

Digital graphic organizers as a tool to foster reading comprehension

Organizadores gráficos digitales como herramienta para fomentar la comprensión lectora

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Abstract

Foreign language learners have difficulties understanding texts because they try to code and decode in their mother tongue; then, the necessity of looking for a strategy to help them is crucial. The objective of this research is to show how digital graphic organizers (DGOs) help students develop reading comprehension, especially in understanding the evolution of the English language. The review of different theories about DGOs guided to identify a proto-typed model of analysis and design digital activities to represent students' understanding of a text. Methodologically, an experimental design consisting of pre and post-treatment tests were applied in the control and experimental group, during fall 2019 in the English Language Teaching Bachelor at BUAP, on a sample of 60 subjects. A treatment phase (didactic intervention) to prove the suitability of the proposal took place by using DGOs as a tool to promote reading comprehension of texts and knowledge representation. The most outstanding results were a deeper understanding of facts, historical events, the ability to synthesize information with DGOs, and the motivation to read about historical events. In conclusion, this way of developing understanding and representation of the knowledge was perceived positively by the subjects.

Digital graphic organizers, Reading comprehension, Knowledge representation

Resumen

Los estudiantes de lenguas extranjeras enfrentan dificultades para comprender textos porque codifican y decodifican en su lengua materna; por ende, es crucial la búsqueda de una estrategia que subsane dicha problemática. El objetivo de esta investigación es mostrar cómo los organizadores gráficos digitales (OGDs) ayudan a los estudiantes a desarrollar la comprensión lectora, especialmente en la evolución del inglés. Se revisaron diferentes teorías sobre OGDs, obteniéndose un modelo de análisis prototipo a partir del cual se diseñaron actividades digitales para representar la comprensión de los estudiantes. Metodológicamente, se aplicó un diseño experimental consistente en pruebas pre y pos-tratamiento a un grupo control y experimental, durante el otoño de 2019 en la Licenciatura en Enseñanza del Inglés, BUAP, en una muestra de 60 sujetos. Para probar la idoneidad de esta propuesta, se diseñó un tratamiento (intervención didáctica) utilizando los OGDs como herramienta para promover la comprensión lectora de textos y la representación del conocimiento. Los resultados más destacados fueron una comprensión más profunda de los hechos y eventos históricos así como la motivación para leer sobre estos y la capacidad de sintetizar información con los OGDs. En conclusión, los sujetos percibieron positivamente la forma de desarrollar la comprensión y representación del conocimiento.

Organizadores gráficos digitales, Comprensión lectora, Representación del conocimiento

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Introduction

Speaking a foreign language like English is a process that requires different skills such as oral, written, reading, and listening. At this point, it is worth mentioning that one of the complex skills to foster in a student is reading. It implies a comprehension process where the learner requires not only to know the vocabulary or grammatical structures but also to read among lines, code, and decode written symbols into sentences and apprehend their meaning to be able to represent what they understood either orally or written, in a process called knowledge representation.

In addition to the above, students sometimes consider reading as complex while it should not be because the proficient reading skill leads to success; otherwise, they will have difficulties like an unsatisfied reading process, comprehension skills decline, and poor spelling and writing.

Other features that contributed to the perceptions of reading as complex are the students' feelings towards it and misconceptions like being described as a process that focuses on every single word, how it is pronounced, and what it means, read one-by-one loudly or read fast with the correct pronunciation.

There is a misunderstanding of what reading is and what the reading process is all about. Then, teachers should look for attractive ways to promote it in and outside the classroom like in this study since students have to read about the history of the language to understand how the English language has been changing from old English until the late modern English period, and comprehend the linguistic, phonological, and stylistic changes among other facts.

Due to all the above, the objective of the present study is to show how digital graphic organizers could help students not only to understand facts but also to grasp the evolution process of the English language.

The present study contributes to the teaching-learning process by providing an instructional model to promote reading comprehension for on-site sessions and virtual environments consisting of using digital graphic organizers as a means to represent their reading comprehension and knowledge from a given text.

It also provides ideas to innovate the teaching practice in terms of the development of collaborative work, reading strategies, and learning of the foreign language at the linguistic and discursive levels since students read said language in a historical context.

Literature review

It is necessary to define concepts related to reading, reading comprehension, graphic organizers, and knowledge representation to have a complete view of the study.

Reading

It should be clear that reading is more than pronunciation or a decoding activity even though when someone reads, he receives written symbols and uses his cognitive process to build up sentences and paragraphs to convey a message. Indeed, reading is a comprehension process that provides students with ways to represent what they understood from a text, either orally or written. Thus, reading classes should focus on providing strategies to recognize main ideas and supporting ideas to have a complete appreciation of a given text and do a mental representation of their knowledge.

Alderson (2000, p. 3) mentions that “the process is likely to be dynamic, variable, and different for the same reader on the same text at a different time or with a different purpose in reading”.

It supposes that in the reading process, readers expect to get new information depending on the type of reading they choose. According to Grellet (1981), they are scanning, skimming, extensive and intensive reading, and all of them interact in the reading act.

For the present study, reading is an active process that asks readers to recognize words to construct meaning based on the new information from the text and previous reader's knowledge to be able to represent that new accumulation of data.

As can be seen, reading needs some instruction and planning since it is not acquired naturally. According to Zuñiga (2001), reading in English as a foreign language demands not only to decode written symbols, know the vocabulary and grammatical structures but also to recognize the cultural background of that specific context to build up meanings.

The latter features show that reading is a complex process due to its multifaceted stages and different variables that take place in the reading comprehension process.

Reading comprehension

Reading in a foreign language asks for the implementation of strategies or models to carry out reading comprehension. According to Flores-González (2019, p. 45), "strategies are procedures used to regulate the activity of the reader within the process of reading comprehension".

Some authors like Alderson (2000), Sereno and Rayner (2003), Carrell (1998), and Goodman (1982) distinguish two models to extract meaning from a text during the reading comprehension stage: bottom-up and top-down processes. The former deals with decoding symbols into words, sentences, paragraphs, and even a complete reading (Carrell, 1998). The latter fixes attention on the relationship between the information from the text and the reader's linguistic, cultural, historical, and syntactic knowledge to get meaning.

A second model called the Interactive model of reading conceives it as a mix of the two previous models. That is why Hedge (2000, p. 188) mentions that "reading can be seen as a kind of dialogue between the reader and the text, or even between the reader and the author" where the first one uses morphological, sociocultural, topic, genre, syntactic and general world knowledge to make sense of the text.

Furthermore, Vaezi (2006), Liao in Hong (2013), Katheleen (1986), Djuwarsih (2006), Macleod in Abdelrahman (2014), and Fatmawati (2014) state that skimming, scanning, prediction, inference, and summary are the core of comprehension strategies and successful reading process.

At this point, McNamara, Boonthum, Levinstein & Millis (2009: 218) mention that "reading strategies are more useful and beneficial for learners who show lack of knowledge in the domain of reading, as well as those with lower reading skill, these kinds of learners are strongly needed to these strategies to achieve reading comprehension".

Besides, there are other strategies which can help learners to understand a text while interacting with it and develop reading comprehension in different environments or contexts such as brainstorming, comparison-contrast chart, question-answer, KWL (Know-Want-Learn), using prior knowledge (previewing), story maps, and graphic organizers among others. Thus, in the following lines, they are described in detail.

Brainstorming. It elicits students' ideas toward a specific topic. According to Arivananthan (2015, p. 1), "brainstorming is meant to stimulate or excite the brain into thinking about issues in a new way. It encourages people to arrest conventional, logical thinking and embrace spontaneity, originality, and imagination". Then, this technique promotes the activation of prior knowledge (linguistic, syntactic, cultural, historical, and social) to engage students in the main topic and focus their attention on the task goal so that they could corroborate or refute their assumptions once they read the text.

Comparison-contrast chart. It consists of analyzing the similarities and differences in given topics, people, and objects. Its format provides students a practical way to organize information into a meaningful representation of what they understood from a text and even summarize it demonstrating some relationships between concepts like cause and effect. Asking students to perform a comparative analysis based on that two criteria is a suitable strategy that guides them to show outstanding achievements in specific areas or contents (Marzano, 2007).

Question-answer. This strategy not only motivates students to ask and answer questions but also to focus on the meaning of a text. Using it in the reading comprehension process requires teachers to design a model of interaction by determining relevant questions to detonate participation and provide students with the ad hoc strategies to identify answers. According to Jones (2007), this strategy shows the relationship between the question and the answer. It makes the reader uses his previous knowledge and the information from the text to provide that answer.

It means that the strategy makes learners go through imbalance, accommodation, and assimilation to achieve reading comprehension. KWL (Know-Want-Learn). It comprises three steps what I know, what I want, and what I learn. In the first one, readers predict what the text or topic is about before reading it. In the second, readers express what they want to learn or corroborate based on what they already know, and finally, in the last step, they look for the answers of what they want to learn or what they wrote in the second stage. According to Ogle (1986), it is useful to approach reading in three phases that are prior, during, and after the reading act, using prior knowledge (previewing). Therefore, this strategy is suitable to accomplish knowledge representation.

Story maps. They are highly recommendable for describing historical themes or narrative genres due to the incorporation of specific features from a text such as setting, characters, plot, and them. Regarding Duman cited by Isikdogan and Kargin (2010: 4), "Story map is a schema construction technique that involves teaching the relationships of parts of a story to the reader and giving basic elements of the story in a schema in order to draw the attention of the reader".

Graphic organizers. They allow readers to elaborate representations of keywords from a text. The following section describes them broadly.

Graphic organizers

As it is well known, there is not a simple method or strategy to encourage reading more, developing reading comprehension and knowledge representation.

That is why there is too much interest in this field, and proof of this is the following facts. On the one hand, taking into account the difficulty of reading comprehension and considered as the final result of reading, it is a phenomenon studied from elementary until higher education levels (Au, 2000; Greenleaf et al., 2001; Balfanz, 2002; Moore et al., 1999; Ruddell et al., 1994). On the other hand, in the literature review, there are lots of studies that suggest a variety of methods, approaches, strategies, and techniques to teach reading meaningfully (Bender et al., 2009; Farris et al., 2004; Duffy, 2009, Grabe, 2009; Chesla, 2000; Beuhl, 2008, Flores-González, et al., 2018; Barzilai et al., 2020). Besides, they have been implementing in different fields like chemistry, biology, social sciences, and others.

Regarding the information above, the present study proposes digital graphic organizers as a strategy to develop reading comprehension and knowledge representation. At this point, it is essential to define and understand how to use them in the reading comprehension process.

Graphic organizers. They are strategic tools for the teaching-learning process to organize information into visual representations showing connections between concepts, facts, and terms in a historical sequence. According to Jones (2007, p.1), the organization of information follows different ways like

- According to main ideas, subtopics, and details.
- In sequence.
- To show the relationships between the different parts.
- According to the similarities and differences between two or more concepts.
- By its components, as in the elements of a story.
- ... and lots of other ways.

Besides, they are used before, during, or after reading to improve comprehension and help students understand text structure or arrange textual information in a way that makes recall information easier as in Bean and Steenwyk's study (1984).

Citing Coburn, graphic organizers are:

... diagrams that represent the relationships between facts, ideas, and concepts. They come in many forms, including flowcharts, webbing, concept mapping, and matrixes. They are not organized in a linear format according to a sequence like traditional outlines; instead, they convey relationships through a visual format that are linked and ordered through a conceptual framework (2003, p. 46).

There are different types of graphic organizers like mind and concept mapping, Venn diagram, timeline, and spider web organizers, among others, to represent knowledge from a text. For the present study, timeline, mind mapping, and spider web organizers were applied in a digital instructional design to grasp information from a written source.

Timeline. Based on various studies such as that of Arévalo (2015), students use different graphic organizers such as semantic networks, concept maps, synoptic tables, and timelines to systematize information to improve their reading comprehension. It is a schematic representation of events arranged chronologically for synthesizing information from reading comprehension and relating it to other ideas. Particularly, this organizer shows a summary of a historical event by identifying its crucial elements such as characters, setting, dates, main events taking place in the narration, causes, and effects.

Mind mapping. Its purpose is to recognize the main topic and establish conceptual relationships spontaneously from efficient reading comprehension. Regarding its characteristics, it demands the organization of knowledge from brainstorming, efficient retention of reading comprehension, and note-taking through drawings, images, and lines.

In other words, they are diagrams that enhance creative thinking through a hierarchy of sequence and logical scheme, and according to Mamani (2010), mind mapping is a way to face problems with reading comprehension.

Spider web organizers. It schematizes knowledge from reading comprehension in a hierarchical way by capturing the relationship of multiple categories with a category that represents the central nucleus. Taking into account Pimienta (2012), the spider webs are schemes that categorized data as topic and subtopics pointing out their characteristics.

How to use graphic organizers to develop reading comprehension?

During its usage, teachers should show how to do them with examples, and later, ask students to do their design with their guidance so that they work independently in due course.

Their implementation requires establishing at least two steps.

- Students' training is necessary for designing to develop some familiarity with formats and how to work with them.
- Teachers must accomplish some changes in guidance and feedback during the process taking into account the cycle of activities during the pre-while-post reading.

McTighe, as cited in Praveen and Premalatha (2013, p.156), proposed that before instruction, graphic organizers should be used to assess the level of the students in terms of understanding. During instruction, thinking is supported by graphic organizers allowing students to explore the content from a cognitive angle. After instruction, organizers help students to summarize the text and to assess their own improvement.

Finally, since reading is an interactive and active task, the implementation of graphic organizers could be applied in groups or pairs to develop collaborative or cooperative work.

Knowledge representation

There is not an agreement to determine why its name and how to evaluate it, but it is the process that allows learners to show information, knowledge, and in general, their comprehension from a source.

In the case of reading, it lets students demonstrate evidence of what they read by being able to represent the information in their own words, showing the connection between their previous knowledge and the new information gotten from the text as a result of the assimilation and accommodation processes. All in all, knowledge representation studies the mental images of cognitive processes where that mental depiction is appropriate if the information and visual knowledge contribute to the formation of a competent user.

In conclusion, students face difficulties when decoding words, sentences, paragraphs, and a complete text, which inhibit reading comprehension and knowledge representation. Then, the suggestion is to look for alternatives to avoid them.

Methodology

Regarding methodology, the study followed a longitudinal experimental quantitative design with a descriptive scope consisting of pre- and post-treatment tests to identify comparison parameters and find out what reading comprehension was like before treatment (didactic intervention) and what happened after it.

Its selection was due to the necessity of evaluating the instructional design that according to Shuttleworth (2014), this is an ad hoc way to approach this phenomenon because it provides the following analysis: a) compare the post-treatment test from the two groups and analyze the effectiveness of the treatment phase, b) offer a whole scope of the control and experimental groups' changes by comparing the pre and post-treatment tests and c) compare the scores from the pre-treatment test to be sure about the random assignment of both groups respectively.

The table below shows the instruments used to collect the data.

Stages	Instruments
Pre-treatment test	Questionnaire of 50 items. Its objective was to measure the subjects' reading comprehension.
Treatment (Didactic intervention)	Instructional design. It comprises digital graphic organizers as a tool to develop reading comprehension and knowledge representation from written sources.
Post-treatment test	Questionnaire of 50 items. (It was the same used in the pre-treatment test). Its objective was to measure subjects' reading comprehension after the treatment, in the case of the experimental group.

Table 1 Instruments used to collect data

Context. This research was done in the English Language Teaching Bachelor at the Benemérita Universidad Autónoma de Puebla on a sample of 60 subjects who were taking the Evolución histórica de la Lengua Inglesa during fall 2019. Control and experimental groups were randomly assigned to be part of the source to get data and analyze this phenomenon of study.

The study comprises three main stages with a total duration of four months.

Stage 1. Pre-treatment test. It was applied at the beginning of the course and consisted of a reading comprehension test of 50 items. The control and experimental groups took it to measure their reading comprehension level.

Stage 2. Treatment. It was a didactic intervention composed of an instructional design based on digital graphic organizers (mind mapping, timeline, and spider webs) as a tool to develop reading comprehension and knowledge representation. It is worth pointing out that the treatment phase was only applied in the experimental group and lasted 14 weeks.

Stage 3. Post-treatment test. In this stage, the test from the pre-treatment measured subjects' reading comprehension level to analyze if there was any change, especially in the experimental group, who learned with the instructional design.

After the application of the instruments, the gathered data provides the following results.

Results

Stage 1. Pre-treatment

Pre-treatment test			
Subjects	Control Group	Subjects	Experimental Group
12	(8/50)	10	(7/50)
13	(9/50)	4	(11/50)
5	(4/50)	9	(4/50)
		7	(6/50)

Table 2 Subjects' reading comprehension level in the pre-treatment test

As the table shows, both groups got low scores. The main problems found were 1) subjects had a linear vision about the reading because they identified facts and elements in isolation. 2) There is no connection between the main idea and supporting ones, which avoids the general comprehension of the text. 3) They did not evidence a complete understanding of the given text when performing a task or solving an exercise because they did not recover the information, which reflected their poor comprehension. 4) They showed a lack of strategies to withhold information. 5) The answers they emitted reflected the lack of connections between the main concepts of the text due to the isolation reading process. 7) Besides, as they are narrative texts, subjects did not systematize the information, which inhibits the global understanding of a written source. 8) A literal reading is evidenced when the item demands an analysis. Indeed, the subjects presented a cognitive conflict because they expected to find the information explicitly in the text. 9) Finally, they spent an unsuccessful time reading, questioning, and retrieving information because they did not apply suitable reading comprehension strategies.

Stage 2

Treatment: instructional design based on the use of graphic organizers to understand narrative texts.

During the treatment, subjects from the experimental group used digital graphic organizers like mind mapping, timeline, and spider webs to represent their knowledge and comprehension of readings about the evolution of the English language for 14 weeks.

This cycle reading strategy used before, while, and after the interaction with a text allows the following:

- Have an interaction between the reader and the writer to present information visually
- Establish meaningful learning by implementing graphic organizers in reading framed in an instructional design according to the program of the subject
- Look for essential information in a text strategically
- Provide a way to graphically represent the relevant ideas of a text, their relationships (cause-consequence, a sequence of facts, and the structure of a written source.). In other words, the superstructure of the text
- Gradually build the meaning of the text to establish a mental model of facts and events described in it (knowledge representation)
- Identify the relationships established between the main ideas, the details that support them, and other items of information which build up the global understanding of a reading
- By structuring the information systematically in the graphic organizers, students easily remember the information that contributes to store it in the long-term memory, privileging their teaching-learning process.

One of the most distinguishable features of this stage was the subjects' motivation to read about historical events and positive perceptions toward the instructional design.

Stage 3

Post-treatment test. Evaluating subjects' reading comprehension level after the implementation of the instructional design.

At the end of the term, the post-treatment test was applied to both the control and experimental groups to identify if the last one showed any change regarding reading comprehension.

Subjects	Pre-treatment test	Subjects	Post-treatment test
12	(8/50)	13	(47/50)
13	(9/50)	7	(44/50)
5	(4/50)	5	(50/50)
		5	(41/50)

Table 3 Experimental group. Subjects' reading comprehension scores

Taking into account the information above, the experimental group demonstrated meaningful changes in their scores. These mean that the treatment, and in this case, the proposal of using digital graphic organizers, is suitable for the teaching of reading comprehension and knowledge representation.

Some of the most outstanding results were a deeper understanding of facts, historical events, ability to synthesize information with digital graphic organizers, and accurate completion of reading exercises with a higher level of difficulty.

Another dominant feature was that in the pre-test, they showed literal interpretations, and in this phase, they got an inferential level by using digital graphic organizers, which helped them to get high scores.

In the case of the control group, they showed some improvement too, but in comparison with the experimental group, the results from the last group were better.

Subjects	Pre-treatment test	Subjects	Post-treatment test
10	(7/50)	12	(27/50)
4	(11/50)	7	(23/50)
9	(4/50)	5	(15/50)
7	(6/50)	3	(21/50)
		3	(28/50)

Table 4 Control group. Subjects' reading comprehension scores

Subjects from this group showed some improvement; however, they still presented difficulties for understanding the superstructure of texts.

Even though they had on-site sessions where they learned about the historical evolution of the English language and had some theoretical background about the topic, this was not enough to face readings about that topic.

The above suggests the necessity of implementing a change in the teaching process, especially in the instructional teaching model. Thus, teachers should look for a strategy to gain reading comprehension that allows readers to show evidence of what they read and achieve knowledge representation. In doing so, teachers should prepare and engage readers before starting the reading process with the help of strategies and ad hoc activities for that purpose. Then, those readers will use that engagement during and after the reading act to reveal the way they approached the text.

Besides, taking into account the findings, it is noticeable that digital graphic organizers benefit reading comprehension and the representation of knowledge by allowing readers to depict the information from a written source visually.

The results from the experimental group in the post-treatment stage corroborated Jones' assumptions, which pointed out that graphic organizers systematize the information in such a way that it is beneficial for the establishment of relationships between concepts, ideas, and organization of reading as Merkle and Jefferies's study also did in 2000.

Moreover, this instructional design requires changes in the students' and teacher's roles. For the first ones, they consist of being an active learner, analyzing information, relating, and categorizing it into a scheme to learn how to learn. For the second actors, it deals with identifying content and designing the course (activities) according to such content in its implementation, and finally, monitoring and guiding learners while working in it.

In this study, the experimental group reported deeper comprehension in their results as well as information retention and retrieval. According to Griffin and Tulbert (1995), apprehension took place if appropriate strategies are applied for the representation of knowledge because they allow the understanding of the superstructure of a text that goes beyond a literal reading.

Undoubtedly, graphic organizers have their origin in cognitive theories of meaningful learning because they help learners to organize, process, categorize and remember new information, to be able to integrate it significantly with their previous knowledge based on the thought processes. However, there is a presumption among cognitive theorists that mental processes operate in an organized and predictable way and that the use of graphic organizers during the learning process improves the functionality of these processes, as well as the ability to understand information, and this study corroborated those assumptions since the experimental group showed significant understanding in the third face.

Additionally, the cycle activities used in this study do promote reading comprehension like Praveen and Premañatha (2013) state in their research. Indeed, it permits the evaluation of the process as well as understand the way students face a text.

Another crucial factor verified with the findings in this research is the fact that digital graphic organizers promote interaction as an essential element for the teaching-learning process, as pointed out by Egan (1999).

Conclusions

The study concludes that digital graphic organizers are suitable to promote reading comprehension in a short time with outstanding results because learners get more insight from the whole text at their own pace. These diagrams foster meaningful apprehension by breaking down larger or complex concepts into fundamental ideas. In this way, they let learners visualize or present information in a way that is easier to comprehend.

The results clearly show that the use of digital graphic organizers will be more useful in the development of reading comprehension only if the subjects practice it more since that practice will allow them to identify main and supporting ideas as well as their relationship between them to make a more accurate comprehensive visual representation of their understanding.

Another conclusion is related to the subjects' positive perceptions to work with this proposal and its effects.

Even though the objective of the study was to analyze digital graphic organizers for reading comprehension, the results of this proposal also identified the development of cognitive skills such as brainstorming, critical and creative thinking, categorizing and prioritizing content, as well as reflection and autonomy.

This study also provided teachers with a way to make learners activate their prior knowledge about a topic and quickly connect it to new information.

In conclusion, digital graphic organizers allowed students to represent their knowledge appropriately by working actively in their construction and proving their reading comprehension until reaching the meta-cognition.

Finally, this research contributes to breaking the traditional schemes, implement strategies to promote attention and interest in the readings addressed in different courses.

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