The impact of Infographics on Language Learning

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Summary

The purpose of this study is to examine the effectiveness, or otherwise, of vector infographics on ESL students' acquisition of grammar, especially the use of tenses. After questioning college teachers about their teaching environment and main challenges, eight infographic designs were created to assist in the teaching of the simple present and simple past tenses. These designs were presented to 20 undergraduates. Mixed research methodologies including questionnaires were applied. Data were analyzed using (t-test) and refined by Wilcoxon Signed Ranks Test using IBM SPSS statistics. The significance of pre and post exam's results showed that $p = 0.028$ (t-test) and 0.027 (Wilcoxon) < 0.05. This means that H0 is rejected and the applied infographics, as a cognitive education tool, improves student learning outcomes.

Key words:
ESL; infographics; higher education; Middle East; graphic design.

1. Introduction

As a visual and symbolic species, we often prefer to know and learn using visual means that simplify the information. Humans started to communicate through pictograms, that is, drawing on walls developed by creating language symbols as found in caves and Egyptian Hieroglyphics [17, PP1-2]. Ultimately, visual representation of data has been simplified so that they are meaningful to kids, adults and elderly people. Fleming and Mills (1992) discussed the power of four used "VARK" models (Visual, Auditory, Read/Write, Kinesthetic) which develop teacher-student learning experiences. These models are: visually (learn by viewing graphics), Auditory (learn by listening), Read/Write and Kinesthetic (learn by doing) [28].

More common variations of visual learning include flash cards, bulletin boards, posters, diagrams and visualizations. This research constitutes a relatively new area which has recently emerged in the graphic design field, namely, infographic design. It is considered another modified visual communication method that converts all the information into a simple visual element which could be received and understood by the target audience easily and within a short time. It has met with great success in many other enterprises such as newspapers, websites, educational and general awareness literature. Students are reluctant to read huge chunks of text, hence the material has to be simplified for them to aid understanding and retention of information.

This is where infographics can help. Since infographics is a new design approach, its application in teaching has not been widely explored. Studies discussing the benefits of using strategies from graphic design to improve learning are few and far between [18]. In this paper, we are going to discuss and focus on infographics. When designing infographics, we concentrate on the following elements: Content (time frames and references); Visual Parts (graphical elements such as colors and graphics); and Knowledge (facts and deductions). To explore the impact of infographics on ESL students, the study poses the hypothesis that infographics accelerates language learning and retention.

Educational Environment

Students join the college after completing Grade 12 at High School. The college offers 3 main streams of study: Computer Information Technology (CIT); BA (Business Administration); and Health Information Technology (HIT). Students choose one of these specializations and continue with it in their 2nd and 3rd years. The first year is a foundation year in which students undergo a programme of Intensive English (GRC 111 and GRC 112), Mathematics, and some Computer Studies. Students are also required to take classes in English for Special Purposes (ESP) in their 2nd and 3rd year depending on the specialization that they have chosen.

Teachers and students use the following books: Interchange Teacher's Manual, Interchange Student's Book, Interchange Workbook, Interchange Video Activity Book, Supplementary material. A variety of teaching methods are employed: groupwork, individual presentations, question and answer, role-play, competitions, project work, field trips, etc. Instructors do take cognizance of the fact that students learn in many different ways. Some students are kinesthetically inclined, some spatial, some numerical, some passive, etc. These different ways of learning are catered for using the available resources and space in – and outside the classroom. Teachers interact with their students using different learning equipment such as: Whiteboard, Smartboard, Language Lab, Computers, Data show projectors, White screen. In addition to the above resources, the College and in particular the GRC Department offers a facility known as the English Support Unit. This unit is

primarily aimed at assisting learners who struggle to master certain skills, concepts, or knowledge necessary to communicate in English.

The student sample in this study was taken from a mix of GRC 111/ 112 students. Many students experience formal learning of English for the first time from Grade 7. Although others may have started English at an earlier grade, the reality is that post-secondary school students do come to college with a very restricted vocabulary. This makes them very reluctant to use English both in – and outside the classroom. Because of their limited lexicon, they are acutely aware of making mistakes and thus feeling embarrassed. Usually, students are exposed to English 4 hours a day. This gives a total of 20 hours contact time per week. The four-hour day of English instruction is split as follows: 2 hours for the Main Book (Grammar and Vocabulary); 1 hour of Reading and Writing; and 1 hour of Listening and Speaking. In this way all four major skills are catered for. A different instructor is assigned for the Main Book, Reading / Writing, and Listening / Speaking class.

2. Literature Review

2.1 English Language Learning

According to Voice of America Learning English (2015), verb tenses can be difficult to learn in a foreign language. Cakir found that non-native English speakers students struggle with tenses because of mother tongue interference [10]. Time is construed differently in various cultures. Chinese, for example, has no grammatical verb tenses. In English, verb tenses give information about time and action, for example, is the action completed or continuing?

Over the years many approaches have been adopted in teaching tenses. One such approach is known as the Inductive Approach. Inductive logic operates on the principle of moving from the particular to the general. The "Your Dictionary" website defines inductive reasoning as "reasoning that takes specific information and makes a broader generalization that's considered probable, while still remaining open to the fact that the conclusion may not be 100% guaranteed.

In the case of tenses, the teacher may write a whole lot of statements on the board and ask students to elicit the rule. For example, the teaching of the simple present tense might utilize the following procedure: (Table 1)

Table 1: Simple present tense

I / We / They as subject	He / She as subject
I/ We / They **speak** English.	He / She **speaks** English.
I/ We / They **work** in a school.	He / She **works** in a school.
I / We / They **play** football.	He / She **plays** football.
Rule: The verb remains unchanged.	**Rule: Add "s" to the verb when "He/She" is subject.**

The inductive method has much to offer in its attempt to lead students to specific insights. Nunan has listed many advantages to the inductive approach. It allows for a greater depth of mental processing which makes learning more meaningful and memorable [23]. Learners are more active in initiating their own learning rather than passively listening to the teacher. It encourages learner autonomy. However, on the flip side, inductive learning is more time consuming. Getting that "Aha, I got it" experience could take more time as opposed to just being told by the teacher. And of course, there is always the possibility that students could engage in erroneous reasoning and therefore arrive at the incorrect conclusion. Rectifying this will just take more time and add to the time constraint! Thornbury has written extensively on the merits and demerits of inductive versus deductive approaches to the teaching of grammar [31].

The past few decades have seen researchers experimenting with different techniques to teach tenses. Amongst the strategies employed were the use of games like "Charades", "Storyboard", and "Climbing Grammar Mountain" [30]; Cognitive Grammar [4]; and Communicative Language Teaching methodology [22]. Other more recent initiatives in the methodology arsenal incorporate technology and include videos "YouTube", blogs, websites, pictograms and infographics. To date infographics has not been used very widely in the teaching of grammar in general and tenses in particular. What distinguishes our initiative is that it is a combination of technology and face-to-face interaction. A learner could very well go online and learn tenses via videos, a blog or a website, but the potential for question and answer after the session is severely limited. Although online programs do have opportunities for clearing up misconceptions, misunderstandings and general queries (like "FAQs"), these cannot compare to the vast opportunities for enhanced clarity of the message afforded by face-to-face interpersonal contact.

2.2 The Evolution of Infographics

By 30,000 BC, cave paintings depicted animals and resources, for example, weapons for haunting. This is generally considered the beginning of the way humans simplify their world through images. This rudimentary custom was followed by Hieroglyphics that told stories of life, work and religion before 3000BC. In 1926 the astronomer Christoph Scheiner employed images to show the sun's rotation. Thereafter Joseph Priestly drew the first timeline in 1765. Abraham Lincoln coded a slavery levels map in 1861. In 1869, Russian chemist Dimitri Mendeleev developed his chemical elements periodic table arrangement to differentiate elements by their atomic mass and numbers. During the period 1850-1900, a giant leap in data visualization (DV) development – a stepping stone to infographics – saw deployment of charts and pictograms in statistical offices. By the time Walter Gropius founded the

Bauhaus school in 1919, the graphic design field showed a different approach to art. In 1936, Otto Neurath presented a pictograph system as a visual language. By the 1940s, infographics in the mass media was transmitting complex information. Using the pictorials and infographics concept, Otl Aicher created 'Stick figures' for the Munich Olympic Games which has since influenced public signage. By 1975, Edward Tufte started to deploy, disseminate and teach ways to display statistical graphics in a simple way. In the era between 1950 to the beginning of this millennium, computer inventions have distinctly changed the way massive sets of data can be visualized [14]. Thirty years ago, information graphics or the term "infographics" appeared in the newspapers and magazine production field. Nigel Holmes' idea was to apply a visual cue to the subject under consideration using a mix between text and static image [25]. In this information age, this term is broadly used to represent a final graphics which merge DV, text, illustrations and images in one visual representation which tells a story. Infographics have three objectives: inform, entertain and persuade. It captures audience attention and then allows time to read the written information [17, P6].

2.2.1 What are Infographics?

In dealing with images, the human brain interprets signals as they are transmitted by external object to the eyes. It creates a memorized visual data for that object to be used or later recalled for other interpretations within the cultural environment [9]. Infographics is a well-structured source of knowledge, easily captured. It represents a type of dramatic plot or a story that has a beginning, middle and end. It starts by attracting the viewer's eye to a coherent designed page with the thrill of trying to complete the follow-up of the rest of the content. Graphic elements such as color and illustrations are salient, integral features of infographics. Identifying the focal points in the drawing that contain the most important information is the designer's first priority. Infography is a term used to define the way of encoding data, concepts and connections into graphics with a different degree of abstraction to be understood easily as visual data representation [32]. Infography can also be referred to as a method of using visual communication skills to form a relationship between audience and the image, audience and text elements to illustrate particular concepts in a simplistic and desirable form. It is considered a language of illustration using texts and images *(language vocabulary)* to interpret the idea effectively. Ben Shneiderman said that, "The purpose of visualization is insight, not pictures" [7]. As a functional art, infographics is a process relating ideas to text with attractive colors, images, drawing, illustrations, etc. and thereafter presenting them as one attractive graphical unit. Even though we can include DV in an infographic, the opposite cannot be done. Fig. 1
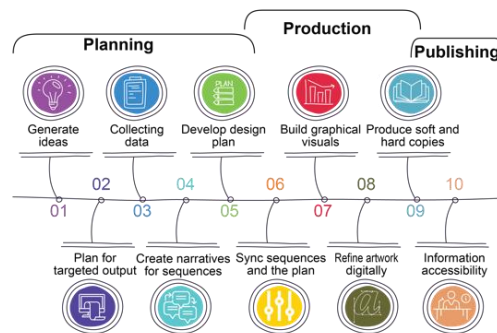

Fig. 1 Infographics workflow

2.2.1.1 Infographics types:

How can infographics be best presented? we find them on printed materials or on screens (online). Online infographics was made possible from the integration of the internet speed development and the huge amount of data available on the internet. Infographics can be used for the following purposes to inform, to persuade, to advertise, to be used in PR, posters etc. In terms of complexity, there are six forms of infographics which are: static, zooming, clickable, animated, video and interactive. [17, PP 31-51]

2.2.1.2 Infographics digital tools:

a. Desktop application software such as: "Adobe Photoshop", "Pixelmator", "GIMP" and "Acorn" for Image editing. "Adobe Illustrator", "Adobe InDesign", "OmniGraffle", "Inkscape", "Microsoft PowerPoint" and "Tableau" for vector graphics editing.
b. Online platforms like: "infogr.am", "Easel.ly", "Creative Market", "Piktochart", "Wordle.net", "Chartle.net", "ChartsBin", "DIY Chart", "Gephi", "Gliffy", "iCharts", "Many Eyes" and "The Noun Project" [29] [33].
c. Data searching tools: in addition to search engines, other rich data resources are available online for example: "Data.gov", "DataMarket", "FactBrowser", "Google Public Data", "Internet World Stats", "Quantcast" and "Wolfram Alpha". [17, PP 305-336]

2.3 Infographics and DV: Prior studies

Past papers that discussed infographics varied from their general application in newspapers to their directed ones in a field like education. Research on infographics application in newspapers discussed infographic and DV terms interchangeably! Due to the recent application in fields other than newspapers, some researchers did not delineate the boundaries between DV and infographics clearly. This

was evident when Chester and Elzer tried to transmit the information displayed in infographics to the sight-impaired users using XML representation [11]. Another example was a study showing applications and influence on newspaper readers [15]. Siricharoen and Brigham tried to discuss the concept in a wider scope. They demonstrated method of generating infographics, even though they discussed infographics as if they were DV [27] [6]. Through their DV taxonomy, Sancho, Domínguez and Ochoa presented the DV term development which has been integrated into infographics [26]. Few researchers discussed both terms together and succeeded in drawing a clear distinction in meaning between both [2].

They has been a paucity of papers discussing the use of infographics for ESL learners [1]. The researcher showed how infographics influenced students' perception through investigating students' achievement. Notably, this research studied two different groups to gauge comparative effects. Other studies discussed the general psychological impact of infography in education [3].

When authors generally explore the field of infographics, the term itself is very loosely employed. Bloggers and writers have often confused infographics with DV generated by spreadsheet application software such as (Microsoft® Excel). So, what are the differences between these two data representation methods?

Infographics and DV are two sides of the same coin. They both involve the language of context. In fact, every infographic and every DV have their own presentation and exploration component. Both present and facilitate the analysis of what has been displayed. The main difference is in the continuity of presenting the information. As a subjective, infographics resulted from mixing technology and art that allow more presentation with a minimum degree of exploration [21]. The opposite is true of objective DV [19]. In a nutshell, infographics tell stories while DV helps readers to discover stories by themselves [13].

Although the application was different, some authors developed their infographics based on the important role of combining visual and text design in one form to deliver the information [8].

3. Methodological Framework

This study combined elements of qualitative and quantitative research designs. It was a comparative study based on a "before" and "after" scenario. As an exploratory study, this paper targets students at a male's College. The authors created eight relevant infographic designs and compiled two different questionnaires to investigate teachers' and students' behavior and feedback on modern technological and educational innovations via the use of designed infographics.

Examinations were conducted for 20 First Year students before and after exposing them to infographics on 21st April 2019. The tests were prepared by the authors of the Interchange series. For the Main Book the focus of testing was Grammar and Vocabulary. Typical questions would be fill in the blanks for correct verb tenses, rewrite sentences as questions, re-arrange words to form sentences, fill in the correct prepositions, two-part verbs, etc. The Reading and Writing test normally has 2 texts from different genres which students are required to read and provide written responses to. Some of the items here include Multiple Choice questions and True / False. The Listening and Speaking test consists of 2 audio recordings which students have to listen attentively to before giving written responses. Again, questions requiring recall of content are set, often including Multiple Choice, Matching, and True / False items.

3.1 GRC 112 Course Specifications:

The aims of "Intensive English II GRC 112" course are to develop students understanding of general English so they can be able to write, speak, listen and read at a B1 level. This course follows the multi-skills syllabus in which components of the course are linked. It covers the four skills of listening, speaking, reading and writing as well as improving pronunciations and expanding vocabulary.

Learning strategies in this course include a combination of classroom and online interactions. Classroom materials include the use of the course book "Interchange Level 2 Student's Book with Online Self-Study 5th Edition by Jack C. Richards". Students explore the course book with their instructor who uses group, pair and individual work to complete learning activities. The grade scales for each aspect of work are presented in table 2 below.

Different assessment techniques are used to evaluate and develop students' level. The authors concentrated their data gathering based on the results of the quiz given in week 11 (highlighted below).

Table 2: Course's grade scales

Grades scales topics	1-2	3-4	5-6	7-8	Mid Term	9-10	11-12	13-14	15-16	Final	%
Forum Discussion	■		■		■		■		■		25%
Quizzes/simple exam		■		■			*		■		20%
Assignment1					■						15%
Assignment2									■		15%
Project Work									■		25%

3.2 Design Process

Initially, a teachers' questionnaire (TQ) was designed to focus on their attitude towards infographics, and how they and their students perceived new educational technologies. This TQ was distributed on 4th November 2018. Teachers' hierarchical perceptions and experiences of JCC students' weaknesses in grammar were: Tenses followed by Parts of Speech, Subject/Verb agreement, Prepositions, Collocations and Conditionals. The authors started the design process as follows:

d. Based on the student book, lectures and topic discussions, the authors wished to highlight the authenticity of infographics as an efficient cognitive tool to simplify an otherwise complex course plan [20]. They thus went about simplifying the ideas from the course books into sketches. They reformulated the simple present and past tense verbs, vocabulary, sentences, etc to illustrate their content for the planned series of static infographics.

e. The authors utilized common everyday words familiar to students such as: eat, play, marry, sleep, pizza, rice, ice-cream, coffee, kabsa and Ma'asoub (Saudi food), while at the same time keeping in mind modern youth's attitude towards mobile phones, internet e-games, speed, cartoons, entertainment, etc. [16]

f. Adopting the educator's situational quality listed by Dunlap and Lowenthal, information was placed around the mid axis. Considerations such as: logic, consistency and relevance were used to construct clear and simplified graphics, etc to evoke interest, admiration and a connection to information, figures and ideas. [12].

g. Based on the authors' experiences in visual communication fields in the Middle East, the use of color and its cultural significance was carefully considered. Orange and blue were used as the main identifying coding colors (Linear and radial shades) for simple past and simple present tenses consecutively. [5]

h. The simple sans serif "Arial" font family was used in typing the information text.

i. Infographics used the time line for different purposes; first, to identify tenses using the timeline and second, to show how to use the tenses keyword to point the suitable time.

j. Sequences of eight infographics were formulated to present the applied tense(s) in different situations followed by the language rule.

k. In each sequence, the authors designed different poses of animated stick figures to reinforce the concept of time in tenses.

l. The infographics applied a simple clipart to symbolize a human figure to avoid depiction which could be offensive to students' culture.

m. Designs carry different psychological connotations of feelings such as (anger, love, surprise, …) which has been symbolized in iconic representations such as a heart, punch, animation poses, etc.

n. The authors transformed all of the designed rough sketches digitally using a vector drawing application software "Adobe Illustrator®" to prepare high quality soft and hard copies for students.

o. Using the VARK model, the authors have re-used ESL material with the infographics to assist in the comprehension of tenses. A "PowerPoint" presentation using the infographics as an embedded picture was undertaken.

p. The students could use the digital infographic form on their mobile phones.

q. Students were tested at two consecutive times, the first prior to learning with infographics and the second, after using them. (Fig. 2)

Infographics with different color scheme were designed to interpret the information about the following:

• Sentence components (Subject, Object and Verb) infograph [I-SOV] (Fig. 3)

• Present and Past Tenses timeline infograph [I-TL] (Fig. 4)

• Present and Past Simple Tenses' structure infograph [I-SMPL] (Fig. 5)

• Present and Past Simple Tenses' examples infograph [I-EX] (Fig. 6)

• Simple Past Tense' Affirmative infograph [I-AFFV1] (Fig. 7)

• Simple Past Tense' Irregulars infograph [I-RV2] (Fig. 8)

• Simple Past Tense' Irregulars infograph [I-IRV2] (Fig. 9)

• Present and Simple Tenses' Time Keywords infograph [I-TKEY] (Fig. 10)

In the infographics design process, the authors didn't depend solely on artistic considerations or fancy decorative elements which might have led to obfuscation of the planned learning concepts. Rather, it was used as a tool to impress, express and expand language perception and cognition. Finally, another questionnaire was developed to gauge students' impressions (SQ). Twenty JCC students were requested to give their perceptions of infographics and their educational environment. TQ consisted of three sections, the first being general questions on gender, age, etc to elicit personal profiles. The second part of the questionnaire dealt with teachers' experiences with new educational technologies and infographics. The third set of

questions gleaned responses about their students' levels and weaknesses in the English language. The SQ also contained three sections which elicited information on demographic details, technological experiences, and students' attitudes to the designed infographics.
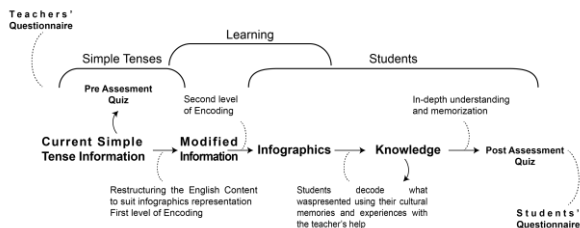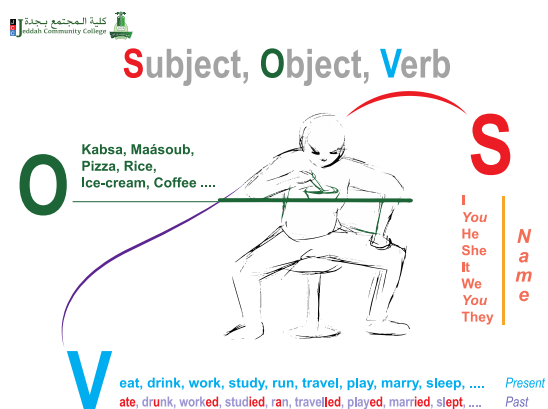

Fig. 2 Schematic diagram of the research workflow

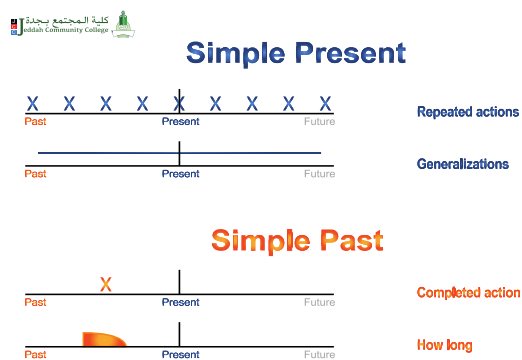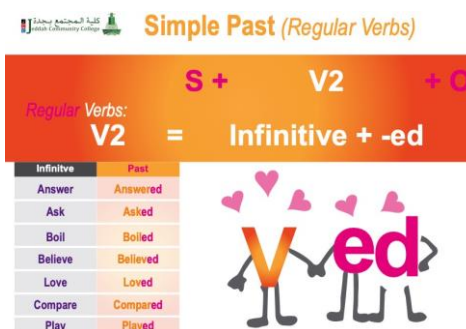Fig. 3 Sentence components (Subject, Object and Verb) infographics (I-SOV)

Fig. 4 Present and Past Tenses: timeline infographic (I-TL)

Fig. 5 Present and Past Simple Tenses: structure infographic (I-SMPL)

Fig. 6 Present and Past Simple Tenses: examples infographic (I-EX)

Fig. 7 Simple Past Tense: Affirmative infograph (I-AFFV1)

Fig. 8 Simple Past Tense: Irregulars infograph (I-RV2)

Fig. 9 Simple Past Tense: Irregular verb infographic (I-IRV2)

Fig. 10 Present and Simple Tenses: Time Keywords infographic (I-TKEY)

3.3 Teachers' Profile:

All 16 teacher respondents have their own PCs and believe that infographics will promote students learning. They are from different educational systems and experiences which reflect as follows: 6.3% each from (UK, India, Pakistan, KSA, Tunisia, USA), 12.5% from Egypt, 18.8% from KSA who have experienced with Saudi students only. The TQ also revealed that more than half (53%) of JCC English teachers were teaching ESL/EFL for more than 21 years with more than a quarter (26.7%) having taught between 10-20 years. They were experienced in the Middle East educational system (M = 11.3, range = 1-26 Years). The average teaching load was 17.8 hours, while class sizes

ranged from 20-30 students with the average being 27 students. Former students' grade average was 72%.

With regard to educational environment preference, 14.3% preferred the traditional educational system while 85.7% indicated that technologies added much to ESL learning. Most teachers (81.3%) relied on information technology (IT) in their teaching. Only 12.5% used it occasionally. Teachers admitted that a minority of their students practice the English language outside JCC frequently, the rest hovering between "sometimes" and "rarely" using the language 46.7% each.

The beginner students were the most problematic level in acquiring ESL followed by the pre-intermediate, intermediate and upper-intermediate levels. During the academic term, teachers experienced fair attendance of classes: 13.3% of students attended all lectures, 40% attended 80-95% of lectures, 40% of them attended 60-94% of sessions, and 6.7% rarely attended classes.

Teachers expressed interest in further infographic designs in the area of vocabulary enrichment based on the following order: use in sentence, meaning, antonym/synonym, idiomatic usage, form-meaning-pronunciation and spelling. The TQ also addressed teachers' feedback about pictogram, infographics, graphics, drawings, etc. The results showed that 14.3% of them were on a way of the pictogram concept, whereas 21.4%, 50%, 14.3% used them "always", "sometime" and "rarely" in teaching respectively. Most teachers who used pictograms (96%) used the pre-designed models either from books or online. It was that 80% of teachers are aware of infographics generally, while 23.1% didn't use it at all in their academic vocation (Fig. 11)

It was interesting to note that 86.7% used animated images in their classes to create some kind of amusement for students. 53.3% of the total sample used the still image type. Interestingly, 13.3% preferred using monochromatic image type during their lectures. (Fig. 12)
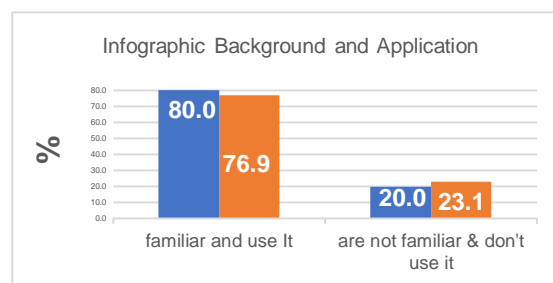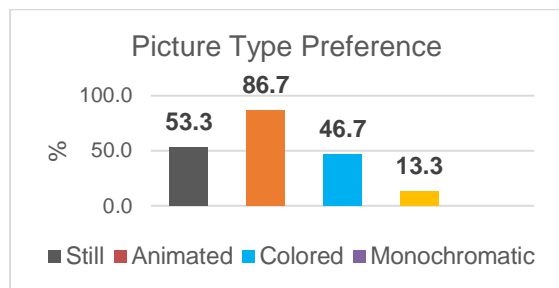

Fig. 11 Teachers' feedback about infographics

Fig. 12 Teachers' preference for digital pictures

3.4 Students' Profile:

The sample consisted of male students who joined JCC in 2018. Their ages ranged between19 and 22 years. Most of them were born in the western province (91.7%) with 8.3% born in the middle province. Nearly 8.3% were 22, 16.7% were 21 years of age, 33.3% were 20, and the majority (41.7%) were 19 years. In terms of GPA, each quarter of the sample received "B, C+" and "D". The last quarter distributed between "C" and "D+" which was 12.5% and 8.3% respectively. As for their English language grades, almost one-third of the sample (33.4%) were excellent students as they received "A+, A" distributed evenly in 16.7% each. On the other hand, a quarter of the sample was slightly under achieving as they obtained "D" and 16.7% received "C". 8.3 % attained "B+" and 8.3% had "C+". Almost half the sample (58.3%) owned a personal computer. Although all of their smart mobile phones are connected to the internet most of the time, only 66.7% preferred to navigate the internet using their phones. 75% of students admitted that JCC computer processing speed was faster than their personal computers. When asked about their preferences in searching for information, 75% of them preferred the internet only, 25% used internet and libraries, 58.3% preferred to look for information Arabic, and only 8.3% preferred English. 58.3% used both Arabic and English in their search. Interestingly, students showed that they had difficulties in learning the simple present tense in comparison with the simple past. (Fig. 13)

In terms of graphical elements, the sample was first questioned about electronic games (e-games). The results showed that 16.7% of them don't play e-games, 25% play on smart phones, and 66.7% of them preferred modern console games such as "Microsoft Xbox®" and "Sony PlayStation®". With respect to looking for information it was found that 83.3% opt for videos, 50% favor pictures and 41.5% would rather use text in addition.

With regard to infographic designs feedback, 75% admitted not having any prior knowledge of the term! Due to the sample visual literacy, two thirds of students (66.7%) liked applied colors and drawings together in one design information; 25% were interested in drawings and 8.3% in

colors only. Figures 14, 15, 16, 17 show students' feedback on the eight attributes of designed infographics [24].
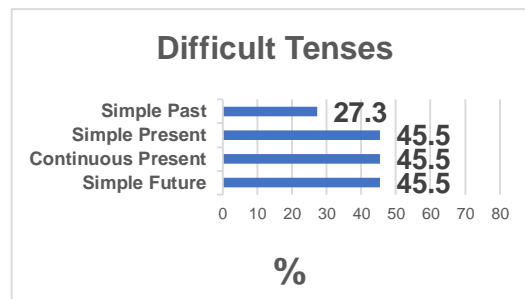

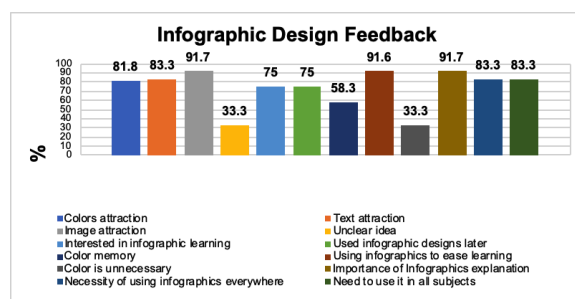Fig. 13 Students' feedback on difficult tense

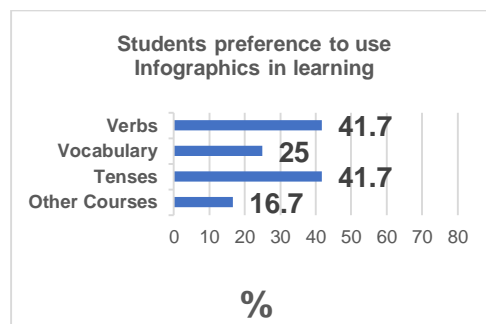Fig. 14 Students' feedback about provided infographics

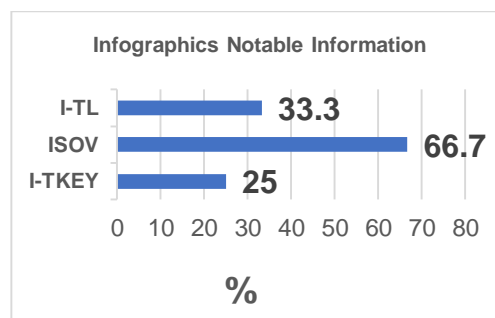Fig. 15 Students' learning preferences using infographics

Fig. 16 Students' feedback on notable information via provided infographics
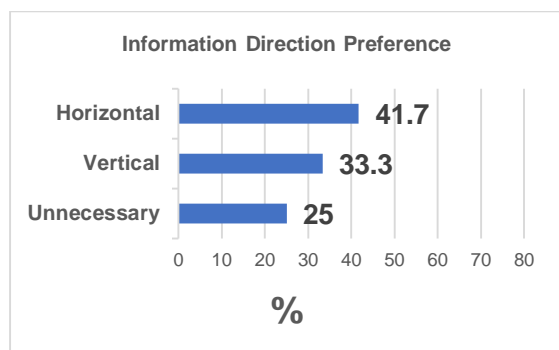
Fig. 17 Students' preference on infographics orientation

4. Results and Analysis

The statistical analyses for students and teachers used in this paper are descriptive. Correlation analysis has been conducted using IBM SPSS.

Twenty students who attended the exam and completed the questionnaire submitted their feedback. The correlation analysis was conducted using Kendall rank (Kendall's tau-b) as a non-parametric test. It revealed the following:

Students who desired infographics in their educational environment correlate with their opinion on subject and object (Coefficient -0.632*, Sig. (2-tailed) 0.036)

- Most students (97%) have more than one means of digital entertainment
- Correlation between their PC ownership and prior infographics knowledge (Coefficient -0.683, Sig. (2-tailed) 0.026)
- Their marks before using infographics correlate with their preferred search in both languages (Arabic & English) (Coefficient 0.493*, Sig. (2-tailed) 0.048)
- Video preference for any information correlate with "Subject and Object" Design (Coefficient 0.632*, Sig. (2-tailed) 0.036)
- Correlation between prior knowledge of infographics and students who didn't prefer the designed colors (Coefficient -0.770*, Sig. (2-tailed) 0.015)
- Students who prefer browsing using desktop computers are interested in information about "Vocabulary" (Coefficient 0.683*, Sig. (2-tailed) 0.023)
- Students who were successful in using infographics for tenses also expressed interest in knowing about "Verbs" via the designed (I-TL) (Coefficient 0.598*, Sig. (2-tailed) 0.047)
- Students who didn't like the written text correlate with students who would like more colors (Coefficient 0.674*, Sig. (2-tailed) 0.025)
- Students who liked the designed (I-TL) prefer to learn more about verbs using infographics (Coefficient 0.598*, Sig. (2-tailed) 0.047).

The remaining students' responses were analyzed and correlated with each other/s to find the impact of the attributes and the relationship between students' feedback and status. These have been tabulated in table (3). The descriptive statistics presented in Table (4), show that there is an overall improvement in the students' level. The mean results before and after using infographics was 53.436 and 62.991 respectively.

The Confidence Interval Percentage was 95%. The authors used two different tests (T-Test) and later (Wilcoxon Signed Ranks Test) to scrutinize the exam results.

When comparing students' results before and after using infographics, it was found that significant improvement in the level of the underachieving students' profile occurred (though it is not the best). By the same token, according to the data there was remarkable development in the proficient students, having attained full marks. (Fig. 18, 19)

Data presented in the exam's box plot after infographics shows that it is comparatively high compared to the previous one. Although the median remained almost constant, there was nevertheless a different distribution. This suggests that the marks have been distributed more across the highest level one the upper quartile. (Fig. 20,21)
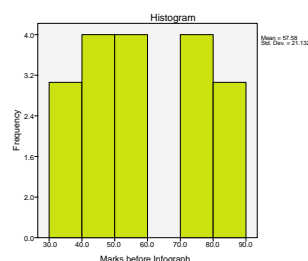

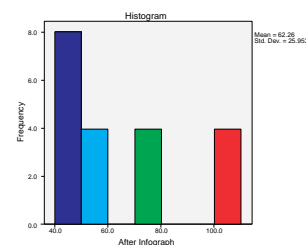Fig. 18 Students' mark distribution before using infographics

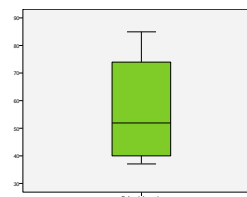Fig. 19 Students' mark distribution after using infographs

Fig. 20 Students' marks "Box Plot" before using infographics

Table 3: Correlation analysis between students' characteristics attributes using (Kendall's tau-b) in SPSS

Serial	Attribute 01	Attribute/s 02	Correlation Coefficient	Sig. (2-tailed)
1	GPA	English grade	0.779**	0.001
		Prefer mobile games	0.538*	0.048
		Interesting drawings & colors in Infographics	0.587*	0.026
		Infographics' horizontal direction preference	0.546*	0.034
		Difficult exams (students' opinion)	0.642*	0.015
		Exam before learning via Infographics	-0.625**	0.007
2	English grade	Prefer drawing & colors	0.515*	0.049
		Exam before Infographics	-0.734**	0.002
		Exam after Infographics	-0.530*	0.023
3	PC browsing preference	Prefer to use Infographics for Vocabulary	0.683*	0.023
		Interested in [I-SOV] infographics	0.598*	0.047
		Liked Infographics' colors	0.657*	0.025
		Most difficult tense (Simple Past)	0.810*	0.010
4	Mobile browsing preference	PC availability for browsing preference	-0.837**	0.006
		Liked Infographics' colors	-0.747*	0.011
		Most difficult tense (Simple Past)	-0.810*	0.010
5	Students prefer mobile games	Faster network speed	0.775*	0.010
		Used Infographics printed papers later	-0.775*	0.010
		Infographics data clarity	-0.674*	0.025
6	Use Internet and conventional Libraries for searching	Prefer Infographics for tenses	0.683*	0.023
		Nothing is missing in information supplied via Infographics	0.775*	0.010
7	Text preference for any information	Didn't like colors	0.624*	0.049
		Like [I-TL] infographics more than others	0.598*	0.047

Serial	Attribute 01	Attribute/s 02	Correlation Coefficient	Sig. (2-tailed)
17	Colored designs are the best option for infographics	The most interesting in infographs were drawing, colors and text	-0.706*	0.011
		Text information direction (V-H-UN)***	0.609*	0.025
		The text was the first	-0.835**	0.003
18	Text was the best	The most interesting in infographics were drawing, colors and text	0.650*	0.022
		Text information direction (V-H-UN) ***	-0.724**	0.009
19	Remember infographics' colors symbolized the time	Liked the infographic colors	0.704*	0.011
		The most difficult tense (Simple Past)	0.738*	0.013
		Liked the infographic colors	0.704*	0.011
20	Liked Infographics' colors	The most difficult tense in understanding is Simple Past	0.880**	0.004
21	Need more drawings in infographics	There is nothing missing in infographics	-0.632*	0.036
22	Need more text in infographics	Drawing comes first in their preference	0.683*	0.023
23	Need more colors in infographics	Didn't like the text	0.674*	0.025

No.	Variable	Correlated with	Correlation	Sig.
8	Most interesting element in infographics were drawings and colors	Colors comes as the first priority	-0.706*	0.011
		Text comes as the first priority	0.650*	0.022
9	Learn more about tenses	Use both Arabic & English languages in searching	0.683*	0.023
		Exceptional information was [I-SOV]	0.598*|	0.047
10	Use Infographics to learn more courses	Use the infographics later	-0.775*	0.010
		Exceptional infographics was the subject and object	-0.632*	0.036
		How clear was the information from the info	-0.674*	0.025
11	Didn't like colors	Prior infographic knowledge	-0.770*	0.015
		Information clarity from the infographics	-0.671*	0.034
12	The idea from the infographics was unclear	Generally, the difficult tense was Simple Present	0.656*	0.032
13	Students who used the infographics later	prefer playing using their mobile phones	-0.775*	0.010
		Prefer to repeat with other courses	-0.775*	0.010
14	Significant information from infographics was Subject and Object	Preferred method to get information via videos	0.632*	0.036
		Prefer to learn tenses	0.598*	0.047
		Prefer to apply it in other courses	-0.632*	0.036
		Prefer infographics everywhere	-0.632*	0.036
15	Significant information was tenses and their applications	Difficult Exams	-0.594*	0.042
		Difficult tense to understand is Simple Present	0.671*	0.034
16	Drawing was the best in infographics	More text is preferred	0.683*	0.023
24	Prefer searching via internet and library	Nothing is missing in infographics	0.775*	0.010
		Infographics requires more drawings	-0.632*	0.036
25	Information was clear	Need to use it in different courses	-0.674*	0.025
		Didn't like applied colors	-0.671*	0.034
		Want to use infographs in other courses	-0.674*	0.025
		Colors come as first in infographics	0.609*	0.025
26	Infographic horizontal direction preference	Text comes as first in infographics	-0.724**	0.009
27	Difficult Exams	Significant information was Subject and Object	-0.566	0.053
		The most difficult tense was the Simple Present	-0.656*	0.032
28	Most difficult tense (Simple Past)	Liked more colors in infographics	0.880**	0.004
		Most difficult tense (Simple Future)	0.671*	0.034
29	Most difficult tense (Simple Future)	Most difficult tense (Simple Past)	0.671*	0.034
		Most difficult tense (Continuous Present)	-0.633*	0.045
30	Want to use infographics for other courses	Use infograph later to assist learning	-0.775*	0.010
		Most significant infographics is Subject and Object slide	-0.632*	0.036
31	Marks before infographics	English Grade	-0.734**	0.002
		Prefer searching in both languages	0.493*	0.048
32	Marks after infographics	English Grade	-0.530*	0.023
		Time for daily browsing	-0.508*	0.050
		Before infographics	0.723**	0.000

* Correlation is significant at the 0.05 level (1-tailed).
** Correlation is significant at the 0.01 level (1-tailed).
*** V= Vertical, H= Horizontal, AD= Any Direction

In table (5), the Sig. (2-tailed) result (0.028) shows that H0 is rejected, as there is a difference before and after. Since the sample size was small and the statistical population couldn't be assumed to be normally distributed, another analysis using the Wilcoxon T test (Wilcoxon Signed Ranks Test) was conducted to refine the results. The Wilcoxon test was used to check if there is a difference in means between the students' marks after using the pre-designed infographics as a learning tool. Furthermore, table (6) results show that P< 0.05 and the positive ranks are 20 which means that the H0 has been rejected and the students' level has improved using infographics. It can be concluded that using infographics as a teaching tool has a significant and positive impact on students' learning.

Table 4: Students' Descriptive Statistics

	N	Mean	Std. Deviation	Min.	Max.	Percentiles		
						25th	50th (Median)	75th
Before Using Infographics	20	53.436	15.8653	37.0	85.0	38.500	51.900	79.500
After Using Infographics	20	62.991	18.0588	40.8	100.0	40.800	51.900	88.900

Table 5: (T-Test) analysis: Students' mark Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean	Correlation
Pair 1	Before using Infographics	58.43628	20	15.8647955	6.7261	.969
	After using Infographics	62.991114	20	18.0588978	7.3072	

Paired Samples Test

	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Before & after using infographics	-7.0429	6.4493	2.4376	-13.0074	-1.0783	-2.889	19	**.028**

Table 6: Students' marks statistics correlation using Wilcoxon Signed Ranks Test

Ranks					Test Statistics[d]	
		N	Mean Rank	Sum of Ranks		
Before & after using infographics	Negative	0[a]	0.00	0.00		After and Before using Infographics
	Positive	20[b]	3.50	21.00	Z	-2.207[e]
	Ties	1[c]			Asymp. Sig. (2-tailed)	**.027**
	Total	20				
a. After Infographics < Before Infographics					d. Wilcoxon Signed Ranks Test	
b. After Infographics > Before Infographics						
c. After Infographics = Before Infographics					e. Based on negative ranks.	

5. Limitations

This study was undertaken with a homogenous sample of male students at a College. It would be preferable in a follow up study to expand the sample base to include females, different age groups, and students of more diverse cultural background and interests.

Moreover, this study focused on only one topic or component of English grammar for a specific educational level. This limited the study to a certain extent, which in turn had an impact on the results. This point will be elaborated in the next section. Although teachers had ample experience, some of them lacked knowledge of modern technological tools that facilitate the use of infographics.

6. Conclusion and recommendations

Designing the infographics is a recursive process which involves the student as an end user. Although male students in this region considered graphics as a decorative element rather than a medium to transfer meanings, they regarded

infographics as one of the most entertaining learning tools since it mixes attractive graphical elements in one model to present information easily. Second, using IBM SPSS the findings showed the results of significance test (t-test) with p= 0.028 and the Wilcoxon test represented p= 0.027. Thus, the null hypothesis clarifies that students' level did improve using infographics. Students showed an overall preference for infographics. These results prove that there are differences in learning outcomes before and after implementing infographics as learning tool.

Using infographics to teach one aspect of grammar (Tenses) has implications for other areas of the English language. This study holds promise for further investigation into the benefits of infographics for the holistic development of students. If they found infographics useful for one aspect of grammar, one can only marvel at the myriad possibilities for the development of skills such as Reading, Writing, and Speaking. Students' feedback led the authors to consider the very real possibility of teachers researching and using infographics in other subject disciplines such as: Social Sciences and Mathematics. Teacher practitioners may well be advised to apply Action Research in their investigations. An additional recommendation involves essential elements in teacher training. Pre-service and in-service teachers could be required as ongoing training, to attend workshops, seminars, short courses, materials development, training, etc on the creative use of infographics and other visual means for example, cartooning and animated figures which simplify and capture meaning easily. Furthermore, students require different extra-curricular sessions to expose them to new learning technologies and their applications.

Finally, the infographic design process is time consuming and labor intensive. The authors would like to suggest the establishment of in-house student-teacher committees to focus on in creating interesting infographics related to the course being studied.

Acknowledgement

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