motivation for learning.

Makebeliefscomix

1. A collaborative reading of instructions was carried out, establishing the target lexical learning and the exemplification to elaborate on each part of the comic.
2. Each student developed their e-comic, choosing characters and settings to associate images with their stories to promote form-meaning identification, recovery, and memory.
3. Finally, the story is built by adding dialogue balloons in which attention to the keywords and spaced and productive recovery took place for the narrative thread, contributing to the awareness of learning new lexis and motivation towards the process.

Pixton

1. Students' attention was encouraged through an individual activity by highlighting the target words and clarifying the lexical learning objective to associate them with images to remember their meaning through the mental-lexical image. After that, students select the keywords for vocabulary recovery, representing their understanding through the form-meaning union.
2. Participants did a group activity called the use of context that consisted of multiple recoveries of the keywords in different exercises provided by the teacher like the construction and combination of sentences with exemplification, spaced recovery with gap filling, and productive recovery with the generation of simple texts
3. As a final activity, they individually wrote the narrative of the e-comic, taking into account the productive generation of the dialogues and the marking of keywords to be aware of the new vocabulary. Then, the students read aloud to identify the key ideas in their narratives and negotiated the correct use of words in the dialogues to avoid interference or confusion, contemplating the high degree of generation in the final evidence of their learning, enhancing their motivation in this task.

The activities were both individual and collaborative, based on active methodologies, gamification, and the use of technological applications. Besides, to evaluate the participants' LC in each implementation period, two instruments were used:

- Receptive and productive written tests were used to evaluate the three applications where every 100 words have a ten-weighted score in both instruments. The receptive test consists of a list of 100 target words for each application in English and asks the student to enter their meaning in Spanish. In contrast, the productive test contains the same target words in Spanish and asks the student to write them in English.

- In each task, the TFA model was used to identify which of the three applications promotes the most vocabulary learning, based on the premise that 1 means presence and 0 absence of each element belonging to five categories: motivation, notation, recovery, generation, and retention with a maximum of 18 points [see Table 3] (Nation & Webb, 2011).

Sample

Sixty first-semester students, the entire population of the English Teaching Bachelor of the Benemérita Universidad Autónoma de Puebla, who signed the informed consent form, participated in this research. Some of their characteristics are low proficiency level in communicative situations, lack of lexical background to interact in varied situations or contexts, and enrolled in virtual classes for six hours a week. Half of the students were randomly assigned to the control group and the rest to the experimental group.

Data Collection and Analysis

Data collection was done in three phases. Phase 1: Pre-treatment. This was administered at the beginning of the study and before the treatment to both the control and experimental groups to assess their level of lexical competence. Phase 2: Treatment. Data was collected only from the experimental group at the end of each implementation of the applications (Canva, Makebeliefscomix, and Pixton). First, the receptive test was administered individually. Subsequently, the teacher administered the TFA instrument as a group so that each student recognized the absence or presence of the 18 elements in each application task. Finally, each participant answered the productive test. Phase 3: Post-treatment. This was administered after the treatment to both groups and at the end of the 2023 semester to obtain a reference for evaluating the proposal and to corroborate the hypothesis. Table 2 presents the data analysis model used to display the results.

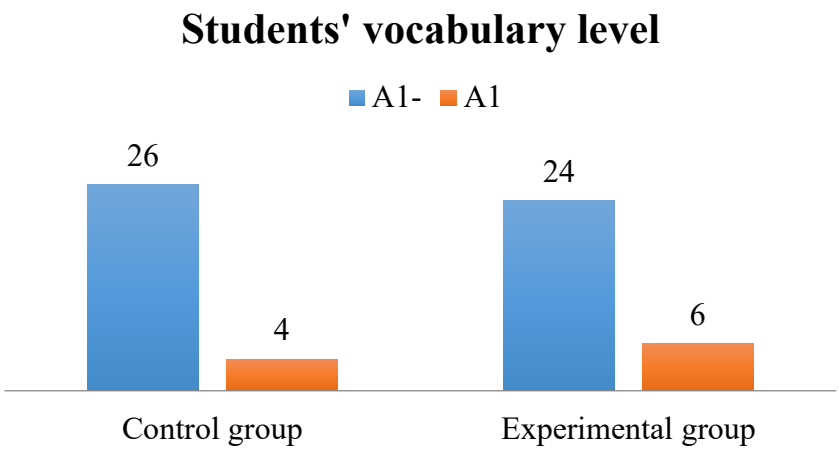
Table 2
Analysis Model. Own Elaboration

Phases	Purpose
Pre-treatment	Measure initial lexical competence
Treatment	Measure vocabulary learning from e-comic strips using the Canva, Makebeliefscomix, and Pixton applications
Post-treatment	Measure final lexical competence

Results

The following section presents findings related to participants' baseline LC, the results of LC according to the TFA model, the receptive and productive tests, and the post-treatment results to analyze and verify the influence of e-comics on LC.

Figure 1
Pre-Treatment Stage Results



As seen in Figure 1, in both groups, a majority of students are at level A1- (26 in the control and 24 in the experimental group), with only a few students at level A2 (4 in the control and 6 in the experimental group. The graph corroborates the background information on the participants, as it shows a lack of vocabulary diversity, resulting in the use of simple words and phrases that do not align with the level demanded by the course. It has led to poor communication, which can even cause misunderstandings. The results suggest a limited development of higher-level linguistic skills, impacting reading comprehension and written production. It underscores that a limited vocabulary hinders the successful expression and communication of ideas, affecting the student's confidence and motivation to communicate in the target language, in this case, English.

Treatment

Table 3
Components and Criteria of the Technique Feature Analysis (TFA) Model. Source: Nation and Webb, 2011.

		Number of students who perceived presence of element		
Criterion	**Explanation**	**Week 1-4 Canva**	**Week 5-8 Makebeliefs comix**	**Week 9-12 Pixton**
		N=30	**N=30**	**N=30**
Motivation				
1. Objective: lexical learning	Is there a clear objective for lexical learning?	2	**29**	**29**
2. Motivation toward learning	Do they motivate students?	**29**	**28**	**29**

3. Student word selection	Do students choose the words they will learn?	1	2	**30**
Noticing				
4. Attention to keywords	Does it encourage students to pay attention to keywords?	3	**27**	**30**
5. Awareness of new lexical learning	Does the activity make students aware they are learning new vocabulary?	**28**	**29**	**30**
6. Negotiation	Does the activity offer negotiation opportunities?	1	2	**29**
Retrievaal				
7. Retrieval	Does the activity provide retrieval opportunities?	**28**	**29**	**30**
8. Productive retrieval	Is there productive retrieval?	**29**	**29**	**30**
9. Recall	Does it involve recall?	**28**	**29**	**30**
10. Multiple retrievals	Does the activity involve multiple retrieval opportunities for each keyword?	1	1	**30**
11. Spaced retrievals	Does the activity lead to spaced retrievals?	**27**	**29**	**30**
Generation				
12. Generation	Does the activity promote generation?	2	**29**	**30**
13. Productive generation	Does the activity involve productive generation?	2	3	**30**
14. High degree of generation	Does the activity involve a high degree of generation?	0	1	**29**
Retention				
15. Retention	Does the activity provide opportunities to successfully link form and meaning?	**28**	**29**	**30**

16. Exemplification	Does the activity promote exemplification?	1	**30**	**30**
17. Mental image of the concept	Does the activity promote a mental image of the concept?	**30**	1	**30**
18. Avoiding interference	Does the activity avoid interference or confussion between words?	0	0	**30**

In the first month when using Canva, majority of participants distinguished 8 out of 18 components of the TFA model: one component for the motivation dimension (motivation towards learning), one component for notoriety (awareness of learning new lexicon) with the generation of the outline of its narrative, four for recovery (recovery, productive recovery, remembering, spaced recovery), and two of retention (form-meaning union and mental image of the concept) with recreational activities, use of graphic organizers and writing the narrative. For the generation dimension with the Canva application, they did not identify any of its three components.

During the second month, while working with the Makebeliefscomix application, students pointed out 11 of the 18 components of the TFA model. In each dimension, they observed the lack of one or two components. Considering the motivation category, the clarity of the lexical learning objectives and motivation towards learning through construction activities in the comic stood out. For noticing, they consider attention to keywords and awareness of the new lexicon in the comic construction. In the recovery component, the evocation and form-meaning union through associated images with meanings stood out, as well as productive and spaced recoveries. Finally, through reading instructions aloud, they perceived the receptive generative use of the word and exemplification.

In the third month with Pixton, participants recognized the development of the 18 components of the 5-dimensional TFA model in the task. With the activity of using or reusing the keyword, they identified lexical learning objectives, a motivation towards learning, and an appropriate selection of words. In the dimension of noticing, the reading activity with marking allowed them to highlight the attention to the keywords, become aware of learning new lexis, and manage negotiation. The mental-lexical image activity helped them perform the productive, multiple, and spaced retrieval tasks. In the case of the generation component, reading aloud detonated productive generation and a high degree of generation through creativity and appropriate use of words. Finally, the mental-lexical image task promoted retention by stimulating the form-meaning union, exemplification, and mental concept image, avoiding interference.

At the end of the four weeks of working with each application, receptive and productive acquisition tests were administered to identify the average lexical knowledge of participants' target words after the treatment.

Table 4
Results of the Receptive Acquisition Test

	Sum of grades	Average	Variance	TFA elements
Canva	243	8.10	0.67	8
Makebeliefscomix	262	8.73	0.76	11
Pixton	283	9.43	0.58	18

Pixton reflects the highest average in receptive acquisition (Table 4) and less variability in ratings (Table 3). These data indicate that the majority of students have a consistent and positive opinion about the application to learn vocabulary. Besides, Makebeliefscomix has a high average but presents dispersion in the grades, so the students' perceptions vary. Finally, Canva shows the lowest average and an intermediate variance. Then, students evaluated it more uniformly but less favorably than the other applications.

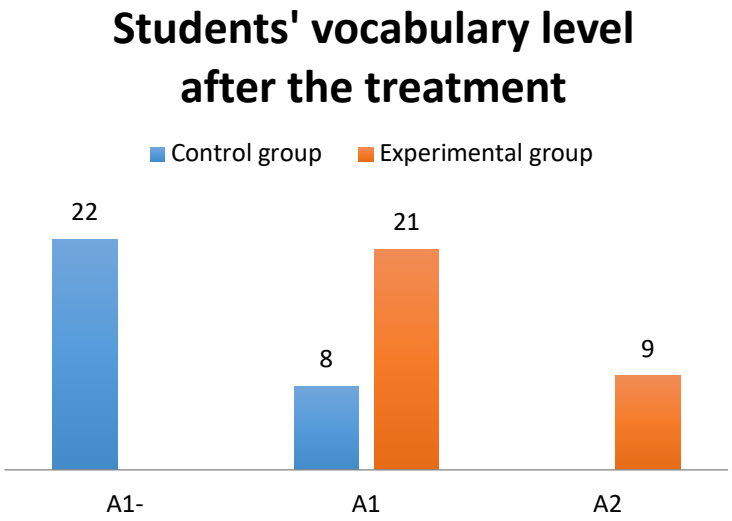
Table 5
Results of the Productive Acquisition Test

	Sum of grades	Average	Variance
Canva	242	8.07	0.26
Makebeliefscomix	261	8.70	0.22
Pixton	281	9.37	0.18

Pixton recorded the highest average along with the lowest variance in the productive aquisition test, making it the best-evaluated tool, with strong consensus for user satisfaction. Makebeliefscomix has a lower average than Pixton and a lower variance than Canva, however, satisfaction with this tool is more consistent despite the lower average. Last but not the least, Canva reports the lowest average but high variance, which means that opinions about this tool are discrepant.

Post-Treatment

Figure 2
Results of the Post-Diagnostic Stage



With a radical change in experimental group and minimal change in control group, the results highlight the relevance of implementing e-comics to develop lexical competence. Post-treatment, 21 students are at level A1, and nine students at A2. In contrast, only four more students from the control group reached level A2 compared to the pre-treatment stage, where eight students were at this level and 22 at level A1-. This phase demonstrates a positive association between e-comics and LC, asserting that digital co mics with three applications influence the development of students' lexical competence.

Discussion

The findings suggest that the use of e-comics as a pedagogical tool promotes lexical competence in English as a foreign language, which was achieved from ludic, creative, and dynamic activities based on the components of the TFA, exposing the student to keywords within dialogues and texts for subsequent recovery and use, improving the acquisition of new vocabulary. These indicators coincide with the studies by Hidalgo (2020), Breda (2021), Aristu & Torres (2021), and Verano & Carrillo (2023).

In the process of using Canva to create the first e-comic, the individual recreational activities proved to be plausible for lexical learning due to the activation of 8 TFA components such as motivation towards learning from the tasks, awareness of learning new vocabulary, recovery, productive and spaced recoveries, memory retrievals, form-meaning union and mental image of the concept. The findings indicate that the presentation and retrieval of target words through exercises such as word searches, crossword puzzles, and e-comics facilitated the memorization and learning of target words. This data matches Mayer's (2017) assertion that learning based

on interactive activities significantly improves information retention by involving students in active and continuous learning.

Furthermore, the development of collaborative graphic organizers with Canva allowed the categorization of ideas and spaced retrievals, techniques that enabled the visual organization of information, contributing to the connection between form and meaning, especially when they integrated their dialogues into digital narratives in the e-comic template. This supports Johnson & Johnson's (2019) assertion that collaborative learning leads to deeper and more retentive understanding. Finally, individual narratives using dialogues and clipart images in Canva favored productive recovery and recognition of the mental image, a process that reinforces the learned vocabulary, stimulating creativity and metacognitive awareness. In this way, visual applications and techniques enhance retention and understanding by creating a dynamic environment.

When creating the second e-comic with the application of Makebeliesfscomix, the 11 components identified by students for each dimension were: in the motivation dimension, clarity of the objectives of lexical learning and motivation towards learning generated by construction of the e-comics, seen as a unique experience to learn vocabulary that goes beyond memorization. As it was based on a design already established by the application itself, it promoted a didactic sequence guided through the construction of dialogues, scenes, and narratives in their e-comics. This coincides with the study by Sanhueza (2018), which alludes to the idea that narrative activities promote the generation process that deals with the reconceptualization processing. Thus, it consists of generating or creatively using the vocabulary acquired in a different context within e-comics.

In the noticing dimension, the results showed that with this application, students focused their attention on word marking and becoming aware of the new lexicon, which led them to focus on the target word connotation, being aware of their lexical growth and learning. Similarly, Gohar et al. (2018) and Sánchez et al. (2019) also found that input in the comic helps highlight and capture students' curiosity towards a target word, improving lexical memory.

In the recovery dimension, productive and spaced recovery was highlighted and remembered due to image-meaning association, making students creative and facilitating the assimilation of the new lexicon. This is in line with studies by Palacios & Plazas (2019) and Morales (2021), who mention that comic illustrations generate emotions, positively influencing the student's attitude toward learning and stimulating their imagination, facilitating conceptual assimilation due to the visual-lexical association process in multiple scenarios. Besides, images helped generate a playful environment that favors understanding the communicative situation, as Marin's (2022) study shows.

Considering retention, form-meaning union, and exemplification were identified with the practice of writing the e-comic sentences taking into account the contextualization and correct use of the words in combination and sentence construction activities as mentioned by Olagbaju & Popoola (2020) in their study. Finally, in the generation dimension, receptive generative use

was achieved by reading instructions aloud and writing their e-comics, stimulating their creativity, and increasing lexicon, coinciding with Jiménez's work (2023).

Regarding the third e-comic design with the Pixton application, the students developed the most vocabulary acquisition according to the receptive and productive tests and a post-treatment test. This is because of the activation of the 18 components of the dimensions from the TFA model thanks to the ludic, dynamic, and creative activities. Students perceived the motivation of lexical learning through experimenting with activities that focused on the clarity of the lexical learning objective and an appropriate selection of words. Findings by Caiza (2023) and Jiménez (2023) similarly affirm that activities using target words in sentence replacement favor retention.

In noticing, students could highlight attention to keywords, be aware of learning the new lexicon, and manage negotiation of meanings with activities such as reading and marking the words within their productions. Olagbaju & Popoola (2020) and Tovar & Pineda (2021) have also demonstrated that target-word noticing in narrative texts allows students to become aware of vocabulary use, developing lexical competence. Furthermore, mental-lexical image activity, sentence combination and construction, gap filling, and image-to-lexical association in Pixton performed productive, multiple, and spaced retrieval tasks, similar to Chinga & Pérez's study (2023), where sentence creation allows students to understand the use of keyword in different writing situations.

In the case of the retention dimension, four elements are present for the treatement group: the form-meaning union, exemplification, mental image of the concept, and interference avoided, thanks to the mental-lexical image task that took place at the same time when the students designed the characters, settings, and images they used in their e-comics. This confirms the findings by Alcaraz-Mármol (2021) and Hidalgo (2020) that the mental image of the word stimulates creativity in writing dialogues in a comic strip and avoids word confusion.

Finally, in the generation dimension, the students focused on writing their e-comic and reading it aloud to develop a productive and high-grade generation that evidenced creativity and appropriate use of words. Similar studies by Sanhueza (2018), Sánchez et al. (2019), and Nadal & Thome (2021) affirm that the implementation of reading aloud as a generative activity promotes clarity of meaning of words, expanding lexical knowledge.

It follows that using the e-comic strip based on intentional activities is more conducive to improving vocabulary learning in English, primarily promoting the retrieval, creation, and extension of the lexicon. Moreover, the results show that the e-comic strip stimulates students' creativity through visual, sensory, and graphic elements that capture their attention, promote active participation, and increase L2 literacy. To achieve this, the teacher selects specific lexical content and segments the comic strip's themes into semantic fields that categorize the words for easy assimilation (Caiza, 2023). In linguistic terms, the comic strip emphasizes deducing lexical meaning through its illustrations and situational content. In summary, the e-

comic strip offers a new, easily readable experience with simple and accessible syntax, creating enriching experiences with varied linguistic and lexical content.

It is worth mentioning that previous studies have focused on activities using physical materials and are conducted in face-to-face settings (Hu & Nassaji, 2016; Zou & Xie, 2018 and Nakata & Webb, 2016). The contribution of this study lies in its analysis of the development of lexical competence through technology-mediated activities in a virtual environment.

Recommendations

The didactic applications of e-comics go beyond simple language exposure making it a favorable means for learning vocabulary in a foreign language. However, it is worth noting that one of the main limitations of this research is the sample size, as it only works with English language learning. There is also variation in the participants' performance with each app, prompting reflection on the possibility of considering the specific characteristics of the applications used in activities. Thus, exposing students to different resources may lead to enriched data to interpret individual perceptions (Hidalgo, 2020). Secondly, before replicating the research in favor of innovating teaching practices in hybrid or virtual environments, we suggest verifying that participants have access to the Internet and possess a device for work, as well as minimal digital skills to carry out their activities. Teachers need to design a techno-pedagogical model framed within an active methodology and aligned with their program, containing activities with explanatory tutorials and evaluation instruments. Finally, we recommend collecting qualitative data to complement quantitative findings for a more complete understanding of the phenomenon.

It is crucial to consider these limitations for future research and expose the same groups to different treatments. Thus, future research could explore the influence of grammatical categories and their relationships for vocabulary learning, implications of incidental vocabulary teaching mediated by technology, the articulation between writing and reading in L2 through comics, creativity in discursive areas, the digitalization of comic strips as a techno-pedagogical tool, the development of cultural and colloquial language in L2 through narrative comics, cultural analysis through idiomatic expressions in English, among others.

Conclusion

As a pedagogical resource for vocabulary learning in English, the comic strip has proven to be a creative medium to develop receptive and productive lexical skills. The activities developed around its application generated motivation, creativity, and student engagement in new learning. This process of interest contributed to the cognitive processing of reflective recall, reducing lexical forgetting. The characteristics of the comic strip, such as visibility, graphics, and color, generated confidence and enthusiasm for actively participating in constructive exercises. Likewise, these properties stimulated the student's memory through the form-meaning association of words, reinforcing lexical recall. Additionally, the search for word meanings encouraged participants to expand their tools and sources of information. They

utilized dialogue, negotiation, internal memory, and various means to diversify their resources, thus demonstrating a more active and committed approach to their learning.

At the same time, negotiation promoted the development of communicative skills in the language, significantly improving the student's oral and written expression. Regarding form retrieval, it was also observed that using definitions or derivations mitigated confusion or guessing of word connotations. The tasks of filling in gaps, creating sentences, and writing a comic strip did not merely involve using notable words but also activated the cognitive base for lexical learning through decontextualization exercises. These activities stimulated the need for appropriate use of the learned words, which in the long term led to their satisfactory application in different communicative contexts. Similarly, enhanced analysis and synthesis skills offered by ICTs, created innovative spaces for activities and fostering creativity in task design. The digitalization of exercises facilitated the development of technological competencies related to learning English vocabulary.

Finally, it is essential to highlight that our hypothesis was confirmed, demonstrating that the e-comic strips as a pedagogical tool supported by technological mediation (using applications like Canva, Makebeliefscomix, and Pixton) with well-designed activities is effective for learning vocabulary and even developing reading and writing skills in an innovative and motivational way from the student's perspective; a model that addresses the needs and demands of today's educational modalities.

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