Infographics as a Learning Tool in Higher Education: The Design Process and Perception of an Instructional Designer

Dalia Alyahya
Educational Technology Department,
College of Education,
King Saud University

Abstract. Infographics, as an instructional tool, enable support in the creation of an easy to read platform for learners. Steps involved to develop an infographic, play an essential role in optimizing visual literacy transfers. This study has presented a qualitative analysis of the proposed design strategy, which focuses on the infographic development process. The results have proposed that Infographics assignment design when included in instructional technology disciplines, helps instructional designers to enhance message delivery during visual transfers that eventually leads to increased learning interests among learners. The study also revealed five vital themes that emerged upon analyzing the collected data from participants involved. The present study has provided research scholars, an insight of the developed state-of-the-art tool, which in future research studies might serve as a basis for the development of an Instructional Infographic model.

Keywords: Visual literacy; Infographics; Visual design; Instructional design; Visual instruction; Visual literacy assignments; Instructional designer.

1. Introduction

In the 21st century, technological innovation has revolutionized the educational practices (Costley, 2016). It has integrated into the component of classroom visual literacy which substantially contributes to the transfer of information (Ozdamlı et al., 2016). Visual literacy is essential for educators, which requires the ability to implement visual aid to enhance information transfers. This transfer process is categorized into various steps such as information selection, organization, and integration (Kibar & Akkoyunlu, 2015). Visual tools, directly reinforce complex information processing to draw simple interpretations of the given data (Borkin et al, 2013). Infographic, a tool for visual communication, is the most effective stimulant of the visual communication in the digital era today

(Siricharoen, 2015), which continues to gain popularity among the educators (Afify, 2018).

The visual representation helps to portray ideas or the information in a prescribed contextual manner. Typical implementations can be observed from information communication media, such as newspapers, television broadcasts, websites etc., where it is used to convey enticing and perpetual ideas (Naparin & Saad, 2017).

Given the current dynamics across the world, the use of web applications has escalated such as Piktochart, Thinglink, Canva, etc along with graphics editing tool such as Adobe Photoshop, Illustrator, etc. which assist the designer in the designing of infographics. The use of these applications necessitates the acquisition of the skills and knowledge related to the infographic design process (Ozdamli and Ozdal, 2018). Reflecting upon the increased usage of infographics, the instructional designs are required to instigate infographics for enhancing the educational prospects.

Though the use of technology has expanded, the application of infographic in classroom teaching remains limited (Fadzil, 2018; Costley, 2016). The researches on the integration of the infographic as the effective tool for facilitating students learning and conducting their assessment were difficult to find (Dunlap and Lowenthal, 2016). Moreover, the study by Davis and Quinn (2013) supplements that utilization of infographic assists in the students' knowledge development. Likewise, Lazard and Atkinson (2015) paper reported that learners' skills and knowledge develops with their exposure to the infographic in the learning practices. Therefore, there exists a need for the educational institute to utilize innovative strategies for progressing the students' learning and improving their academic achievement. Particularly for Saudi Arabia, where various researches have indicated low achievement of the students (Shaltout & Fatani, 2017; Akbarov, Gönen & Aydogan, 2018).

Infographic use in Saudi Arabia has been evaluated by Al-Mohammadi (2017), who showed that it helps in developing the analytical thinking of the Saudi students'. The use of infographic in Saudi Arabia has expanded which are being utilized at various social platforms for communicating information (Afify, 2018). The availability of the information graphic in Saudi Arabia is also highlighted by the number of institutes which offer graphic design courses, particularly for the females. Al-Asmari & Rabb Khan (2014) found the use of infographic in the training of the education faculty members. Despite the increased use of the infographic across Saudi Arabia, its implementation in the educational instructions remains limited. Therefore, the present study explores the use of the infographic as an educational tool.

With regard to the emphasis on the development of the individual's knowledge, it is necessary to assess the instructional design advancement, application, and assessment for the design and usage of infographics in teaching. Therefore, from an instructional designers' perspective, it is essential to critically examine how the design and implementation of infographics, impacts processing complex information. The study explores the instructional design students' perceptions related to the creation of infographics for teaching and learning of an educational technology course.

2. Literature Review

Infographic is recognized as the visualization of data, which exhibits complex information in an effective and clear manner. It constitutes various components such as the maps, charts, graphics, and images. The visual representation of the information allows the effective flow of information, which facilitates the data interpretation (Rahim et al, 2016). It further assimilated the qualitative as well as quantitative data to assist learners in easy understanding of the complicated procedures (Gebre and Polman, 2016). The representation of the information in simple form supplements the learning and teaching process (Kifor, 2017). Matrix and Hodson (2014) state that,

> *"Similar to a traditional research essay, an infographic assignment challenges the student to visually communicate a thesis, supported by citations and statistics sourced from scholarly literature … students must design an information visualization to illustrate their argument".*

Infographics primarily focus on easy to view fonts, bold graphs, and simple charts; hence technologies assist creators to visualize comprehensively; thereby, making the Infographics an effective aid for data representation. It facilitates the individual in the easy and effective communication of their message (Siricharoen, 2015). Therefore, infographics development activity, in a students' learning process becomes essentially important.

Information literacy is the ability to locate, vet and apply information instantly and effectively. For the learner, using infographics can reduce development time, and allow them to portray information to their corresponding peers, educators, or future businesses. Studies show that the process of collecting, communicating of information, and visual literacy as assignments can facilitate learning (Alshehri, & Ebaid, 2016). Shanks et al (2017) found that using infographic assignment facilitate learning about accessing and translating data for college-age audiences in health education. A study based on mathematics achievement test compares learning based on interactive infographic with the learning that uses a traditional method, reveals that interactive infographics-based learning is more effective than the traditional teaching method (Alshehri & Ebaid, 2016). Higher order thinking skills play a significant role in developing infographics. When creating infographics, developers use different cognitive skills such as interpretation, analysis, evaluation, conclusion, and explanation. These are more than likely the most basic set of tools developers and readers would use while working with infographics.

The use of infographics and relevant models provide an environment that encourages higher level cognizance and provides opportunities to optimize cognitive abilities. The development of students' cognitive abilities through internalization and interpretation also promotes self-dependence and creativity within students and learners. These qualities can be promoted by infographics (Damyanov & Tsankov, 2018). Moreover, during the process of creating infographics, the focus is on learner rather than the instructor. This promotes learners' motivation, collaborative learning, epigrammatic information presentation, and acquire ownership of their learning (Fadzil, 2018).

In today's technology-enabled classroom, students are expected to adapt and comprehend visual materials. Often, students are exposed to many computer-based texts grounded in graphical interphases and aid. Based on graphics, these

contribute to newly emerging learning models in education; hence, the demand for increased computer literacy levels in students ensure higher cognitive abilities to not only understand visual information but also to create and design infographics and other visual materials. Eventually, this phenomenon also drives instructional design programs to incorporate visual literacy and visual materials within courses and training programs (Ervine, 2016).

Higher education programs need to focus on opportunities that promote and encourage critical learning and thinking abilities in students. It is vital to present these students with a core curriculum, centered on a visual culture and challenges students, as visual literacy constitutes to the major part of their learning visionary and perception. Furthermore, members of the workforce are expected to frequently create and critically interpret visual content. This signifies that for the employees with higher order thinking skills, there is an increased demand in job markets (Bleed, 2005). Currently, higher education implements visuals as a mere illustration rather than combining visuals and texts, to provide opportunities for users to critically associate meaning between the visual aid and text.

Therefore, the instructional design programs must incorporate visual literacy and infographics as the core curriculum to prepare higher education students for the workforce. With respect to the increased education demand and global academic performance competition, teachers are required to instill the skills and capabilities required for meeting the students learning needs. Learning domains that may require a large part of visual design and literacy include educational technology, audio-visual instruction, visual literacy, message design, and the design of instructional material. According to The Visual Literacy Task Force (Hattwig, et al, 2013), to be visually literate, one must hold the following skill sets:

- Determine the nature and extent of the visual materials needed, find and access needed images and visual media effectively and efficiently;
- Interpret and analyze the meaning of images and visual media;
- Evaluate images and their sources;
- Use images and visual media effectively;
- Design and create meaningful images and visual media;
- Understand many of the ethical, legal, social and economic issues surrounding the creation and the use of images and visual media, and access and use visual materials ethically (The Visual Literacy Task Force, 2013, p.97).

Due to the amount of visual information available, it puts a great deal of responsibility on users and instructional designers to effectively choose images and visual aid that would greatly help in the creation of a lesson and message that needs to be conveyed. Unfortunately, instead of focusing on learning skills as such and providing formal education, higher education programs advertently presume the learners' skill set possession. A study introduces infographics to students as a learning tool and showcases the struggle that students face while attempting to include and utilize visuals in the infographics (Kibar & Akkoyunlu, 2014). This leads to the importance of making visual literacy, visual

design, and creation as a core part of the higher education curriculum. By including visual literacy and visual information within the core curriculum, instructional designers will be able to gain the knowledge and take necessary measures required for creating infographics (Ervine, 2016).

2.1 Theoretical Framework
Instructional design encompasses a variety of instructional approaches including visual literacy. It subjugates instruction and learning from multiple domains and varied perceptions. Instructional design now focuses on a new perspective of learning, which disperses the information in an understandable form. The goal of the receiver is to gain knowledge, understanding or even insight on a specific idea or objective (Pettersson, 2012). The message design model is a theoretical model showing that different knowledge areas influence and contribute to message design (Pettersson, 2009). According to Figure 1, the message design model contains three different components: the message design family, which includes five design genera: 1) graphic design; 2) Information design; 3) instruction design; 4) mass design; and 5) persuasion design. All include the theoretical as well as the practical components.
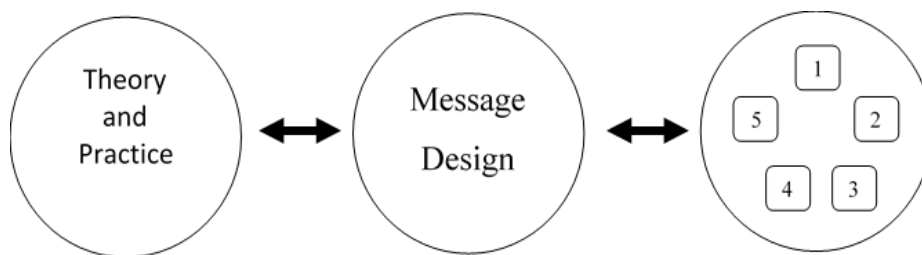

Figure 1: Theoretical Model for Infographic Design (Pettersson, 2009)

Irrespective of the model chosen, the creation of instruction design constitutes of various activities such as design analysis, outlining, understanding and delivering. For example, Pettersson (2012) creates a message design following specific steps to effectively convey information to the relevant audience. The steps include Analysis and synopsis, Production of the draft, Production of the script, Production of original and master.
Designer decision-making approach is one of the unique types of research in the field of Instructional Technology. Generally, research designer selection of the model is based on its effectiveness in solving the problem, deriving its impact and further its utilization. The design decision is based on the student's projects and learning needs. This design decision signifies towards his recognition as a beginner or expert.
Since decision-making research involves qualitative methodologies, designers' thoughts and decision making have been analyzed. These thoughts and decision-making criteria reflect upon the process associated with the completion of the given instructional design (Richey, 2013). Therefore, this study focuses on the processes and activities of instructional designers, involved in the design and development of infographics. In addition to the need to understand how visual literacy skills are used to create effective instructional message design (Ervine, 2016), this study attempts to answer the following questions:

- Question 1: What necessary steps an instructional designer follows to create an instructional infographic?
- Question 2: What level of perception and experience, an instructional designer holds in the creation of instructional infographic for learning?

3. Methodology

3.1 Study Design
For answering the determined research questions, the study employed the use of assignment, subsequent to its completion, interviews were conducted. Participants were given consent forms that provided an agreement of participation and privacy. This agreement ensured confidentiality, in which all identification details of the participants were concealed. For the assignments, participants were required to read a chapter from a book that provided information on a given topic. The participants were instructed to design the infographic of the provided material. The assignment objectives were as follows: understand and implement infographics in many ways effectively and provide creative visuals to empower communication skills, gather and showcase complex information focused on educational technology topics. To facilitate and guide student learning, a rubric was provided and was adopted from Yildirim et al (2016). This assignment was assigned after studying the chapter focused on educational technology. The specified target was to design and portray the information in the form of an infographic with the support of a suitable technology tool such as Piktochart. Students were given the choice to decide on whatever technology tool was suitable for them to create an effective infographic.

3.2 Study Sample
In the study, a total of 49 female students were recruited. The limitation to just female gender is due to gender segregation practiced in higher educational institutes in Saudi Arabia (Alwedinani, 2016). The students were enrolled at the University in Saudi Arabia. These students were recruited based on their voluntary participation.

Table 1: Demographics

Variable		Participants (n=49)	
		F	%
Age			
	18 – 22 years old	16	32.65
	23 – 27 years old	19	38.77
	28 – 32 years old	14	28.57

Academic year			
	1st Year	7	14.2
	2nd Year	13	26.53
	3rd Year	28	57.14
	4th Year	11	22.44

3.3 Data collection

To efficiently collect data, students were asked to participate in a structured individual interview, during which students were asked open-ended questions. For example, "What steps did you follow in creating the instructional infographic? The questions were centered on the practices of the instructional designer and his perspective on its effectiveness in learning the curriculum. Along with it, the interviews were conducted in a comfortable environment in a natural setting and secluded area where the answers of the participants were audiotaped, followed by its transcription by the researcher. The interview time allotted to each participant was 30 to 45 minutes. Participants were free to refrain from answering the questions as per their wish while remaining a part of the study. The rights of the participants were communicated such as they can withdraw from the study at any point devoid of any potential consequence. Based on the data and patterns from the student answers, and after categorizing and analyzing of data, eleven themes have emerged. Finally, Triangulation method was used to ensure the reliability and validity of the overall findings (Fadzil, 2018).

3.3.1 Research Triangulation

According to Creswell (2007), the process of triangulation assimilated evidence from various sources for elucidating the theme or perspective. Based on this, the paper assessed various information sources such as interviews, review articles, individual journals, and assessment of the completed assignments by the students for evaluating their perceptions and for checking data and ensuring that no inconsistencies and irregularities prevail. The triangulation of data was ensured by the researcher by carrying check on the participants, supplementing detailed descriptions, and integrating reflexibility for establishing credibility. The data collected from the participants was collected in Arabic.

Subsequent to the interviews, a reflexive journal was used by the researcher to assess the procedure, and reflect upon the personal values, exposure and interest of the participant which mold the research. The validity of the research was maintained to its generalizability or transferability in a certain context, situation, and population as referred by Leung (2015). The integration of the detailed description enhanced the transferability aspect of the study. The detailed information regarding the participants was noted for data interpretation, ensuring the validity and reliability, setting the base for trustworthiness (Noble and Smith, 2015).

3.4 Data Analysis
The data analysis was done by using thematic analysis and; therefore, themes were derived from the collected interviews. To maintain the confidentiality of data, interview participants were given a particular code number from 001 to 049. The collected answered were then translated into English.

4. Results and Discussion
The responses of the study were evaluated by the use of themes. The results are divided into two different sections. The first section presents themes related to the designing of infographic instructional design while the second section presents themes related to the perception and experience of the instructional designer. Interestingly, using infographics as a visual learning tool leads to increased learning comprehension, and also extends support to connected collaborative learning environments where instruction design using Infographic assignments is fundamental. This study provides a qualitative analysis of the proposed design strategy, focused on the infographic development process and revealed that Infographics assignment design when included in instructional technology disciplines, helps instructional designers to develop enhance content delivery to learners and, eventually promotes intrinsic learning interests among students. Moreover, it also enriches the group-based learning necessary in today's 21st century based visual classroom literacy model.
The study supplements that the designing of the infographic serves as a great tool for overcoming the challenges and realizing the shortcoming and benefits associated such as developing visual literacy. The findings of the study coincide with that of Sasova (2011) and Chan Lin (2008).

4.1 Steps in Instructional Design
The steps which the instructional designer follows in pursuance of developing an infographic play a major role in its effectiveness. In this study, subsequent to the evaluation of the students' answers, five vital themes were identified. The themes selection was based on the frequency of their use, which most participants followed while creating their respective infographic. These five themes are listed as follows: Preparation, Planning, Development, Evaluation, and Publicize.

4.1.1 Preparation
The first theme that was most frequently practiced by the students include the preparation for instructional design. Design preparation was a large part, which leads to the creation of infographic among all students. For example, participants identified a specific idea and decided their objective related to their infographic. They also evaluated the message they wanted to portray to their audience. Participants also addressed the main concepts that were included in their infographic along with the sources they were using.

4.1.2 Planning Step

The second theme identified in this study is labeled as planning step. The students outlined the valuable and important information along with the visual sketch of the infographic. Furthermore, participants stated that within this step they gathered graphics and visuals that would best visualize the information within the infographic. These visuals also included suitable background and color scheme. This step is also observed in the study findings of Ishak, Din & Mohamed (2018), which support the instructional designer outlining of the information for the creation of infographics.

4.1.3 Development Step

The development theme includes steps such as the implementation of the step one and two while deciding the most efficient and effective software to develop their infographic. In this theme, participants also stated the references that supported their information. These are parallel to the study findings of Gayoung et al (2016), which investigated the MOOC model designing.

4.1.4 Evaluation Step

Based on student responses, they stated that the evaluation step was ongoing throughout the entire process to create an infographic. The continual evaluation aspect was also observed in the investigation of Cabrera, de Dios & Rodilla (2013) study, where infographic was used as an interpretation tool.

4.1.5 Publication Step

Participants modified and edited their infographic based on peer evaluations and teachers' feedback. Finally, some students made the executive decision to publish their infographic. The modification upon the basis of the feedback in infographic designing has been indicated by Shanks et al (2017), which assessed the use of infographic in the health sector. Figure 2 showcases the summary of steps participants took throughout the process of creating an infographic.

Figure 2: Generated steps of the process of designing an infographic

4.2 Instructional Designer Experience and Perception

The second aspect of this study is to evaluate the experience and perception of the instructional designer in relation to the development of instructional infographic as a means of learning. Based on the data collected in this study, six themes emerged along with 15 subthemes. The main themes are as follows: understanding, professional development skills, higher order thinking skills, future implementation, and overall experience. Based on these themes, students' responses were very optimistic while discussing their experience in creating

infographics. Student's response showed an increased growth while creating, analyzing and sharing information through infographics. Table 2 exhibits the major themes of which emerged while analyzing the data. Understanding was found to be the primary theme in the study. Most participants provided that in-depth analysis makes it easy to comprehend the concept. Further, the understanding of the subject allows the collection of relevant information in an effective and efficient manner. Students also showed that infographic improves the interpretation of the information by making it easy followed by developing cohesive learning. The study results provided that infographic usage facilitates the learning of the students which is parallel to the previous study findings such as Becerra (2015) as well as Davis & Quinn (2013).

Professional development is recognized as another major theme based on the responses. The perception of the designer also varies based on the subthemes such as his motivation. Along with it, the concise form of information allows professionals to develop their skills by comprehending the meaning. It helps in the evaluation of their skills and improves their creativity in terms of design. These are in-congruence with the study outcomes of Bowles-Terry et al (2017) who also provided similar results when assessing the transparent assignment design. Table 1 also provides that the participants view thinking skills as most essential for designing as the critical thinking ability makes it easy to strategize the information in the form of an info graphic and mapping it accordingly for cohesive learning.

The study results provide that the students were enthusiastic about the opportunity to represent information in the form of visuals. As the students perform this activity, the skills they possess continued to develop in terms of critical thinking, and understanding of concepts related to the scientific domain. This filtering of the information introduced in the study is considered as the best information, which is derived for the infographic, making them visual literate. These findings are endorsed by Matusiak et al (2019), who highlighted that the provision of such assignment allows students to develop and apply the essential skills with respect to the educational tools provided by technology, essential for the creation of cohesive information.

The responses of the participants highlighted that it saves time which makes one progress to learn additional concepts. Moreover, it's designing also helps in meeting the emerging needs of the learner, as these can be altered accordingly. These are in line with the Alrwele (2017) study which assessed the academic achievement of the students using infographics. The response showed that the use of infographic for sharing information motivates the learners and help in clearly comprehending the subject. The motivation by the sharing of information is also reported by Yıldırım et al (2016) who assessed the infographic application in the educational sector.

The last theme observed is related to the overall experience of the respondent. The study showed that some students thought that the development of instructional infographic as a means of learning was positive. Whereas some participants said the constraint on the time serves as a major obstacle making their overall experience negative. Though, the findings of Kpolovie and Lale (2017) on the use of technologies in education curriculum are stated to provide meaningful and positive learning experiences to the students.

Table 2: Themes

Theme	Subtheme	Select Student Quotes
Understanding		
	Depth	"When concepts are difficult or complex, using an infographic model helps create a deeper understanding."
	Retrieving information	"Infographic helps in retrieving information because it is hands on."
	Easy to understand	"Infographics gives readers an idea of the topic with the support of visuals, this makes it easy to understand."
	Cohesive concepts	"Infographic shows a clear relationship between the information and other components."
	Visual Learner	"Infographics makes it easy to retrieve information for visual learners like myself."
Professional development skills		
	Motivation	"It motivates learners because it gives an opportunity to implement their own experience and point of view."
	Innovatively summarize information	"Infographics helped me summarize in a way that keeps the quality of information without losing its meaning."
	Evaluation tool	"Infographics help in evaluating because it clearly shows the students' understanding of a topic due to the way information is organized."
	Creativity and organization	"Infographic helps learners strengthen designing and organization skills in creative ways while implementing artistic details."
Higher order thinking skills		
	Create and analyze	"While organizing infographics, designers must critically think and analyze the information by strategically placing both text and visuals within their infographic."
	Mind mapping	"While creating infographics I was able to form mind mapping about the topic."
Future implementation		
	Saves time	"As an educator, infographics help save time. Instead of explaining an idea, I can showcase the topic and its relationship with different components."
	Meeting student needs	"Students are able to change and modify infographics as their knowledge grows on a certain topic.
Sharing information		
	Teamwork	"I received positive feedback from my peers after sharing my infographic. They stated my infographic helped them clearly understand the message that was being portrayed."

Overall experience		
	Positive	"I enjoyed creating infographics because the experience allowed me to explore new skills in portraying information."
	Negative	"I like the idea although I was not excited about it due to the limited time."

4.3 Practical Implication
At this juncture, the study emphasizes the integration of the technological instruments in the achievement of excellence among the students, which assist in their social as well as economic growth. The study has critically evaluated every step required for the creation of infographic by the instructional design, as to how infographics are developed, what are the perceptions of the students considering its usage in their learning. The study suggests to develop infographics based on the varied content of the subject and publish it on the web environment or web based on the infographic for providing easy accessibility to the students and the course facilitator.

4.4 Limitations
The study followed a qualitative approach to evaluating the use of an infographic as a tool for learning; though, a quantitative approach can also be implied for providing more authentic results. Furthermore, the other shortcomings observed include the small sample size and the inclusion of the female population. Future studies can also include a large sample size and diverse population sample to add to the study results effectiveness. Along with it, more studies can be conducted on a similar topic in various regions which assists in expanding the existing knowledge in the field.

5. Conclusion
The present study proposes that visual literacy assignments, such as infographics are the essential element to the Instructional design process and should be included in future learning models. It emphasizes insight on the development of a state-of-the-art tool, which serves as a base for future research studies for the development of an Instructional Infographic model. The effectiveness of the infographic for different grades can also be evaluated regarding the educational lesson's effectiveness and learner's performance.

It further recommends that new educational policies need to be initiated by integrating the use of infographics for the electronic courses. This allows the teacher to improve the students' learning opportunities as well as their retention of information over a long period of time. It further suggests the inclusion of the quality design elements in the presentation of the design following proper standards and principles, as it improves the students' aesthetic sense and performance for producing visually effective educational materials.

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