Using Infographics to Enhance STEM Students' Vocabulary Retention and Visual Literacy

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Abstract

T his study aimed at using infographics to enhance STEM students' vocabulary retention and visual literacy. The study was conducted in the second term of the academic year 2022-2023 during the "English for STEM2" course. The study adopted the quasi-experimental research design. Thirty-nine students enrolled in the 1st year STEM program at Minia Faculty of Education participated in the study and acted as one study group. The instruments of the study included a test for vocabulary retention and a scale of visual literacy. The course consisted of ten sessions, one hour a week through face-to-face instruction. Results showed statistical improvement in the post-measurement of the vocabulary retention test and visual literacy scale. Recommendations and suggestions for further research are presented.
Keywords: Infographics, Vocabulary retention, visual literacy

Introduction

   Vocabulary is one of the most basic language aspects required by foreign language learners in the process of acquiring the target language. Having the target language's vocabulary considerably enables learners to enhance their abilities to listen, speak, read, and write in that language. English language learners need continuous vocabulary knowledge to improve receptive and productive skills in foreign languages. Without this adequate knowledge, it is difficult for students to enhance their ability in a foreign language. Vocabulary acquisition involves memorizing the vocabulary's form and comprehending its significance to

use it in a particular situation properly. Learners' ability to remember and recall words, phrases, and utterances to be used in a learning process and in the future (written or spoken form) is closely associated with how they acquire and retain the vocabulary.

Vocabulary retention is an essential element in learning English as a foreign language (EFL). It refers to the ability to remember and recall words and their meanings after some time. It is an important aspect of any language learning as it allows learners to effectively use and understand words in different contexts. Several studies have explored the factors that influence vocabulary retention. Manzanera (2023) stated that presenting vocabulary with context-embedded words was more effective for short-term retention, while multi-word items were better identified with no-context vocabulary tests. Herusatoto (2019) assured that learning words in isolation, such as through word lists, was more effective for retention compared to learning words from context. Vocabulary retention is influenced by various factors, including the learning strategies used and the presence of contextual clues. Accordingly, language teachers need to be aware of the effectiveness of different methods of vocabulary teaching to choose the ones that are the most effective for their students (Al-Lahham, 2016).

Bader (2017) mentioned that there are some techniques that learners should follow to increase vocabulary retention. One of these techniques is imaging. Tests have shown that associating words with pictures lets them become more memorable. This suggests that even abstract words can be associated with mental images to help retention. Infographics are considered as an essential part

of information visualization that presents complex information quickly and clearly which includes signs, images, maps, graphics, and charts. Infographics are visual representations that integrate information derived from data and graphics to convey a message. Many researchers and educators stressed the importance of infographics (Al-Muhammadi & Alrwele, Dahmash, Al-Hamid & Alrajhi, 2017). Abu Almagd (2016) suggested that using infographics to teach new vocabulary helps in vocabulary retention.

Visual literacy is a set of skills that enables an individual to successfully find, interpret, evaluate, use, and create images and visual media. Visual literacy skills equip a learner to understand and analyze the contextual, cultural, ethical, aesthetic, intellectual, and technical components involved in the production and usage of visual materials. A visually literate individual is both a critical consumer of visual media and an experienced contributor to a body of shared knowledge and culture. Visual literacy strategies can engage learners to think critically as they can create opportunities for learners to derive meaning from images of everything that they see, and evaluate, apply, or create conceptual visual representations from these meanings. An infographic is a powerful data visualization tool for showing relationships; clarifying concepts; and facilitating communication and information on a particular topic, event, or program.

Infographics do what visualization does since they are part of information visualization as Mol (2011) stated. This means that infographics allow understanding data and information provided in large amounts, their structures and properties as well as detecting their reliability, clarity, and

accuracy. Infographics are introduced as a teaching tool to assist the instructors in the teaching and learning session to facilitate learners, particularly in higher learning institutions. The infographic is a combination of the words information and graphics. It can be defined as images that combine the data into a design, to enable individuals or to spread the information to the audience concisely.

Manickam and Aziz (2020) stated that infographics can play a significant role in simplifying information retention among students by enhancing their attention during teaching, fostering an enjoyable and engaging learning experience, and expediting the comprehension and integration of educational objectives through the concentrated and visually presented information.

Al-Mohammadi (2017) said that using infographics in teaching foreign languages can serve several functions. It can enforce the process of saving information as far as possible. Moreover, it transfers data and information from its traditional form as represented by letters and numbers into interesting figures and drawings. According to Parker (2012) using infographics is a great way to explore and learn vocabulary since they are the key for language simplification and vocabulary instruction strategies to facilitate learning. Additionally, the utilization of visual aids in education not only enhances the communication of abstract ideas and facilitates a deeper comprehension among students, but also serves to simplify complicated information and helps in the vocabulary retention process. Moreover, the extensive supply of visual content among students is accelerated through the continuous sharing capabilities offered by social media networks (Al-Behadili & Al-Dayni, 2022).

STEM is an educational program developed to prepare primary and secondary students for college, graduate study, and careers in the fields of science, technology, engineering, and mathematics (STEM). In addition to subject-specific learning, STEM aims to foster inquiring minds, logical reasoning, and collaboration skills. STEM education is the key to unlocking the potential of the next generation of scientists and innovators. Learning how a strong foundation in STEM subjects can set students up for a successful future in a rapidly evolving world. STEM education plays a crucial role in equipping students with the knowledge, skills, and critical thinking abilities necessary to address these challenges and contribute positively to the world around them. Let's take a look at the reasons why STEM education is essential for students' future success.

STEM students who learn English courses need some important skills such as vocabulary retention and visual literacy to help them in their subjects and courses. They must have the power to read science journals, computers, data processing, and much more. Many of those activities use the English language. A significant portion of the world's knowledge, especially in science and technology, is documented in English. Mastery of the language provides direct access to a vast reservoir of information, research, and educational resources. For STEM students, this access is crucial for staying updated with the latest developments in their field, fostering continuous learning and innovation.

Theoretical Background and Related Previous Studies

Krum (2014) described infographics as a kind of graphic design that blends text, illustrations, pictures, and data visualizations. In line with Parkinson (2016), it might

also refer to a visual representation of abstract facts, information, or knowledge. It is an information graphic, which presents facts in an easily comprehensible visual manner. Thus, an infographic is a collection of visuals, images, diagrams, or charts with little to no text to help readers better understand the subject matter. Additionally, the integration of visual aids in educational settings fosters the development of crucial skills such as image recognition, interpretation, comparison, construction, and evaluation. The effectiveness of this fact lies in its ability to cultivate a robust cognitive understanding or rectify erroneous perceptions among students (Habeeb, 2020). This is achieved through the careful incorporation of clarity, simplicity, scientific accuracy, and linguistic precision in the infographic's design. Furthermore, the infographic undergoes rigorous experimentation and refinement processes before its ultimate production in its definitive format (Pazilah & Hashim, 2018).

Using infographics as a visualization tool enhances information transfer and applies data quickly and effectively. Rahim et al. (2016) claimed that infographics as the most effective stimulant of visual representation cause an efficient flow of data. As infographics integrate various modes of representation such as language, graphs, images, and charts, they are effective tools for facilitating learning (Dunlap & Lowenthal, 2016). One advantage of using infographics is that the instructor can present lots of information in the shortest period. Creative teachers could provide new vocabulary which belongs to the same category. by combining images, graphs, and charts.

The value of infographics and their advantages are rooted in their significant influence on the three primary

components of the educational process: the instructor, the learner, and the subject matter. Infographics have the capacity to stimulate students, enhance their motivation, reinforce information, and facilitate its retention (Jaleniauskiene & Kasperiuniene, 2023). The infographic provides a valuable opportunity for diversifying activities, which aids in bridging the gap between individual differences and facilitates the transformation of complex material into visual representations such as drawings, symbols, pictures, and memory cues, hence facilitating students' comprehension and retention of knowledge. Infographics have been found to facilitate active student engagement in the acquisition of experience, knowledge, critical thinking skills, and observational accuracy (Lestari & Purnama, 2023). The utilization of infographics by the teacher facilitates the process of simplifying the lesson, hence enhancing its accessibility and relevance to the student's cognitive processes and personal interests (Alqudah et al., 2019).

Infographic components

Siricharoen&Siricharoen(2015)argued that infographics include three main components:
1. Visual elements (color, graphics, icons, maps, signs, etc.),
2. Content elements (facts, references, statistics, texts, etc.), and
3. Knowledge elements (conclusions, messages, etc.).

Infographic types

Suleiman (2022) mentioned that the most common types of infographics are:

1- Statistical infographics

Statistical infographics are used to show the survey results, present some data or show the data or keep some information in a very easy way. The statistical infographic will keep the focus on the data, while the visuals and layout tell the story related to the data.

2- Informational infographics

An informational infographic is divided into sections with descriptive headers. Numbering each section will help infographic design to flow. Plus, people tend to like infographics with numbers in the title. This informational infographic template is one of the most popular by far. It keeps the information brief with five points. Descriptive headers and illustrative icons help communicate each point clearly

3- Timeline infographics

Timeline infographics are the best type of infographic for visualizing the history of something, highlighting important dates, or giving an overview of events (for example, a project timeline). Because humans tend to make sense of time spatially, a visual like a timeline infographic can help create a clearer picture of a timeframe. Visual aids like lines, icons, photos, and labels all help to highlight and explain points in time.

4- Process infographics

Process infographics will allow you to simplify and clarify each step. Most process infographics follow a straightforward top-to-bottom or left-to-right flow. Numbering the steps will make your process easy to follow. For example, this process infographic template uses a different color for the headers of each step. Notice how the colors of numbered icons on the right side of the infographic correspond with the headers.

5- Geographic infographics

Geographic infographics use map charts as the focus visual. Different types of map charts work better for different types of data. For example, this geographic infographic template uses a heat map to show regions hierarchically

6- Comparison infographics

A comparison infographic is a visual representation that uses charts, graphs, or other design elements to showcase the similarities and differences between two or more subjects, products or concepts.

7- Hierarchical infographics

A hierarchical infographic is a method of structuring information such that it can be read from top to bottom. It arranges ranks in a hierarchy to make the chain of command easier to understand. The pyramid is a well-known example of this sort of infographic

8- List infographics

A list infographic is an informational graphic that uses a written list to get a message across. It is full of written copies, but it's also highly visual. Like other kinds of graphics, it is eye-catching and typically includes a wide range of design elements

9- Resume infographics

An infographic resume, also called a visual resume, uses graphic design elements, such as colors, fonts, layouts, charts, and images, to convey the professional experience

According to Davis and Quinn (2014), to design a successful infographic, the following conditions should be considered.

1. Identification of the use target of the infographic,

2. Identification of the components necessary for infographic design,

3. Deciding on the infographic type to be designed,

4. Submission of information in a way that matches the target.

Infographics and vocabulary retention

ALMashaleh (2023) mentioned that infographics are commonly referred to as a kind of artistic expression that involves the conversion of intricate data, information, and concepts into visually appealing visuals and illustrations, hence facilitating comprehension and engagement. This approach is distinguished by its ability to communicate intricate and challenging material in a coherent, accessible, and lucid manner. The utilization of infographics facilitates the presentation of information including vocabulary in a manner that is easily comprehensible and digestible (Ismaeel & Al Mulhim, 2021).

This visual representation enhances the persuasiveness and appeal of the information, thereby increasing its retention over an extended period. In contrast to abstract textual formats, infographics transform data, numbers, and letters into visually engaging images and illustrations (Hope & Cheta, 2018). The act of sharing and publishing content on social media platforms is not only pleasurable but also facilitates ease of dissemination. Furthermore, engaging in such activities fosters the development of various cognitive abilities, such as critical and visual thinking skills (Yılmaz et al., 2019).

Infographics refer to visual representations of information, data, or knowledge that are designed to convey complex concepts or data clearly and concisely.

Visual representations are crucial and indispensable tools for effectively presenting intricate data and information in a concise, comprehensible manner (Habeeb, 2020). By utilizing graphics, these representations have the potential to increase the perceptual abilities of the visual system, enabling individuals to more easily, identify and comprehend trends and patterns. The art of presentation encompasses the harmonious integration of simplicity, efficiency, and engagement, facilitating the effective dissemination of information to recipients in a captivating and appealing manner (Pazilah & Hashim, 2018). A significant proportion of individuals engage in cognitive processes primarily involving visual representations.

The utilization of vivid and interconnected imagery, accompanied by carefully chosen language, possesses a greater capacity to convey meaning compared to textual explanations and descriptions. Infographics are effective in enhancing interest and fostering motivation by their visually engaging and vibrant images, which effectively guide the viewer's gaze, capture their attention, and elicit a desired response (Salihu & Abubakar, 2020). The motivation to engage in the act of reading it and the benefits of a well-executed infographic can be succinctly described as the simplification of intricate information, facilitating comprehension, and leveraging visual elements to effectively communicate the data. Additionally, it reduces the duration. Rather than engaging in extensive textual analysis, visual scanning offers a more efficient means of information processing (Elaldi & Çifçi, 2021).

The process of converting everyday numerical and textual data into visually captivating images and illustrations enhances efficiency and expedites the

transmission of information. The act of studying and grasping various subjects on the internet has been found to alleviate stress when compared to conventional drawings and images (Ozdamli & Ozdal, 2018). Additionally, this practice facilitates the dissemination and publication of infographics on social media platforms, while also improving cognitive abilities such as information processing, association, and organization. Furthermore, it has been observed that this method aids in the long-term retention of acquired knowledge (Aydemir, 2021).

Infographics and visual literacy

Visual literacy is the ability to read, understand, interpret, and write a visual message or a language, whereas Brown (2015) defines it as a group of abilities that support the individual to find information, understand, evaluate, and use it, and then effectively create images and visual means. These definitions stress that visual literacy skills provide the learner with the tools to understand and analyze the environmental, cultural, moral, aesthetic, intellectual, and artistic components involved in the two processes of creating and using visual materials.

Visual literacy has acquired the status of one of the active areas in the education sector to induce learners of the present times. It is based on the theoretical dogma that visualization has a direct connection with a variety of cognition processes. According to Conner and Browne (2013), visual literacy can be commonly stated as a course of developing skills to find images, evaluate, appraise them, apply them to a purpose, and yield them. Thus, it is a direct controlling of the learning process through cognizance, involving many cognitive processes like perception, evaluation, appraisal, analysis, and invention.

As a technique of visual literacy, infographics have emerged out of the notion that they support the understanding of a phenomenon through both illustrations as well as decorated information.

In the educational context, teachers use visual representations for some purposes as Eilam (2012) proposed: (a) to have self-professional development, and (b) to enhance their students' understanding of concepts, processes structures, interactions, and live phenomena. To do this successfully, some teaching objectives for visual literacy might be proposed. Students should (a) read visual messages, (b) transform the textual content into a visual one, (c) structure, save, and arrange visual messages, (d) function colors in various forms, (e) find relationships between visuals, and (f) extract information from visuals and creative visual messages.

Visual literacy competencies are essential for 21st Century learners. As mentioned by Conner (2012), it is generally realized as a process that includes finding images, investigating and analyzing, evaluating, applying them to a purpose, and creating them. Incorporating an infographic assignment is one way to respond to educators' need to develop assessment tools and design curricula that reflect the information and media literacy demands of current-day digital culture (Osterman 2013). An infographic, otherwise identified as data visualization, is created using graphic design software and uses some mind maps like pie charts, icons, decorative fonts, diagrams, etc. to demonstrate information and statistics, creating a visual narrative.

An infographic assignment challenges students to visually communicate a topic, reinforced by records, citations, and statistics sourced from scholarly literature

and the popular press. Instead of presenting this situation in a text-based format, students must design an information visualization to validate their argument, using tools such as those from Adobe Creative Cloud (Photoshop, InDesign, Illustrator), or using online design tools to semi-automate the process (such as Piktochart, Infogr. am, or Pixlr).

For example, studies have shown that some learners experience greater self-efficacy and even achieve higher course performance when faculty provide resources that cater to various ways of knowing, communicating information, and remembering it (Hawk & Shaw, 2007). Students who prefer information visualizations, the research shows, retain material most effectively when they can see it that is when the material is presented with illustrations and photos, slides, or other graphic forms. This means that pictures can help the visual learner to process material, but so can flow charts, diagrams, and of course infographics (Felder and Solomon, 2000).

Using images in the classroom can be an important tool to encourage general visual literacy among all students (Thomas, Place & Hillyard, 2008). Engaging learners in image creation thus help them understand visual culture, or the 'visual construction which forms part of their often-unseen day-to-day experience of the world around them (Mitchell, 2002). Visual learners learn visually via drawings, images, graphs, pictures, and other visual forms. Therefore, visual learning which is represented by infographics seems to be a combination of data and information with graphic design

Infographics combine the process of transmitting messages including data, information, and knowledge orally, in writing, or visually, and the acts of communication that are concerned with interpreting those

messages and creating new meanings as well. By so doing, the visual association of the objects represented visually and their meanings can constitute a visual culture or literacy. This means that the layout with its different elements (lines, signs, colors, and relationships) and the content can function as the message or the meaning intended by the infographic initiator. With the development of technological enterprise and social media attractions, global academia is fronting serious complications in engaging pupils in the learning process.

One of the outcomes is the emergence of visual literacy which promises to engage students' attention. According to Marabella (2014), the new digital age needs new digitized ways to grasp learners' curiosity; and visual representation of data is a relevant way to do this. The new generation has been raised in the age of multimedia where the traditional methods are a source of boredom for them. Thus, the visual literacy concept emerged as one of the operative remedies to stimulate students for a better learning process. There are various modes of visual literacy and one of them is infographics.

It should be mentioned that there has recently been an essential change from traditional to innovative approaches. For instance, visualization is a kind of instructional material and practical metacognitive strategy that paves the way for beneficial language learning. An infographic visualizes data that conveys complex information to the learners to be easily understood. Infographics are a graphic visual representation of data (Smiciklas, 2012).

There are similarities between infographics and data visualizations, but some use them interchangeably. Both of them are visual representations of data; however, they are not the same. One of the main differences between them is

that the former largely contains multiple data visualizations. In contrast, the latter is just one (e.g., a map, graph, chart, or diagram). Besides, the infographic expresses a certain topic in a story-like presentation using different graphical elements and texts, while data visualization presents only a single moment of the story (Dur, 2014).

Fu (2009) conducted a study in China that reported that most EFL learners are visual and teaching through visual learning aids could facilitate the learning process. Creative teachers simplify new input for learners by presenting information in visualized forms. Some benefits of using infographics were summarized as (a) helping learners to comprehend the concept easily, (b) developing critical thinking and organization of ideas, and (c) enhancing retention and recalling of information.

The importance of infographics in literacy education is essential. Literate people can infer meaning, communicate with others, and capture ideas in many different ways. With infographics, educators can broaden students' visual literacy. Visual literacy is the unique structure and practice of conveying and enhancing information through primarily pictorial representations, Infographics can play a key role in visual literacy. An infographic is a visualization that uses words and pictures to make a point or tell a story. In simpler terms, it's known today as visual storytelling. Through graphs, charts, and tables, the creator exhibits evidence for analysis, and the analysis process can lead to deeper thinking and richer engagement.

Advances in information and communication technologies have elevated new digital literacy challenges. These challenges include a demanding need for visual and

digital communication skills. In what some have called the rise of the visual culture of the web, images, photos and videos are becoming a form of social currency to be shared (Verma 2013; Walter 2012; Rainie 2012; Kern 2013). Today, for users to magnificently navigate the web they must have the digital visual literacy skills to comprehend and evaluate both graphical information and multimedia messages (Lambert 2008). Even those students who are part of the Facebook generation, growing up sharing in a highly visual online culture do not inevitably have the skills to engage and participate critically and effectively with images and media in an academic environment (Hattwig, 2013).

The use of infographics is an important step towards developing a pedagogical approach that draws on visuals. This kind of approach is appreciated for many reasons. Firstly, it stands for what we might call different 'learning styles' or communication modalities. For example, studies have shown that some learners experience greater self-efficacy and even achieve higher course performance when faculty provide resources that is suitable to various ways of knowing, communicating information, and remembering it (Hawk and Shaw, 2007).

Students who prefer information visualizations, the research shows, recall material most effectively when they can see it that is when the material is presented with illustrations and photos, slides, or other graphic forms. This means that pictures can help the visual learner to process material, but so can flow charts, diagrams, and of course infographics (Felder and Solomon, 2000). Secondly, it is not just a pedagogical strategy for reaching visual learners; using images in the classroom can be an important tool to

encourage general visual literacy among all students (Thomas, Place, and Hillyard, 2008).

Engaging learners in image creation thus helps them understand visual culture, or the visual construction of the social' which forms part of their often-unseen day-to-day experience of the world around them (Mitchell, 2002). Finally, the creation of pictorial representations of written arguments requires that students engage in important critical analysis of the material that they are learning. Hence, the activity of designing a diagram or a visual representation of an idea can help students to engage with an argument, perfecting their rhetorical skills (Danis, 1993).

The theory behind infographics

Mayer (2005) mentioned that it has convincingly been shown that EFL learners recall more information if a text is with images and graphics. Moreover, several studies have found that learners retain information for the long term when a text is followed by pictures. A theory was suggested by Sweller (2017), which is called cognitive load theory (CLT). According to this theory, using graphics with text decreases the cognitive load, and learners can easily focus on the content and reduce the effort needed to decode the materials. The Cognitive Load Theory (CLT) suggests that our working memory is only able to hold a small amount of information at any one time and that instructional methods should avoid overloading it to maximize learning.

Moreover, infographics reduce cognitive overload for learners by eliminating unnecessary portions of information and knowledge. In today's fast-paced world, they also ensure both the transmission and comprehension of information faster. As a result, infographics have become a very popular form of modern communication.

Infographics are helpful and effective in critical thinking, analyzing, and creating structural design skills. The flexible structure and visualization of information in alternative forms are two main characteristics of infographics (Schroeder, 2004).

Related Studies

Mahmoud (2024) investigated the effectiveness of using interactive digital games inside classrooms to enhance preparatory school students' vocabulary retention and grammar achievement. The study was conducted during the second semester of 2021/2022, in which 60 participants were enrolled in the experimental group (30 participants) and the control group (30 participants). the experimental group used digital games, while the control group was taught regularly. The data were obtained using the grammar pre-posttest, the vocabulary pre-posttest, and class observations documented by photos. The study lasted for two months. During the training, students were introduced to competitive and interactive online games to boost their vocabulary and grammatical skills. The findings revealed that there was a statistically significant difference in the mean scores of the posttests. The results demonstrated that the experimental group exceeded the control group, and the statistical results were favorable. Accordingly, it was revealed that digital games can help students retain unfamiliar vocabulary and enhance their grammatical skills.

Al Mashaleh (2023) aimed to study the effect of the infographic display style (fixed, animated, and interactive) on learning and retaining the vocabulary of the Noble Quran among third-grade students. Participants were 112 male and female third-grade students and were distributed

into three groups. A quasi-experimental design was used. The results showed that all infographic patterns (fixed, animated, and interactive) have an impact on learning the vocabulary of the Noble Quran. The results showed that the three patterns (fixed, animated, and interactive) had an impact on retaining learning the vocabulary of the Noble Quran.

Manzanera (2023) explored how vocabulary presented with context and without context is retained. Thirty-nine undergraduate students were assigned to each of these conditions, after performing a communicative task that included a warm-up activity with a set of 15 target words, they completed a word meaning test (post-test) and repeated the same test after two weeks. The data gathered was analyzed using a quantitative approach. Findings indicate that the type of vocabulary test with context-embedded words is more effective for vocabulary retention in the short term. Nevertheless, multi-word items were better identified with the no-context vocabulary test, a finding supported by previous research. The present study increases the opportunity that different vocabulary strategies are used by EFL learners and that warm-up activities may contribute to L2 vocabulary learning.

Taghizadeh, & Zafarpour (2022) attempted to consider the use of animated infographics on the vocabulary gain and retention of Iranian intermediate EFL students. The classes were held online through the Jitsi Meet website in the autumn of 2021. Sixty EFL students were selected. At the beginning of the treatment period, a pretest was administered to both groups and then, the participants attended 13 sessions. In these sessions, the animated group (AG) was taught through animated infographics, while the

control group (CG) was instructed regularly. The posttest and delayed posttests were administered to test the student's vocabulary gain and retention. The findings indicated that the AG outperformed the CG significantly in the posttest and delayed posttest. Therefore, the animated infographics proved to be more effective in learning English vocabulary for these students.

Alrajhi's study (2020) with 78 Arabic learners at a Saudi university, revealed the effectiveness of static infographics on learning English idioms. The results showed statistical significance in test performance when using static infographics for vocabulary learning among EFL students. Alrajhi (2020) also argued that infographics could be used as a learning tool to enhance retention, motivation, interests, and positive attitudes toward learning. Alrajhi's study is indicative of the possibility of including infographics into an EFL setting, which is also where our study aimed.

Herusatoto (2019) examined the effectiveness of two different vocabulary learning strategies on vocabulary retention. The first is learning words in isolation in which learners learn new words and their meanings presented in the form of word lists, and the second is learning words from context in which learners use clues in sentences in texts to produce meanings for the target words. In the instruction sessions, a group of senior high school students learning vocabulary in isolation was presented with some words in English and their meanings. Their task was to say and repeat the words and their meanings several times as they attempted to learn the new words and their meanings. The group of students learning words from context was presented with some texts containing the target words and

was asked to find out the meanings of the target words by using clues in the texts. Recall tests were administered twice, a week and two weeks after the instruction sessions. For word retention, the results of the recall tests revealed that learning words in isolation appeared to be more effective than learning words from context. Students learning words in isolation retained the target words and the meanings better than those in the other group.

Steyn, Botha, and Mennega (2018) conducted a study with 210 students taking the course System Analysis Design at a college in South Africa and found infographics to be an effective teaching tool to supplement the course contents.

Alrewle (2017) conducted a study to evaluate whether using infographics results in significant differences in the university female students' achievement and examined the students' attitudes towards utilizing infographics in the EFL class. The collected data showed about 90 % of the learners in the EG had a positive attitude toward using infographics in the EFL class.

Dahmash et al. (2017) examined the impact of using infographics in teaching linguistics. The infographics created by the students were the instruments to collect data in the current study. The second instrument was a questionnaire filled out by the students at the end of the semester to examine their attitudes after designing their infographics. Analyzing the collected data revealed the students' positive attitudes toward using infographics. Most of them were motivated to use infographics in their teaching and learning. They benefited from higher thinking skills and collaborative learning while designing infographics.

Al-Mohammadi (2017) proposed that infographics can be an effective visual approach to teaching programming fundamentals for developing analytical thinking skills. In order to achieve her study objective, the researcher drew her study participants (N=64) from a secondary school for girls in Makkah, Saudi Arabia. The control group (N=32) followed the regular way of studying the Computer course, while the experimental group (N=32) was exposed to infographics-based teaching lessons in the same course focusing on programming fundamentals. Results indicated a significant improvement of the experimental group's analytical thinking skills.

Bicen and Beheshti (2017) investigated the psychological impact of infographics in education. The study was conducted at Near East University, Cyprus. The design of the study was quantitative. The participants were 163 undergraduate students from four different departments of Education faculty at Near East University. The data were collected through a questionnaire that measures the students' perceptions and attitudes toward utilizing infographics in educational contexts. The results specified that most students had positive attitudes about using infographics in the classes because most students preferred to learn with visual material rather than traditional books and materials.

In 2016, Al Hosni explored the effectiveness of infographics as a teaching and learning tool on EFL learners' reading comprehension and memory retention. The study sample was 27 participants from two different programs at Sultan Qabus University and formed two groups: the control group (N=14) and the experimental group (N=13). The control group used the regular way of

learning, i.e., the set textbook for reading while the experimental group used the interactive infographics to understand the reading texts. The mean scores on the reading comprehension post and delayed quizzes showed that the infographic group outperformed the non-infographic one in comprehension and retention memory, stressing the positive impact of infographics in EFL teaching and learning.

Additionally, Yildirim (2016) conducted a study to determine the effects of using infographics for educational purposes. The participants were given some tasks during the semester and asked each student to prepare five presentations. Then, an Infographics Reader Survey was used to collect the participant's ' preferences regarding using infographics. The current study found that the infographics were more instructive than the text materials and facilitated learning.

Noh et al. (2014) examined the effect of infographics on facilitating EFL learners. To this end, 99 EFL learners were asked to complete questionnaires about their experiences with infographics. The researchers found that infographic design significantly influenced their learning rate. A good infographic design includes attractive colors, concise texts, and relevant diagrams to facilitate learning.

In 2014, Kibar and Akkoyunlu did a case study adopting infographics as a new approach for enhancing visual literacy skills stressing the idea that students of visual age require visual literacy skills. During the academic year 2012/2013, sixty-four students enrolled in the Computer Education and Instructional Technology Department participated in the study to acquire instructional design skills reflected in infographics. The

data were collected from the infographics designed by the participants in different dimensions shown by the rubric. It was found that page layout, visualization, fonts, and colors scored higher percentages than title, elements, and organization of information. It was recommended that students should receive more practice in analyzing infographics to improve their performance in the visualization phase.

Matrix and Hodson (2014) used infographics as a teaching assignment. They taught college students at two different institutions incorporating infographics into online and blended coursework. Results showed that students of various academic backgrounds could benefit from infographics personally and academically, and had become visually literate.

Vanichvasin (2013) sampled 20 undergraduate students in a knowledge management course and examined the effect of infographics in the classroom. The results revealed that infographics used as an educational tool enhanced appeal, comprehension, and retention, thereby enhancing the effectiveness of communication. Thus, infographics promoted satisfaction and contributed to improving the quality of learning in the classroom.

Although several studies (Bicen & Beheshti, 2017; Noh et al., 2014) have been conducted on using infographics in the process of learning English as a foreign language, very few studies have been conducted to investigate using infographics to enhance STEM students' vocabulary retention and visual literacy. Accordingly, the present study aimed to investigate using infographics in learning vocabulary in EFL classes.

Commentary

Reviewing the above literature made it clear that few studies were conducted to investigate the effect of using infographics for enhancing students' vocabulary retention and visual literacy. Therefore, the present study attempted to measure the effect of using Infographics for enhancing STEM students' vocabulary retention and their visual literacy. Besides, reviewing the literature on infographics, vocabulary retention, and visual literacy gave the researcher enough ideas to state the hypotheses of the study. It also revealed the importance of enhancing infographics, vocabulary retention, and visual literacy in designing tests.

Context of the Problem

Based on reviewing the literature and the personal observation as a faculty member who teaches the English for STEM2 course and as a regular examiner of students' levels, the researcher could verify the current study problem. 1st year STEM students have low levels of vocabulary retention and visual literacy. The researcher also conducted a diagnostic test on vocabulary retention. STEM students' scores were unsatisfactory (see Appendix 1). Moreover, the review of the literature assured the importance of using infographics as an independent variable because it offered benefits such as enhancing comprehension, increasing engagement, and easy sharing. All such reasons confirmed the problem and highlighted the need for moving towards the use of infographics as a solution to overcome the students' problems in vocabulary retention and visual literacy.

Statement of the problem

Based on the results of the diagnostic test and the literature review that showed a lack of studies that were conducted to investigate the effect of using infographics for

enhancing STEM students' vocabulary retention and their visual literacy, the researcher could verify the study problem. The statement of the present study problem could be summarized in the low level of 1st year STEM students in vocabulary retention and visual literacy. Consequently, the present study tried to investigate the effect of using infographics for enhancing 1st year STEM students' vocabulary retention and their visual literacy.

Aims of the study

This study aimed at using infographics to enhance 1st year STEM students'
1. Vocabulary retention.
2. Visual literacy.

Hypotheses

The following hypotheses were tested
1. There would be a statistically significant difference between the study group's mean scores of vocabulary retention pre-posttest (favoring the post-testing).
2. There would be a statistically significant difference between the study group's mean scores of delayed vocabulary retention post-posttest (favoring the post-testing).
3. There would be a statistically significant difference between the study group's mean values of visual literacy pre-post scale (favoring the post-testing).

Significance

The significance of the present study emerged from the following:

1. It tried to fill in the gap in the review of literature about studies dealing with enhancing STEM students' vocabulary retention and visual literacy.
2. It helped the study group to practice using Infographics for the sake of enhancing comprehension, increasing engagement, and easy sharing
3. It offered a test in vocabulary retention.
4. It offered a scale in visual literacy.

Delimitations

This study was delimited to:
1. Thirty-nine students enrolled in the 1st year STEM program at Minia Faculty of Education participated in the study and acted as one study group.
2. The study was conducted during the second term of the academic year 2022-2023 and lasted for ten weeks (an hour a week) during the "English for STEM2" course through face-to-face instruction.

Definitions

Infographics

Alyahya (2019) defined the infographic, or "information graphic" as a visual representation of information, data, or knowledge that blends data with design, enabling more effective and concise communication.

Ozdamli and Ozdal (2018) defined Infographics as graphic visual representations of data and information that facilitate the delivery and understanding of complex information.

Infographics is operationally defined as a graphic visual representation of information or data that is designed to convey complex concepts clearly and concisely

Vocabulary retention

Ramezanali (2017) defined vocabulary retention as the ability to save a new word and provide its meaning after a given period.

Alfaki (2015) defined vocabulary retention as the ability to remember and retain knowledge of words or phrases throughout time, allowing for their retrieval and proper usage in a variety of circumstances.

Vocabulary retention was operationally defined as the ability to remember and retain vocabulary knowledge and associations after a period of time.

Visual literacy

Yenawine (2015) defined visual literacy as the skill of finding the meaning in images.

Frank and Baker (2012) defined visual literacy as the ability to both read and write visual information and to think and solve problems in the visual domain.

Visual literacy was operationally defined as the skill of transferring information to or from an infographic.

Method

Research design

The present study adopted the quasi pre-experimental design where one group (n=39) pre-posttest was used to assess the effect of using infographics on enhancing students' vocabulary retention and their visual literacy The study group was exposed to using the Infographics. The material was derived from the topics of the (English2

course) was being taught during this term. Participants were examined on how to use Infographics to have vocabulary retention test and to fill in a visual literacy scale (see Appendix 3 and Appendix 4)

Participants of the study

This study included (39) students enrolled in the 1st year STEM program at Minia Faculty of Education. All participants were from the same regional background and age.

Duration

The training began in the second week of February 2023 and ended in the fourth week of April of the same term (in the academic year 2022-2023). The total sessions of the course were ten, an hour a week with face to face instruction.

Role of the Instructor

The instructors' role was to acquaint students with what they were going to learn before starting the sessions to give them sufficient notion about the material. The instructor asked stimulating questions to provoke students' thinking and learning. Class activities included a number of well-planned activities such as brainstorming and group discussion.

Role of the Students

Students' roles included: engaging with learning goals, providing feedback to peers and receiving feedback from instructor and peers. Their participation included asking and answering in-class questions. They were divided into groups. Students were introduced to the content and the activities. They also gave their reflections on using Infographics.

Activities
In- class activities included brainstorming, discussions and reflections
Evaluation Techniques
Short Answer Questions
Variables of the study
Independent variable
    Using infographics
Dependent variables
  1. Enhancing STEM students' vocabulary retention
  2. Enhancing STEM students' visual literacy

Instruments of the study
    For the study, the researcher prepared three main instruments:
 1. A diagnostic test in vocabulary retention. (Appendix 1)
 2. A test in vocabulary retention. (Appendix 3)
 3. A visual literacy scale. (Appendix 4)
1. Diagnostic Test

    This test aimed at assessing students' vocabulary retention to be sure that they actually need training in it. The test consists of (15) MCQ items. Appendix (1)
2. A list of vocabulary items

    (30) Items collected from the English2 course presented to 1ˢᵗ year STEM students. Appendix (2)
3. Vocabulary Retention Test
        a. Objective: The objective of this test was to assess the participants' level in
    Vocabulary retention pre-, post, and delayed test using infographics.
        b. Construction: This test consisted of 30 MCQ items. Appendix (3)

Part 1: MCQ items in written form (from 1 to 10)
Part 2: MCQ items on meaning (from 11 to 20)
Part 3: MCQ items on the relationship between items (from 21 to 30)
The test was constructed according to a table of specifications. (see Appendix 5)
Delayed vocabulary test: Three weeks after the immediate post-test was given, it was re-administered to the study group. The purpose of the delayed post-test is to check to what extent can the students remember the target words, in terms of spelling, word recognition, as well as use. Hence, all the questions in the retention test are identical to the immediate test.

c. **Duration:** The time taken by each student was recorded and divided by the total number of students. Answering the test items lasted 30 minutes.

d. **Validity:** The validity of the test was determined by computing the internal consistency of each item. This was calculated by using (the Pearson correlation formula). The Correlation coefficient ranged from 0.62 to 0.71. See Table (1).

Table (1)
Internal Consistency of   Vocabulary Retention Test, Correlation &Alpha between Individual Question and the Total Test

Parts of the test	Dimensions	Correlations	Alpha
Part 1	Written form	0.71*	0.88**
Part 2	Meaning	0.65*	0.77**
Part 3	Relationship between items	0.62*	0.58*

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

e. Reliability: The Alpha Cronbach formula was used. As shown in Table (1), the reliability coefficient ranged from (0.58) to (0.88). It can be concluded that the test has an acceptable reliability level**.** The reliability coefficient of this test is considered within the acceptable range.

f. Item Analysis   Responses to individual items were analyzed to determine the item difficulty index which ranged from 0.35 to 0.50. Hence, the difficulty index of the items is acceptable. Item discrimination ranged between 0.49 and 0.75

g. Scoring: One point is given for each test item. The total score of this test is (30).

Piloting the Test: Seventeen students from 1st year STEM program were randomly selected. Piloting helped to correct unclear and ambiguous items. It helped also to determine whether the items were functioning for use in the main study or not. Content validity was determined by consulting (9) EFL staff members.

3. Visual Literacy Scale (Developed by the researcher)

a. Objective: A visual literacy scale was developed by the researcher to measure the study group's level of visual literacy before and after using Infographics.

b. Construction: The scale consisted of thirty statements divided into three main domains Allegorical meaning (12 statements), explicit meaning (10 statements), and symbolic meaning (8 statements). Appendix (3)

c. Duration: Thirty minutes were devoted to responding to the scale.

d. Content Validity: Nine TEFL staff members approved the content validity of the scale and its suitability for the group. They also approved the domains and confirmed the suitability of the scale to assess students' visual literacy. They stated that the items were inclusive, easy to respond

to, varied, and focused. Their suggestions were taken into consideration. The total score on the scale is 150. The rating scale ranged from 5 to 1, respectively from (Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree). The study group students were required to indicate their opinions in each statement.

e. The internal consistency: The correlation between the score of each item and the total score of the scale ranged from (0. 74) to (0.81). This indicates that the scale has a high degree of validity. See table (2).

Table (2)
Internal consistency of the Visual Literacy Scale Correlation Between each Domain and the Total Score (Validity)

Domain	Correlation	No. of items
Allegorical meaning	0.77**	12
Explicit meaning	0.81**	10
Symbolic meaning	0.74**	8

** Significant at 0.01   total score = 150

The reliability coefficients of the scale are (0.74, 0.84, and 0.81) for dimensions, successively. This shows that the visual literacy scale has a high degree of reliability.

Piloting the scale

A pilot study was conducted to estimate the validity and reliability of the visual literacy scale. A group of twenty students were randomly selected. Piloting helped to correct unclear and ambiguous items. It helped to determine if the items in the scale were suitable for use. Content Validity was determined by consulting (9) TEFL staff members.

Timing

Timing the scale was computed by counting the time taken by each student divided by the whole number of the students to take the average (30 minutes).

Experimental Procedures

Pre-Testing

Students were pre-tested to measure their vocabulary retention and visual literacy levels before using Infographics and to identify the degree of improvement in both instruments. The researcher explained the purposes of using Infographics and students were enrolled in face-to-face instruction.

The Experimentation

The study group was exposed to ten sessions on vocabulary retention one hour a week with face-to-face instruction. They were divided into groups. Students were given homework assignments to be ready for classroom activities and discussions. During the course, the study group students were involved in a number of in-class activities.

Steps in constructing the infographics course:

1. Reviewing the literature related to vocabulary retention and visual literacy.

2. Preparing a list of the vocabulary skills.

3. Evaluating the list by a panel of (9) TEFL experts.

4. Stating the main objectives of the course and having them evaluated.

5. The whole course was evaluated by the same panel to judge the stating of the items, verification of the content, and whether the activities were appropriate to the group of the study.

Material

Infographics aimed at achieving the objectives of the study. The course consists of ten sessions each having a number of behavioral objectives, and different activities, and ends with evaluation questions of different types to assess the students' performance in vocabulary skills and visual literacy.

Content of the course

The course consists of the following sessions:

Session (1): Overview

Session (2): Statistical infographics

Session (3): Informational infographics

Session (4): Timeline infographics

Session (5): Process infographics

Session (6): Geographic infographics

Session (7): Comparison infographics

Session (8): Hierarchical infographics

Session (9): List infographics

Session (10): Resume infographics

Steps in implementing the course:

- Each session started with face-to-face interaction to arouse participants' interest in the course.
- The researcher gave an overview of the content of the sessions.
- Each session lasted approximately an hour.
- The participants then were asked to respond to the vocabulary test and the visual literacy scale.
- Cheating or talking to one of the friends while taking the exam was prevented.
- Feedback was given immediately after they finished the sessions.

Post Testing

At the end of the course, students were post-tested in vocabulary and the visual literacy scale. They were asked to write their reflections on using Infographics. Data were treated statistically and the findings are described below.

Delayed-post Testing

After three weeks, students were re-tested in vocabulary. They were asked to write their reflections on using Infographics. Data were treated statistically and the findings are described below.

Results

This study explored the effect of using Infographics to enhance the study group's performance on vocabulary retention test and visual literacy scale. The "t-test" was utilized for the analysis of data. Scores on the pre-post performance were analyzed and compared.

This study aimed at using Infographics to enhance STEM students' vocabulary retention and their visual literacy. The study was conducted in the second term of the academic year 2022-2023 during the "English for STEM2" course. The study adopted the pre-experimental design. Thirty-nine students enrolled in the 1st year STEM program.

Hypothesis One

Hypothesis one predicted that there would be a statistically significant difference between the study group's mean scores on vocabulary retention pre-posttest (favoring the post-testing). Analysis of data using t-test showed that students post-testing was better. As their means of post-test scores were higher and statistically significant compared to the pre-administration. (See Table 3)

Table (3)

Means, Standard Deviations, t-values, and Cohen's d and the Difference between Mean scores obtained by the Study Groups' Pre-Post vocabulary retention Test

Test		Mean	No.	SD	t- value	DF	Cohen's d	Sig.
Written form	**Pre**	**11.39**		**1.44**	**50.22****		**0.61**	**0.01**
	Post	**17.05**	**39**	**1.98**		**38**		
Meaning	**Pre**	**12.36**		**1.02**	**53.14***		**0.64**	**0.05**
	Post	**16.66**	**39**	**1.77**		**38**		
Relationship between items	**Pre**	**13.18**		**1.39**	**52.19****		**0.60**	**0.01**
	Post	**16.19**	**39**	**1.87**		**38**		
Vocabulary Retention as a whole	**Pre**	**14.22**		**1.55**	**51.12****		**0.66**	**0.01.**
	Post	**18.61**	**39**	**1.84**		**38**		

*Significant at (0.05) level   **Significant at (0.01) level   Maximum score =30

Hypothesis Two

Hypothesis two predicted that there would be a statistically significant difference between the study group's mean scores on the vocabulary retention delayed test (favoring the delayed testing). Analysis of data using t-test showed that students delayed testing was better. (See table 4)

Table (4)

Means, Standard Deviations, t-values, and Cohen's d and the Difference between Mean scores obtained by the Study Groups' delayed vocabulary retention Test

Test		Mean	No.	SD	t-value	DF	Cohen's d	Sig.
Synonyms	**Post**	**17.05**		**1.98**	**12.38**		**0.01**	**0.221**
	Delayed	**16.55**	**39**	**1.02**		**38**		
Collocations	**Post**	**16.66**		**1.77**	**13.19**		**0.03**	**0.310**
	Delayed	**17.01**	**39**	**1.54**		**38**		
Expressions	**Post**	**16.19**		**1.87**	**15.17**		**0.07**	**0.234**
	Delayed	**16.88**	**39**	**1.84**		**38**		
Vocabulary Retention as a whole	**Post**	**18.61**		**1.84**	**14.18**		**0.10**	**0.204**
	Delayed	**18.44**	**39**	**1.88**		**38**		

*Significant at (0.05) level **Significant at (0.01) level   Maximum score =30

Hypothesis Three

Hypothesis three predicted that there would be a statistically significant difference between the study group's mean values of the pre-post administrations of the visual literacy scale (favoring the post-administration). Statistical analysis in Table (5) shows that this hypothesis was accepted as the students' post-testing surpassed their pre-testing and the t- t-value is (19.34) and this value was significant at 0.05.

Results also showed that students scored better in post-performance as the t-value of the allegorical meaning domain is (12.11) while the t-value of the explicit meaning domain is (14.12) and that of the symbolic meaning domain is (11.29).

Table (5)

Means, Standard Deviations, t-values, and Cohen's d and the Difference between Mean scores obtained by the Study Groups' Pre-Post Testing on The visual Literacy Scale (N=39)

Domain		Mean	No.	Std. Deviation	t- value	D.F	Cohen's d	Sig.
Allegorical meaning	Pre	62.18		1.03	12.11*	38	0.75	0.05
	Post	68.77	39	1.91				
Explicit meaning	Pre	51.44		1.22	14.12*	38	0.69	0.05
	Post	74.12	39	1.54				
Symbolic meaning	Pre	49.33		1.94	11.29*	38	0.61	0.05
	Post	65.47	39	2.01				
Visual Literacy as a whole	Pre	51.32		1.64	19.34*	38	0.69	0.05
	Post	59.66	39	1.97				

*Significant at (0.05) level   **Significant at (0.01) level Maximum score =150

Discussion

The present study was conducted to investigate the effect of using infographics to enhance STEM students' vocabulary retention and visual literacy. Students' scores on the pretest of vocabulary retention and visual literacy scale were low. It was important to keep in mind that the purpose of using infographics was to improve students' vocabulary retention and visual literacy. After analyzing the data of the vocabulary retention test and the visual

literacy scale statistically, there were differences between the study group's pre and post-responses on both instruments, in favor of the post-measurement.

Based on the findings of the current study, results showed that using infographics had a significant effect on the students' levels of vocabulary retention and visual literacy. These results could be attributed to some factors. Infographics can be considered effective in enhancing students' vocabulary development and retention as they offer a collection of motivating activities through the sessions which provide an encouraging atmosphere and add excitement to the learning environment. In addition, the active participation of the study group and the well-planned and organized sessions could arouse the students' interest and achieve a high degree of student engagement during the in-class activities. Besides, these good results would be attributed to the active role of the researcher and her willingness to raise the students' levels of understanding and retaining the vocabulary needed in their English for STEM2 course and the other STEM courses. It took time and effort to find suitable infographics with good design. It was suggested by the researcher that students exchange and share effective infographics with peers to expand the collections as in some sessions, they were asked to work in groups. The researcher also presented the topics related to infographics in the form of handouts, PowerPoint presentations, and sometimes in the form of videos or other displays that were easy to refer to.

It was noticed throughout the sessions that infographics had a great power of persuasion and guidance as they included numerical data and written information. There are several advantages of using infographics with the

study group such as simplifying the existing information, presentation of the course content, summarizing learned information, and showing relationships between concepts. Besides, infographics helped to organize and present the information correctly, in an effective way with creative visual design. Consequently, this positively affected the learning experience of the students.

In addition to what was mentioned above, infographics provided students with the possibility of facilitating vocabulary retention and visual literacy. Infographics were used as supporting materials along with the course materials to develop students' levels in vocabulary retention and visual literacy. This goes with Rezaei and Sayadian (2015) who explored the impact of infographic instruction on vocabulary and grammar learning. Similar findings were reported by Calabro (2015) who conducted a study to determine the effectiveness of infographics in improving the receptive learning of EFL words.

The researcher monitored and assessed the students' work developed in each group or individual during and after each session to improve their vocabulary skills and increase their visual literacy. In this, the active role of the students was quite relevant, since they were interested in and encouraged to participate actively in all sessions. Individual and group feedback was immediately given. This was done according to the observation of the participation of each student within the group during group discussion.

The researcher provided students with feedback about their level of performance in vocabulary retention skills, Consequently, this helped them achieve continuous progress during the sessions and in the post-tests.

Therefore, infographics became a very valuable resource to foster students' confidence and motivation to understand and retain vocabulary for a long time. These results of the current study correspond to the results of (Dahmash et al., and Bicen & Beheshti 2017) studies which showed that infographics effectively present information, help teachers and students learn visually, and increase motivation.

Knowing that vocabulary learning is at the heart of any language learning means that it needs comprehensive research. Moreover, retaining a large number of new words in memory has always been a challenging task for FL learners. Yet, no clear understanding has been accomplished of what vocabulary learning strategies can best help FL learners learn new words and remember them for later use.

The vocabulary retention pre-post test was administered twice. Immediately after ending the sessions and three weeks after the instruction sessions. For word retention, the results of the recall tests revealed that learning words through infographics appeared to be more effective than learning words from lists. Students, through learning words related to infographics, retained the target words and their meanings better. These results agreed with Manzanera (2023) who explored how vocabulary presented with context and without context is retained. Students were assigned to each of these conditions, after performing a communicative task which included a warm-up activity with a set of 15 target words, they completed a word meaning test (post-test) and repeated the same test after two weeks.

The content presented in the present study was based on the Cognitive Load Theory (CLT) suggested by Sweller (2017), who proposed that our working memory is only able to hold a small amount of information at any one time

and that instructional methods should avoid overloading it to maximize learning. According to this theory, using graphics with text in the present study decreases the cognitive load, and learners can easily focus on the content and reduce the effort needed to decode the materials. Moreover, the use of infographics reduced cognitive overload by eliminating unnecessary portions of information and knowledge.

The results of the current study also coincide with the results of Bicen and Heshti (2017) who supported the use of infographics to help students improve their learning. Infographics could make students more motivated to learn and increase their knowledge as well as their learning skills efficiently, especially vocabulary retention.

To conclude, this study is beneficial for EFL learners since infographics are motivating and attractive for most students. Students preferred to use infographics in authentic contexts and they could apply them to other STEM courses. The use of infographics could be a crucial factor in vocabulary retention which encourages EFL learners to improve their learning process.

Students' Reflections

During the study group training the following points were noticed:

During the sessions, 1st year STEM students followed the instructions and procedures accurately and as the sessions went on, most shy students and low achievers got involved and cooperated with their peers effectively as they felt more confident, released, and less stressed.   Most of them were eager to share with the group and exchange feedback with each other. This allowed them to get over their fear. Students were asked to give their reflections on the whole sessions.

The following are examples of these reflections:

- *"This course made me learn how to recall vocabulary for a long time''.*
- *"This course is so beneficial because we learned how to use different vocabulary items in context to be able to retain them in memory''.*
- *"The instructor was really helpful and active".*
- *"The activities helped me to practice using difficult words in context''.*

Implications

The significant gains obtained by the participants of the study group on post-testing could be attributed to the use of the English course which is mainly based on the idea of using infographics to develop language skills.

Some factors may have helped to enhance the positive effect of the course on developing students' vocabulary retention and visual literacy such as the in-class activities, the discussions between groups, the material presented in an organized way, and the interest and enjoyment of students and the new modes used throughout the sessions.

Challenges

The researchers encountered some challenges throughout the implementation of the course. These include:

1. Being reluctant at the beginning of the course lest it should affect the time allotted to the other subjects.
2. Some students did not frequently attend the class.
3. Some students insisted on using the mother tongue during discussion.

To overcome such challenges, the researchers did the following:

1. Explaining the importance of the course in recalling vocabulary items that they can use in their present and future studies.
2. The frequently absent students were convinced of the importance of attending the class.
3. The instructor provided them with more exercises that necessitate the use of the English language all the time.

Conclusion

Infographics as a visual aid of data could be comprehended comfortably. Therefore, incorporating infographics into teaching could be a dynamic way for EFL learners to engage in learning more. Using infographics in education has become an effective tool in recent years. It has developed into a very necessary element of modern practices in English learning settings. Infographics can help the instructor describe the coursework and the topic flow. The desired emphasis is supported by the visuals so that it is possible to grasp the importance of the topic to the student most simply and understandably. Also, they provide a better understanding of students' knowledge, ideas, and concepts to enhance their learning experience. Finally, infographics allow students to develop critical thinking skills to organize ideas and remember and recall information better in the learning process. Effective teachers recognize the importance of engaging their students in learning. This is why it is necessary to make learning applicable and appealing to students, who are becoming more digital and competence-based to meet the demands of their future jobs.

Recommendations

In the light of the results obtained in the present study, a number of recommendations could be drawn:

1. Instructors are recommended to use infographics to help students recall the learned vocabulary.
2. Immediate feedback is necessary to demonstrate satisfactory results.
3. Paying more attention to the methods and techniques that encourage the engagement of the students in the learning process.
4. STEM students should master reading graphs to use them in other fields.

Suggestions for Further Research

1. Investigating the effect of using infographics to increase students' stock of vocabulary items.
2. Investigating gender differences in using infographics.
3. Investigating students' and instructors' attitudes toward using infographics.

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