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THE EFFECT OF THE LEVEL OF NAVIGATION IN INTERACTIVE INFOGRAPHICS ON THE MOTIVATION FOR ACHIEVEMENT AND THE ATTITUDE TOWARDS DIGITAL VISUAL REPRESENTATIONS

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ABSTRACT: *This study aimed to identify the effect of the level of navigation in interactive infographics (horizontal vs in-depth navigations) on the motivation for achievement and the attitude towards digital visual representations. Aquasi-experimental approach was used to compare the two experimental groups. The first group used infographic based on horizontal navigation while the second used infographic based on an in-depth navigation. The research sample consisted of (64) students who are currently studying a general diploma at the faculty of education at the University of Jeddah, Saudi Arabia. They were randomly assigned into two research groups with (32) students in each group. Two tools were developed, the first is the motivation measure of achievement and consists of (6) themes (sense of responsibility, perseverance, level of ambition, appreciation of the importance of time, enjoying learning practices, and planning for the future) with (36) items. On the other hand, the second tool was developed to measure the attitude towards digital visual representations and it included (3) themes (reading the digital visual representations, the effevtiveness of the digital visual representations, and the requirments for these representations) and this includes (24) items. The results have shown that the in-depth infographic navigation outweighed as compared to the horizontal infographic navigation in developing both the motivation for achievement and the attitude towards digital visual representations. In addition, the research recommended an expansion in the use of interactive infographic in digital educational systems.*

KEYWORDS: interactive infographic, the level of navigation, horizontal navigation, in-depth navigation, motivation for achievement, attitude towards digital visual representations.

INTRODUCTION

Infographic is one of the most Innovative methods for visual representation of data and verbal information (Lee & Cavanaugh, 2016).The names assigned to infographic are numerous, including: Visual representations, Design information visually, and Architecture Information, among these Infographic is the most widely known and used term which is an abbreviation for information graphics (Polman&Gebre, 2015). Infographic is intended to provide content through extensive use of visual elements, in a way that attracts the attention of the receiver and craetes a motive to understand the significance of the graphic content (Dur, 2014). The use of infographic in the educational process leads to the improvement of learning outcomes within the framework of previously-set objectives; for whuch the National Council of Teachers of Mathematics NCTM

recommends using infographics throughout all different stages of education with students participating in designing information by collecting information and then work to represent it visually using various Media and tools (Krauss, 2012).

Smiciklas (2012) defined interactive infographics as graphics supported by interactive elements that enable the user to interact with content and give him the ability to share information with the design by making selections or processes through which the user receives direct responses, creates a rich and extended learning environment that is attractive and engaging. It helps achieve a better involvement with learning practices through different interactions within the content. Smiciklas (2012) named also some of the benefits of using the interactive infographic in education which included an improved comprehension of information, ideas, concepts and an enhanced ability to think critically and organize ideas, in addition to an Improved retention and recall of information. Interactive infographic is referred to by some as an integrated electronic environment for visual learning, and is increasingly becoming effective when using the social networking capabilities associated with sharing, commenting and interacting with images in a variety of ways (Al-halafawy&Tawfiq, 2014; Falk, 2016). However, Interactive infographic is a tool for visual summarization of a large amount of information. It is also a tool for interaction with information and a way to navigate through in broader knowledge extensions; the most important characteristic of good interactive infographic is its attractiveness and its ability to organize and employ visual stimuli of all kinds and its ability to make an interaction that attracts the learner to the information graphics by providing a content rich with different stimul, both static and dynamic, that simplifies the ideas and concepts of content while maintaining the order of events and sequence of time; an image that clarifies relationships, organizes and analyzes the different elements of the content including texts, images, animation, video clips, graphics and symbols, as well as the arrangement of the content of these items in a way that serves the learner, such as the various navigation tools which help the learners achieve their desired goals (Rueda, 2015).

Infographic has been addressed in several research studies, some of which were concerned with measuring the effectiveness of the infographic, such as Yildirim study (2016), which confirmed the effectiveness of infographic in the development of some learning outcomes, in addition to supporting a long-term learning effect, from the viewpoint of (64) University students. There is also Mocek study (2016), which compared two different organizations of the content, one supported by infographic and the other without infographic. The results showed that the organization of curriculum based on infographic is more effective for the development of learners' achievement and the existence of a long-term learning effect.

Although there have been numerous studies on the effectiveness of infographic in educational situations and on the impact of infographic design variables for specific learning outcomes (Dur,2014; Polman&Gebre,2015; Rueda,2015; Falk,2016; Lee& Cavanaugh,2016). these studies have overlooked one of the most important design aspects of infographic, that is, navigation through Infographic (Navigability). The importance of navigations comes from being a tool through which bridges are built between communication gaps and parts of the content which relates to the extent to which the learner can know his /her current status in the environment and how he / she could move to other areas (Sims, 2000). In this context, it can be emphasized that navigation is one of the important structural variables to be studied and experimented with in modern technologies. This is

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because it is the navigation that determines how the user navigates within the system, and therefore reflects on the speed of access to the components of the system and the way it is acquired (McClymont, Shuralyov, &Stuerzlinger, 2011).

It can be noted that navigation levels are based on two basic levels: first is the horizontal level of navigation through which the learner explores the information graphics sequentially without the presence of additional levels of information and thus the learner can move between each component of the graphical environment, and the learner does not have to move into additional illustrations of each component. On the other hand, in-depth navigation level provides an opportunity for the learner to discover and interact with infographic information than in the case of horizontal level. In-depth navigation allows the learner to explore the relationship between any level. This type of navigation is supported by a navigational tree that stores the necessary data, which allows the learner to move forward or backward, with a choice for random navigation. (Aufderheide, 2015; Jaén, Bosch, Esteve, &Mocholí, 2005).

Research questions:
(RQ1) What are the themes and indicatord of motivation for academic achievement?
(RQ2) What are tge themes and indicators of attitude towards digital visualizations?
(RQ3) What is the impact of the navigation methods (horizontal vs in-depth) with the interactive infographic on the motivation for achievement and attitude towards digital visualizations?

Research hypotheses
The study tried to verify the validity of the following hypothesis:
(H1) There is no statistically significant difference at ≤ 0.05 between the average grades of students of the first experimental group (for inforgaphic based on horizontal navigation), and the average score of the second experimental group (for infographic based on in-depth navigation) in the post measurement of the motivation to achieve; that is, due to the effect of different navigation levels.
(H2) There is no statistically significant difference at ≤ 0.05 between the average grades of students of the first experimental group (for inforgaphic based on horizontal navigation), and the average score of the second experimental group (for infographic based on in-depth navigation) in the post measurement of the attitude towards digital visualizations; that is, due to the effect of different navigation levels.

LITERATURE REVIEW

Interactive Infographic
Interactive infographic is a graphical Media loaded with interactive elements that aims at simplifying complex knowledge and presenting it in an attractive visual setting to raise the awareness with iamge content for as many target audiences as possible(Alabdulqader, 2013).They can be seen as highly structured interactive visual representations designed to convey a specific message using visual and textual components (Li et al., 2015). Interactive infographic can also be considered an effective way to transform data and information from being abstract into attractive stories that can easily be interacted with (Harrison, Reinecke, & Chang, 2015). In a rhetorical context, Kelly (Kelly, 2016) states that interactive infographics have been developed to prevail because it relies on colours to speak out, and therefore convincing and facilitating the process of

absorbing complex information. The preference for using infographics as an integrated unit to deliver large or complex content compared to text content comes to the fact that the brain's processing of image information is less complicated than with processing raw texts; the brain processes the image information faster where it deals with the image at once (Simultaneous) while it deals with the text in a sequential linear manner (Beegel, 2014).

In order for interactive infographics to achieve their desired objectives, which are based on the delivery of content in a simplified and more effective manner, several principles must be adhered to when designing these infographics, which can be mentioned as follows (Evans, 2016):

1- the simplicity of the design, its attractiveness and the clarity of its philosophy: the simplicity of design is linked to the designer's creative vision and his ability to highlight the relationships between the elements and the spontaneity in putting forward the idea.
2- Simplified and easy-to-handle interaction tools: The designer's use of infographic interaction tools focuses on easy handling, quick access, color contrasts and constantly changing visual combinations that are the result of the use of interactive elements.
3- The level of navigation through infographic: Cognitive extensions of informatics graphics require the use of tools to navigate through graphic content and its elements, and the level of navigation must be matched by other factors such as the volume of information included in the infographic and the methods of its organization.
4- Serve a clear purpose: Each infographic must have one theme to be highlighted, that is, with all the tools available within the infographic production tools.
5- Use space effectively: White spaces must be maintained within the infographic, and not stacked with graphics.
6- Lead the viewer in a specific direction: the focus should be on the person watching the infographic, and put a sequential or logical arrangement of the components of the image.
7- Highlight important facts visually: taking into consideration colour coding to focus on key elements within an infographic.
8- Use sections to divide content: a proposal for the main parts of the infographic should be planned, and the space used should be equally divided into parts that each has enough space to present specisifc ideas of the main topic of the infographic.
9- Show data clearly: use clear familiar icons and symbols which makes it easy to the user to understand and comprehend the main objective of the infographic.
10- Encourage the eye to compare data: the design of infographic components should be taken into consideration, in a way that enables the user compare the data displayed with each other in case the topic entails that.
11- Use examples and/or ready-made templates: there are many templates for infographic production, which offer unique design solutions, so don't ignore these templates and models as they help the designer find creative solutions.

The level of navigation in interactive infographics:

The level and intensity of information explored within the interactive infographic is an important determinant of the navigation process, for whcih the user navigates within the infographic, acquires his information horizontally and moves from place to place within the infographic without branching out to multiple levels of information. Links between the contents and icons of

infographics have no additional levels of information, so the user within this horizontal level of navigation makes the learner navigates and moves through successive images from one to another through a smooth forward or backward transition without any internal branching. Unlike horizontal navigation, in-depth navigation comes to offer the contents of infographics in a more complicated manner, where infographics at this level of navigation include multiple links between the contents of the infographic in addition to other related information. The user within this level is exposed to a size of information bigger than what he or she might explore within the horizontal level; in-depth navigation allows the user to explore the relationship between any level of information through a navigational tree that stores the necessary data that allows forward or backward progress and a possibility of random navigation. The figure (1) shows the nature of each navigation (Alabdulqader, 2013; Artacho-Ramirez, Diego-Mas, &Alcaide-Marzal, 2008; Falk, 2016; Jaén et al., 2005).

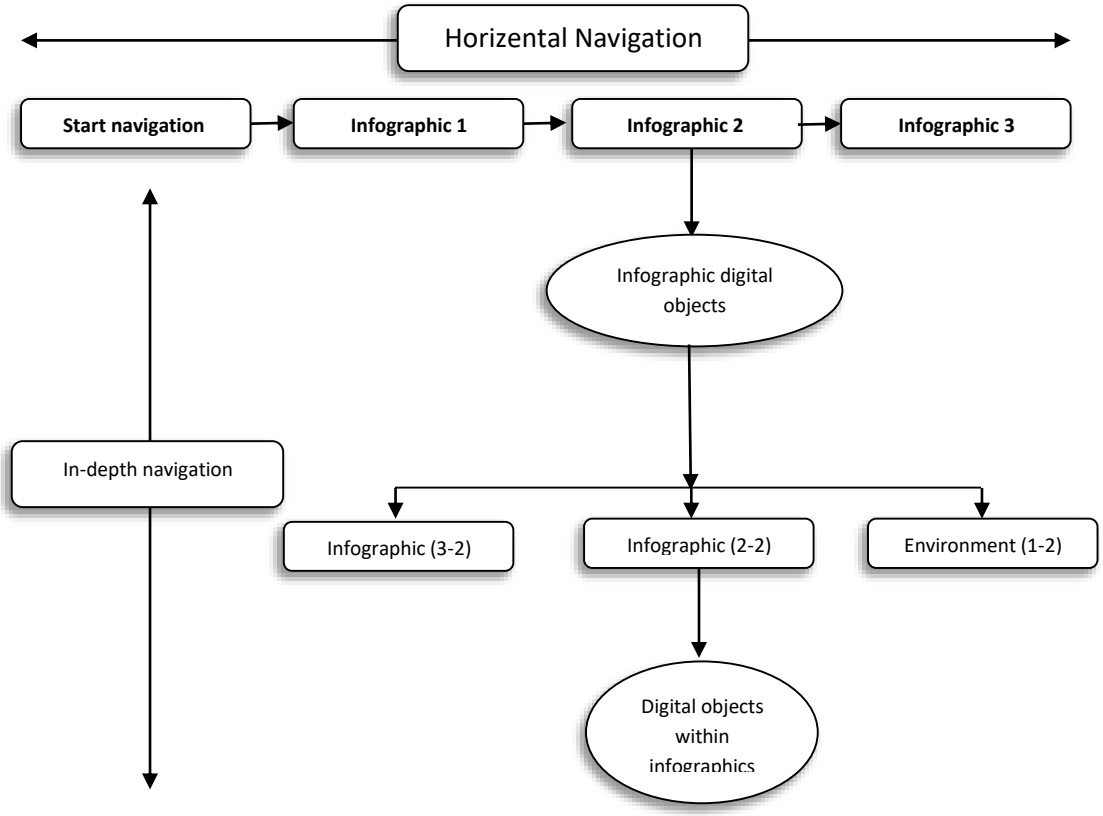

Figure 1: Horizontal and in-depth navigation levels in infographics

As described in the previous figure, horizontal navigation involves a smooth transition from infographic to other infographics without any links branched from within the infographic itself, whereas in case there are subdivisions and links through which the infographic is generated from - within digital objects or icons within the infographic. This is called the level of in-depth navigation that gives the user the freedom when exploring information within the infographic; a freedom that is pertained through a network of interrelated steps. The contents at this level of navigation are fragmented into multiple parts, including extentions and links, and the user can walk in any way

while learning and discovering the contents of the infographic environment (Jaén et al., 2005; Nathan, 2018).

Additionally, the level of horizontal navigation that presents the content in a successive way from beginning till end without any segmentation of the contect can be said to agree with the principles of massed learning, particulary in content management. This kind of learning refers to the concentration of learning attempts or practice sessions in a continuous successive process, while the case for the level of in-depth navigation is different; it is based on the segmentation of content. This is consistent with the principles of distributed learning, which is intended to distribute learning attempts or practices into separate parts. (Murray &Udermann, 2003; Schutte et al., 2015).

The level of in-depth navigation differs from horizontal navigation in that it may require a database from which it stores objects of the infographic through whichthe learner travels. In additionthere must be links between these diverse objects, and in this context many studies have indicated that the level of in-depth navigation is one of the most complex navigation levels and may therefore sometimes require superior methods and technologies to get regulated and patterned, depending on the density of digital content provided via infographic (Dur, 2014; Jaén et al., 2005). However, with the development of photos sharing applications, a second-generation e-learning environment, it can be relied upon to manage infographic-based learning situations in both horizontal and in-depth navigation. Participatory Image Applications can play this role by allowing the creation and management of educational content based on digital illustrations, and a creation of a major and minor links between these illustrations (Waycott& Kennedy, 2009). These applications are huge in number and are available over the network such as the (Flicker) and (Instagram), which are one of the most effective applications in the presentation of digital illustrations and are reliable in creating links (Guo et al., 2017).

The effectiveness of photos sharing applications has been tested in a variety of scientific studies and has proven highly effective (Kim, Seely, & Jung, 2017; Waycott& Kennedy, 2009). photos sharing applications are used as an effective tool in improving infographic views, making them more flexible and interchangeable across systems. (Guo et al., 2017).Thus, the importance of image sharing applications lies in their ability to display the contents of the infographic in a way that interests the learner by linking it to deeper aspects of learning as based on the level of navigation; which makes the learner able to understand what he sees and reads, and thus form his own views on the content displayed (Ahadzadeh, Pahlevan Sharif, & Ong, 2017; Zeidan, Alhalafawy, &Tawfiq, 2017). To put it short, image sharing applications and their features allow teachers to effectively employ them in infographic-based visual learning, as they can include various tools that help create navigation links, providing learners with dynamic learning materials that can be integrated in an integrative framework with the curriculum (Alhalafawy&Zaki, 2019; Ramkumar et al., 2017).

1- Motivation for Achievment

The motivation for achievement is the willingness to perform difficult work, the learner's enjoyment of the learning process, the aspiration for what is new, and the love of perseverance (Gottfried, Fleming, & Gottfried, 1994). Motivation forachievement means achieving something difficult in topics or ideas, addressing and organizing it and doing it quickly and independently with an attempt to overcom obstacles. It also entails achieving a high level of self-superiority and competing with

others to achieve success having also self-esteem that is gained through successful practices, ambition, perseverance and endurance (Gottfried , 2019a). Motivation refers to the set of internal and external conditions that move an individual to rebalance an imbalance, a motive that refers to a tendency to reach a particular goal; a goal that may satisfy internal needs or desires (Gottfried, 2019a). Therefore, if motivation is a means to achieve educational goals, it is one of the most important factors that help achieves knowledge, understanding and other experiences that we usually seek to achieve, like intelligence and previous experience (Steinmayr, Weidinger, Schwinger, &Spinath, 2019).

In general, any educational system, including infographic, which is concerned with the development of motivation for academic achievement, should bear in mind that its key elements have the following characteristics (Kruger, 2006; Smith, 2011):

- **Student**: must be responsible for learning, and able to continue to perform work, duties and applications related to the field of study, whatever problems might appear.
- **Teacher**: must be distinguished in his teaching, keen on using visual learning environments, able to encouragestudentscuriousity to raise questions, and must accept and encourage the learner's self, in addition to his permanent support for the natural curiosity of the learner.
- E**ducationalenvironments**: each environment must have the ability to express the identity and personal characteristics of learners through their productive work and educational activities that can distinguish them from others. Its components must also allow for sharing and social negotiation in a realistic form or in electronic form. Each environment is realistic, that is, flexible and responsive to the authentic needs of learners. The closer the learning environment to the learners' environment, the more credible and realistic it is.
- **EducationalProcesses**: It is better to choose the approaches, strategies and teaching methods that support lerner-centered approach, and its positive role in learning.These processes are known as constructive learning, which emphasizes that knowledge is constructed by the learner rather than the transfer of knowledge by the teacher.
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2- The attitude towards digital Visual representations:

The success of the application of any new technology in the educational process depends largely on the attitudes of learners towards this technology, where the attitudes of learners affect their desire for them, and therefore the attitude mainly affects the efficiency of the work of any new technology system (Akçayır, Akçayır, Pektaş, &Ocak , 2016; Georgiou &Kyza, 2018; Krapp, 2005; Rauschnabel, Rossmann, & tom Dieck, 2017; Zeidan, Alhalafawy, Tawfiq, &Abdelhameed, 2015). Hence, the extent to which the infographic system succeeds or fails to achieve its objectives in the development of the educational process depends largely on the attitudes of learners. Attitudes may be one of the main reasons for endorsing or resisting innovation and thus resisting the use of technology applications in the educational process. Therefore, it is important to recognize the attitudes of learners towards the visualizations that are contained in the infographic as one of the key factors in the employment of these innovative systems.

The current research focuses on the attitude towards digital visual representaions because the effects of the level of horizontal or in-depth navigation levels extend to point where they can affect the

emotions and psychological attitude of the user who views these digital visualizationsthat are contained in the infographic. The level of navigation generates feelings and trends equivalent to real human feelings, and the degree of these feelings and trends vary depending on the level of navigation that can succeed in delivering the intended message to the user effortlessly (Artacho-Ramirez et al., 2008).

Visual representaions are a set of images and shapes that rely on visual competencies and an individual can develop them by integrating their five senses.It enables them to recognize and interpret the objects and symbols they encounter in their lives, and then use them creatively to communicate with others (NuhoğluKibar&Akkoyunlu, 2017). Therefore, visual representaions are all the realistic or fictional components that are converted into images and symbols, which the user sees and interacts with. An Infographic with all its components is one of the images of visualizations, and it is important to give the learner positive attitudes towards these visualization, so as to help them get accepted and used in various learning situations during his/her study, and to psychologically prepare the learner to rely on these visualizations as one of the main components of visual learning system (Artacho-Ramirez et al., 2008; Falk, 2016). Attitudes are distinct from other psychological variables becasue they are acquired and learned by the surrounding environment. They are not hereditary and they are multiple and varied; they vary according to renewable variables. Attitudes generate and link to variables and social attitudes. They can also be changed and modified despite the relative stability, and finally they are the product of past experience, and they relate to the present behavior, and expect the future behavior.

With reference to the relationship between the level of navigation and visualizations, the nature of visualization in itself creates a general state that facilitate the acceptance of an infographic. For example, visualizations that are based on the level of in-depth navigation work to provide the learner with information that meet his/her needs. In-depth navigation gives multiple levels of information in which the learner can easily move between according to his/her own pace. Thus, the learner becomes able to access a variety of informational resources associated with each digital object within the infographic, which helps in developing the learner's attitudes towards infographic as contrasted with the level of horizontal navigation that provides content in a simplified form that may not meet the learner's cognitive needs. In-depth navigation delivers content in a way that can lead to a full comprehension of the content, unlike horizontal navigation, which focuses on basic information about digital infographic objects without displaying additional information that the learner may need, which ultimately affects his/her orientation towards the visualizations that are contained in infographic (Faleer, Fergus, Bailey, & Wu, 2017; NuhoğluKibar&Akkoyunlu, 2017).

THEORETICAL FRAMEWORK

The horizontal level of navigation is supported by the Cognitive Load Theory, which indicates that the learner has a limited short-term memory cache. It participtes in processing the information before transferring it to the permanent long-term memory of unlimited capacity. In the case the sources of information in the short-term memory increased, it may lead to an overload that hinders the learning process; therefore, the increase in the levels of information within the infographic may lead to overload of knowledge on the learner(Wilson & Cole, 1991). In addition, according to the theory of cognitive load, the greater the number of learning resources and the multiple relationships

between these sources, the more cognitive load it imposes on the learner, and the more the subject becomes difficult in the learning process. So one of the solutions that can be considered to solve this problem is to give the learner enough time so that he can process all learning elements and draw diagrams of relationships between these elements (Sweller, Van Merrienboer, &Paas, 1998). This means that an in-depth navigation may lead to a variety of rsources and create thus difficulties in linking between them which may finally lead to a learner having an additional cognitive load. The horizontal navigation usually comes supported by the elaboration theory which is concerned with processing content at larger level scale. This theory believes that the priority in presenting the content is to display it in a holistic manner where the organization of the content of the infographic according to the expansion system means the organization of a set of concepts, principles, procedures, facts or information that are the content of a curriculum topic in integrated unsegmented units of infographic (Reigeluth, 2018).

In-depth navigation is supported by the Hierarchical Theory. This theory emphasizes that the content should have sequenced and multiple levels which allow the learner to move between parts of the content in a way that meets the information needs of the learner, and a sequence from easy to difficult, from bottom to top and from specific to general (Wagner & Rudolph, 2010). In-depth navigation is also supported by the Event Segmentation Theory (EST), which recognizes an important principle. This principle states that individuals perceive and visualize any activity in the form of separate events; that is, through a process called mental segmentation, by setting boundaries between events so that current information can be perceived, attention processes can be organized and knowledge can be stored in long-term memory. This happens through a procedural process in which a person forms models of an event in the working memory, as based on the sensory information received and prior knowledge. Thus, based on these models, predictions of the next steps are being assumed and then compared with what actually happened according to new sensory information received, and when the the new emerging sensory information does not go compatible with the predictions, a new event model is constructed for the next segment; however, perceiving what is called as a boundary of event (Zacks, Speer, Swallow, Braver, & Reynolds, 2007). There is no doubt that the principle of segmentation through the level of in-depth infographic navigation comes in line with the theory of the event. This happens by segmenting the infographic into separate events that make it easier for the learner to process and assimilate its components, and therefore segmentation in this case is one of the solutions through which the amount of information processed by the learner can be controlled without any extra cognitive load (Cheon, Crooks, & Chung, 2014; Lusk et al., 2009; Zaki, 2019).

METHODS

1- Design

The researchers used the experimental design with two experimental groups. The first experimental group used infographic based on the horizontal navigation level, while the second used the in-depth navigation level. Table (1) illustrates the experimental design of the research.

Table (1) Experimental Design

Groups	Independent Variable	Dependant Variable
Experimental group (1)	**Interactive infographics based on horizontal navigation**	**Motivation for achievement attitude towards visual representations**
Experimental group (2)	**Interactive infographics based on in-depth navigation**	

This table shows that the independent variables of the current research is based on the level of navigation (horizontal versus in-depth), and the dependent variable is based on the motivation for achievement and the attitude towards visual representations.

Sample

The research sample consisted of (64) students who are studying a course entitled "innovations of instructional techniques" at the general diploma program in education at the university of Jeddah in the academic year 2017/2018. The sample individuals were identified in two phases. In **thefirst phase**, the sample individuals were selected intentionally according to two criteria, the first was a technical criterion where the sample individuals possess mobile phones, in addition to their use of the application of sharing images (instgram), and the second criterion is the consent of the sample individuals to join the research experiment. **The second phase** is the one in which individuals were randomly distributed with (32) students in each of the two research groups.

Measures

The motivation for Achievemet

The motivation for achievement within this research is related to the indicators of the motivation for achievement that occur as a result of learning through an infographic-based environment (Gottfried, 2019b; Vallerand et al., 1992). In addition to the nature of learning through photo sharing applications, and the nature of graduate students in the current research, a motivation scale has been developed which included six major themes: sense of responsibility, perseverance, level of ambition, appreciation of the importance of time, enjoy learning practices, planning ahead for future.The scale consisted of (36) items, that is, (6) for vocabulary for each theme, (3) of which are positive, and the other (3) are negative. The scale was sent to a group of arbitrators to verify its validity and the appropriateness of the statements that were addressed to the students of the General Diploma in Education.The students were asked to evaluate each item according to the five-level assessment (strongly agree, agree, neutral, disagree, strongly disagree) with assigned grades (1 To 5, respectively) both for positive and negative statements. The stability of the scale was confirmed before application, where the coefficient of A Cronbach (0.82) (Cronbach's $\alpha = 0.82$).

The attitude towards digital visual representations

The current measure aims to measure the attitude of students of general diploma in education – the sample research - towards the digital visualizations that are contained in the infographic. The scale is based on the characteristics of digital visualizations and previous studies on the attitude towards visual learning and visual representations (Kim & Lennon, 2008; Wall, Higgins, & Smith, 2005). The researchers identified the themes of the current scale, which were represented in three themes,

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namely: first is “reading digital visualizations, second“effectiveness of digital visualizations”, and third is “the requirements of digital visualizations”. Based on these themes, the scale consisted of 24 phrases distributed on 3 themes, with each having 8 phrases; with 4 positive and 4 negative. The researcher identified the five-scale Likert scale, with each statement containing (5) response alternatives which are (strongly agree, agree, neutral, disagree, strongly disagree), and took into account the response grades which range as (1 - 5) for positive terms, and similarly for negative phrases. The stability of the scale was verified before being applied, where the coefficient of A. Cronbach (0.76) (Cronbach's $\alpha = 0.76$).

Procedure:
The current research procedures were implemented according to the educational design phaseswhuch are defined in (5) basic stages as follows:

The Analysis Stage: Throughout this stage, the educational tasks that will be implemented through the proposed model were analyzed. The present research was based on the tasks and activities of the educational content for course entitled "innovations of educational technologies" which targeted the students of the General Diploma in Education. (4) educational tasks related to the research and theoretical study of the innovations of educational technologies were identified which are: virtual museums, augmented reality, social media, flipped classes). In addition, **learner characteristics** associated with the use of mobile technology **were analyzed**, resulting in 100% of respondents owning mobile devices and 70 students using the photo sharing application, Instagram.

The Design Stage: Throughout this stage, the proposed Infographic module was designed, as follows:

Designing educational objectives: The educational objectives in the current research were for “innovations of educational tehnologies” course. Accordingly, a list of educational objectives was constructed which included (16) objectives related to the already specified topics: virtual museums, augmented reality, social media, flipped classes)

Designing content: with regards tothepreviously mentioned general and educational objectives, the content was formulated in (10) Infographics, that is, (5) for each process, and the parts that will be presented as follows (concept of innovated, the advantages of the innovated, characteristics of the innovated, components of the innovated).

Designing the level of navigation: The navigation level was designed with regards to both horizontal and in-depth navigation levels, as follows:
4-2-3-1: Designing the level of horizental navigation in the infographic:A learner can use the level of horizontal navigation to move from one infographic into another to sequentially study the educational technologies innovatives as compatible with the curriculum. Here the learner can review each infographindependently and get to know all the information related to the innovates as set in the objectives. It is thus through this level that the learner navigate in between infographics in linear sequential order.Figure (2 shows an Infographic about Flipped Classroom by horizontal navigation level.

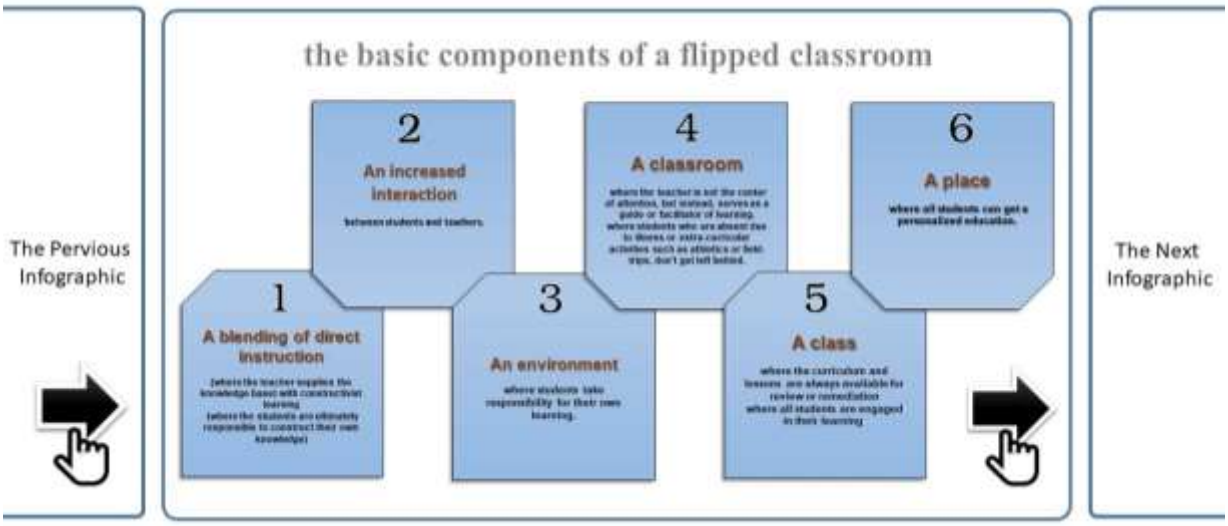

Figure (2): A module for an Infographics with horizontal navigation level

4-2-3-2: Designing the level of in-depth navigation in the infographic: A learner can use the level of in-depth navigation to move inside the main infographic of the educational technologies innovatives and move through to another infographics, each of which is concerned with a particular innovative and by by clicking on any of the main infographic components, you go to a sub-infographic.Figure (3) shows an Infographic about Flipped Classroomwith in-depth navigation level.

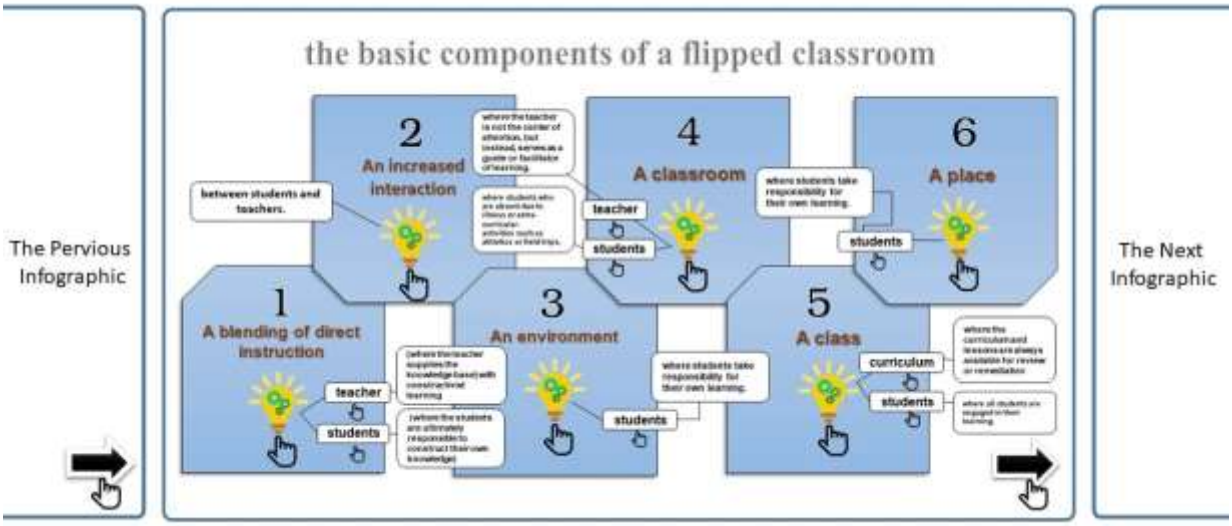

Figure (3): A module for an Infographics with in-depth navigation level

4.2.3. Designing the image sharing application (Instagram): The Instagram image sharing application is an application designed to allow an interaction with images. Therefore, it has been particulary chosen in the current research as a base from which interactive infographic images - that have been developed in the current search depending on the search processors – can be tackled. As such, an account was designed for each processing within the application, so the produced infographic in each process can be made according to the level of navigation. Figure(4) shows the review of one of the models of infographic through the image sharing application.

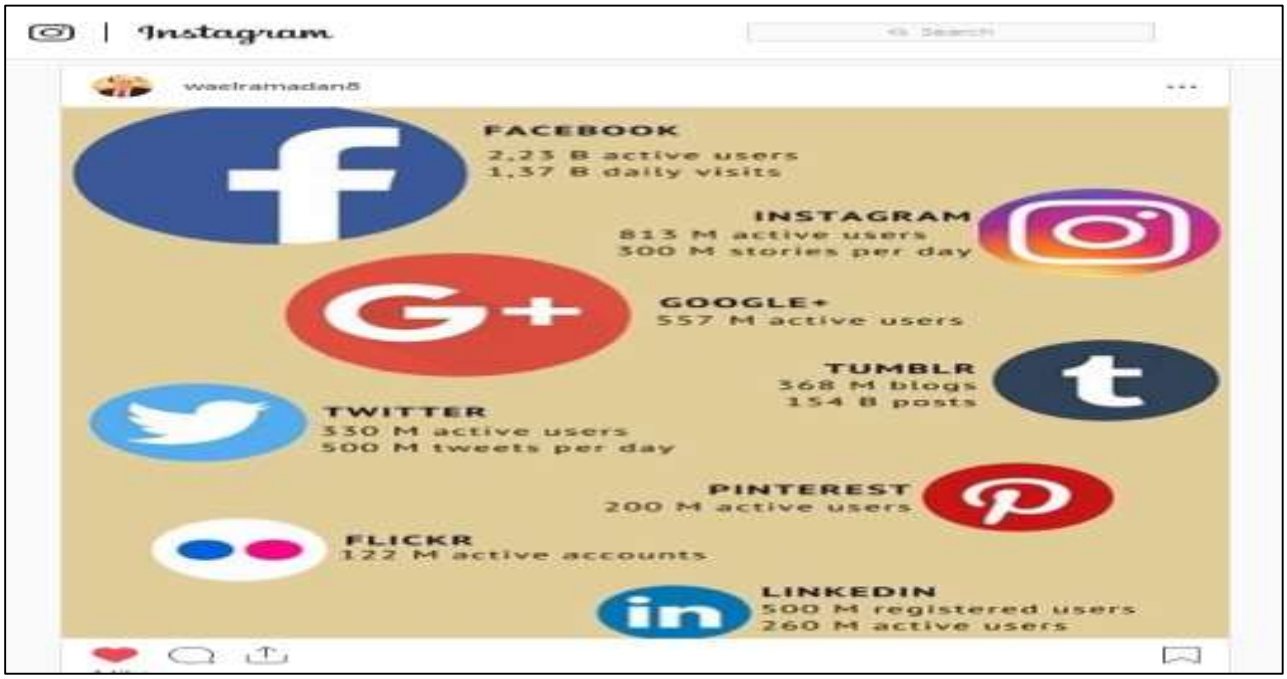

Figure (4): A review of the infographic through image sharing application

Designing the interaction within the experimental processing materials: The interaction is designed so that students interact with the content of the infographic, including various visual representations, in addition to interacting with the infographic through the interaction tools in the image sharing application, which is represented in the ability to control the size of the infographic, add comments, and re-share.

Designing the feedback strategy: Feedback is designed to follow and monitor comments sent by students through the image sharing application, a step followed by the teacher sending his comments to students to answer their questions or clarify some concepts.

Designing the strategies and approaches of learning and teaching: Individual learning has been relied on to interact with the contents of the infographic, and the use of application features to support the participatory learning processes associated with the infographics.

The Development Stage: Throughout this stage, the images of infographics have been produced and they were joined together using the level of navigation (horizontal vs in-depth), then the account iof the image sharing application was developed (Instagram), and each accounht was assignted to a group. Then, an initial evaluation of the infographics through the image sharing application was conducted to verify its validity with the final version of the application. This stage included the presentation of the developed experimental processors to a group of arbitrators to ensure that they are reliable to be used in applying the ingographic-based learning system, and to ensure that the design that was implemented is suitable for both horizontal and in-depth navigation variables. However, in the light of the results of the formative evaluation, the arbitrators agreed that infographic and experimental processing materials were suitable and applicable, and can achieve the research objectives, thus the electronic environments in their final form are ready for field experimentation on the research sample students.

The Application Stage: At this stage, the pre-application of the motivation for achievement and the attitude towards digital representations measure was conducted, then the learning process started

and the tasks were implemented through the image sharing application that included infographics. the learning strategies identified during the course of the of educational tasks were also implemented, and then the final post-application of the motivation for achievement" and "the attitude towards digital representations" measure was conducted.

Results

Results related to the development of "the motivation for achievement" measure

In relation what have been reviewed in theoretical framework and with regards to the procedures implemented whilepreparingthe research tool, the motivation for achievement measure included (6) various themes, namely: sense of responsibility, perseverance, level of ambition, appreciation of the importance of time, enjoying learning practices, planning for the future. The scale consisted of (36) items; that is, (6) items for each theme.

Results related to the development of "attitude towards digital representation" measure

In relation what have been reviewed in theoretical framework and with regards to the procedures implemented while preparing the research tool, the attitude towards digital representation measure included (3) various themes, namely: reading the digital visual represenations, the effectiveness of the digital visual represenations, the requirements of the digital visual represenations. The scale consisted of (24) items; that is, (8) items for each theme.

Results related to the impact of the level of navigation on the motivation for achievment and the atitude towards digital visualizations

Results related to the impact of the level of navigation on the motivation for achievment

To verify the validity of the first hypothesis bycomparing the two experimental groups and in which the first group used the horizontal navigation level, and the second group used the in-depth navigation level regarding the effect of "the motivation for achievement" variable, (T) test was used to identify the significance of differences between the two experimental groups. Table (2) shows the results of the (T) test for the two groups.

Table (2) arithmetic mean, standard deviation and T value of the average scores of the two groups individuals in motivation for achievement

group	n	Mean	SD	t	df	sig
Experimental Group 1 (horizental navigation)	32	122.21	3.32	41.63	62	0.000
Experimental Group 2 (in-depth navigation)	32	172.32	2.99			

As shown in the previous table, there are statistically significant differences between the first experimental group that used an infographic based on horizontal navigation (M = 122.21, SD = 3.32), and the second group that used an infographic based on in-depth navigation (M = 172.32, SD = 2.99).), (T = 41.63), (p = .000). Thus, the hypothesis can be adjusted as there is a statistically significant difference at ≤ 0.05 between the average scores of the first experimental group (an infographic based on horizontal navigation), and the average scores of the second experimental group (an infographic based on in-depth navigation) in the post- measurement of the motivation for

achievement in favor of the second experimental group; that is; due to the effect of the methods of navigation.

Results related to the impact of the level of navigation on the attitude towards digital visual ization

To verify the validity of the second hypothesis by comparing the two experimental groups and in which the first group used the horizontal navigation level, and the second group used the in-depth navigation level regarding the effect of "attitude towards using digital visualization" variable, (T) test was used to identify the significance of differences between the two experimental groups. Table (3) shows the results of the (T) test for the two groups.

Table (3) arithmetic mean, standard deviation and T value of the average scores of the two groups individuals in their attitude towards digital visual represention

group	n	Mean	SD	t	df	sig
Experimental Group 1 (horizental navigation)	32	98.76	4.21	28.21	62	0.000
Experimental Group 2 (in-depth navigation)	32	118.33	3.21			

As shown in the previous table, there are statistically significant differences between the first experimental group that used an infographic based on horizontal navigation (M= 98.76, SD=4.21), and the second group that used an infographic based on in-depth navigation (M=118.33, SD=3.21), (t=28.21), (p = .000). Thus, the hypothesis can be adjusted as there is a statistically significant difference at ≤ 0.05 between the average scores of the first experimental group (an infographic based on horizontal navigation), and the average scores of the second experimental group (an infographic based on in-depth navigation) in the post- measurement of the attitude towards digital**visual**represention in favor of the second experimental group; that is; due to the effect of the methods of navigation.

DISCUSSION

A discussion of the results of the impact of the level of navigation on the motivation for achievement

This result, which pointed to the effectiveness of the level of in-depth navigation in developing the motivation for achievement, may be due to the fact that the level of in-depth navigation always responds to the needs of the learner and provides him with the information and knowledge he needs. Thus, when the learner progresses through the levels of information provided by in-depth navigation he/she gets moremotivated for success and achievement because he is always aware of his needs. The level of in-depth navigation has placed the learner in the active explorer position of the infographiv-based educational environment, which stimulatesa desire to search for new ideas that reate to the level of the basic information. In addition, because of the complexity of information within the level of in-depth navigation, the learner has been given a degree of perseverance to access the information he/she wants. The flexibility of moving between levels of information at the level of in-depth infographic navigation has made it easier for the learner to build his/her knowledge through the infographic-based visual learning environment.

This result, which showed the advantage of in-depth navigational infographic, may be due to the logical linking process that occurs within this level of navigation where the relationship that arises as a result of clicking on certain icons within the infographic to generate new infographics greatly helps deliver the message quickly while saving time and effort. Morevover, this process may lead to increased understanding, comprehension and recalling through the formation of sound perceptions and mental images. This result, which indicates the advantage of in-depth navigation, can also be traced back to the fact that this level of in-depth navigation motivated the learner to practice various educational activities to explore other details related to the basic infographic. This helped the learner collect experiences that were stored in long-term memory in the form of knowledge schemes that helped him acquire new experiences and get motivated him/her to complete the rest of the educational tasks of education.

This result can also be explained in the framework of the theory of motivation, which indicates that the learner's rush to participate in the specified infographic-based learning environment and the high motivation for learning are all due to the flexibility of the level of in-depth navigation that allows the learner to move between levels of visual content. This makes the learning anenjoyable process, and it relects positively on the learner's self-motivatos, which increases more when the learner gets personally to enjoy more with the educational system. Next, this result is consistent with the constructivist theory that aims to create a kind of interaction and disclose changes that constantly occur in the learning environment, which helps to create progressive motives for the learner. This was achieved through the level of in-depth navigation which bridged the knowledge gaps of learners through a flexible transition between visual content.Based on Vygotsky's social learning theory, which states that the learner learns and acquires knowledge well when he is given more hints, guidance information and assistance to think than when he is left alone to explore and learn new concepts and knowledge, It can be pointed out that the level of in-depth navigation starts from within the infographic itself by coding the components that the learner can click on to move to a new infographic. This however gives an explanation of the high growth rates of motivation towards learning in the research sample.

A discussion of the results of the impact of the level of navigation on the attitude towards digital visual representions

This result, which pointed to the effectiveness of the infographic that is based on the level of in-depth navigation as compred with the infographic that is based on the horizontal navigation in developing the attitude towards digital visual represention**s**, may be due to the fact that the level of in-depth navigation helped the students sample to acquire the contents of the infographic easily; which was reflected in the overall effectiveness of the infographic, and led to the improvement of learner attitudes towards the infographic that is based on in-depth navigation. On the other hand, the infographic that is based on horizontal navigation did not occur through the process of logical linking of information and appeared only in the form of a written review of a group of illustrations that led to the distraction of the learner's attention, and therefore did not help in absorbing the entire content, and thus it affects the overall attitude towards digital visual represention**s** that were included in the infographic. Moreover, In-depth navigation helped enhancing the focus of the research sample student on the components of the infographic to identify the parts from which they need to move to another infographic, which forced the learner focus heavily on reading the visual symbols of the components of the infographic; and therefore improved his attitude towards digital

visualrepresention. The ability of the in-depth navigation level to present the contents in a framework of logical coherence, the reduction of irrational relationships that may capture the attention of the learner, and the ability of this level of navigation to clarify the facts and abstract scientific ideas visually, and deliver the message quickly to the learner while saving time and effort have all contributed to the development of the attitude towards digital visual represention.

The result of the current research is consistent with the literature suggesting that a learning environment that gives the learner more freedom and control is the one that is most capable of enhancing learning outcomes (Krapp, 1999). In-depth navigation can stimulate the learner's efficiency through an infographic environment by giving him an control within the environment by navigating without any restictions between the parts of the content, which is consistent with the theory of basic psychological needs that indicated that the most effective system is the one that addresses and supports the learner's competence. According to the theory of self-determination, the learner learns more from the environments that allow him to make decisions according to what he needs and what comes consistent with his motives. This prioritizes the in-depth navigation in which the learner decides where and how to move. According to the flow theory, the learning environment that imposes a specific order and puts restrictions on the learner affects the learner's understanding of the theoretical aspects that correspond to his needs and his relentless pursuit of learning, which means that the restrictions imposed by the horizontal navigation system greatly affect the learner in forming positive attitudes towards this level of navigation.

CONCLUSION

The present research is one of the research studies that focused on the design elements in developing the infographic The research aimed to determine the relationship between levels of infographic navigation (horizontal vs. in-depth navigation), the motivation for achievement and the attitude towards digital visualization. It was concluded that in-depth navigation has been favored in enhancing motivation for achievement and the attitude towards digital visual represention.The researchers believe that future research related to the use of infographic in visual learning processes could be more oriented towards studying the density of visual symbols that can be used within infographic, and efforts could be exerted to find a clear relationship between visual and verbal symbols within infographic. Studying infographics through other e-learning applications is also important, such as e-books and e-courses. The researchers also believe that it is necessary to have a new research approach that intends to establish a clear framework for employing infographic in teaching and learning processes. They also believe that linking dynamic infographic to augmented reality is one of the research issues that should be studied in the future.

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Appendix

Appendix (A) The measure of the motivation for achievement

Appendix (B) The measure of attitude towards digital visualization