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The Level of Acceptance of Preservice Teachers at Kuwait University for Infographics Applications in Light of the Information and Communication Technology Acceptance Model "ICTAM"

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Abstract: This study aimed to determine the level of acceptance of infographics apps among preservice teachers at Kuwait University and examine the effect of several independent variables on the level of acceptance. It used exploratory quasi-experimental descriptive analysis based primarily on a quantitative approach and specifically adopted the information and communication technology acceptance model (ICTAM). A stratified sample of 162 preservice female teachers from the College of Education at Kuwait University participated in this study. The participants were introduced to and trained on various infographics apps. At the end of the semester, an anonymous questionnaire was administered through an online survey tool, and the preservice teachers were asked to voluntarily participate and complete the questionnaire. A set of descriptive statistics (i.e., frequencies, percentages, means, and standard deviations) and inferential comparisons tests (i.e., independent-samples t-tests, one-way analyses of variance "ANOVAs", Dunnett's C multiple comparisons tests, and Scheffe's multiple comparisons tests) were employed to analyze the data. The findings revealed that the level of acceptance among preservice teachers regarding the use of infographics apps was "high" (M = 3.85, SD = 0.67). Although the results uncovered a few significant differences with regard to some independent variables (i.e., year of study, ICT daily usage, and GPA), the level of overall acceptance of the infographics apps was very high.

Keywords: 21st century competencies/skills; data visualization; visual teaching/learning; visual analysis/thinking; infographics; infographics apps; technology acceptance; information and communication technology acceptance model (ICTAM); preservice teachers' perceptions.

1 Introduction

The enormous expansion of scientific knowledge over the years has led to the development of technology, which fundamentally defines the modern world and truly represents the pinnacle of human achievement. Technology has undoubtedly revolutionized every possible aspect of life and has played an instrumental role in spreading prosperity and progress worldwide.

In light of these developments, various domains have been greatly affected by the power of technology, and the educational field is one of them. Over the past 25 years, the domain of education has witnessed many significant and fundamental changes due to technological advancements. Recently, for example, new terms and concepts such as distance learning/teaching, computer-based learning/teaching, web-based learning/teaching, e-learning/teaching, online learning/teaching, social networking-based learning/teaching, e-training, e-content, e-curricula, e-measurement/assessment, virtual classrooms, and even visual learning/teaching/thinking have been added to the glossary of educational terminology (Wallace, 2009). Furthermore, several hundred accredited online universities exist today, providing courses and degrees in almost every academic major. It is worth noting that some of these online universities have helped make high-quality education not only more accessible but also relatively more affordable than traditional schools for most students (Gleason, 2017).

The profound impact that technology has had on education appears to be manifested in practical areas as well, most noticeably in the teaching/learning methods and aids/tools used in classrooms today. Ever since it was proven that the integration of technology into education is effective in facilitating the teaching/learning process, increasingly more educational institutions have sought to embrace it by modernizing their schools and redesigning

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their classrooms (Shelly et al., 2012). Some institutions are even taking an additional step by building or updating and implementing curriculums predicated on the basic principles of distance learning, such as web-based or e-learning curriculum (Kidd, 2008).

Incorporating technology into the curriculum is absolutely vital for helping students cope with the ever-changing demands of modern life. Information and communication technology (ICT) knowledge, skills, and competencies, for instance, in conjunction with reading and writing, have now become basic requirements for almost all jobs. Therefore, it is unquestionably necessary to adopt a futuristic vision for teaching/learning and to set goals and objectives that are conducive to fulfilling it. It is also obligatory for stakeholders to accommodate new technology and update their knowledge to keep up with the latest trends in the field of education, as new ideas and concepts are constantly being introduced.

In today's digital era, in which knowledge is becoming increasingly complex, the need to simplify data has become a primary focus. Accordingly, innovators and graphic designers are avidly seeking to develop new and creative ways to present data in a concise, clear, and straightforward manner, and one of the most exciting and promising trending tools that has been recently developed to serve that purpose is infographics. The word infographic is actually a portmanteau of the words information and graphic, and it simply means a visual representation of data (Kelly, 2019). However, this definition is considered by many to be incomprehensive. Today, the word infographic has taken on a broader meaning, and it is usually defined as "A visualization of data or ideas that tries to convey complex [data] to an audience in a manner that can be quickly consumed and easily understood" (Smiciklas, 2012, p. 3).

Infographics have gained widespread popularity among content designers and editors in recent years due to their effectiveness in simplifying complex data (Lankow et al., 2012); they can effectively break down and transform dense, complicated, and text-heavy content into an easy-to-digest format. Moreover, they can make otherwise boring topics more appealing and engaging through the use of visuals, illustrations, charts, statistics and even pictographs (Krum, 2014). For these simple reasons, infographics are considered ideal tools for visually sharing knowledge.

Using such tools in the classroom has the potential to enhance the quality of teaching and the overall learning experience for learners. In fact, several studies have actually indicated a positive relationship between the use of infographics and students' academic performance (Baglama et al., 2017); hence, arming teachers with these tools is an incremental step in the right direction that will significantly contribute to realizing the ultimate goal of education.

2 Problem of the study

An objective analysis of the current state of the educational system in Kuwait and the rest of the Gulf countries has indicated that the vast majority of people involved in the field of education, particularly preservice teachers, are relatively unfamiliar with the concept of infographics and their educational role in supporting the teaching and learning process. Furthermore, there appears to be a significant paucity of available Arabic literature exploring the educational aspects of infographics, which further proves that this concept has received little attention among educators over the past few decades. It can be said that the lack of ICT knowledge is the major underlying cause of this situation, considering that infographics, for the most part, especially in the early years of digital technology, were planned, designed, and produced by professional graphics designers using specialized graphics design software and video editing programs that often required an advanced level of ICT skills and competencies and a working understanding of computer programming languages.

Nonetheless, the last few years have witnessed a growing understanding and awareness of the instructional value of infographics. It is clear that groundbreaking developments in visual presentation tools as well as the emergence of user-friendly infographics apps have helped spread the concept of infographics throughout the Arab world. However, despite the pervasiveness of these innovative tools, they are inadequately employed in the educational process, which is due to either insufficient experience teaching with technology and/or a general reluctance to experiment with relatively new ideas.

Understanding the gravity of this situation and realizing the implications it has for educational progress, we have decided to carry out a series of quantitative and qualitative studies in an effort to deepen our understanding of the various educational issues concerning infographics. However, before examining the practical effects of infographics, it is necessary to gain a broad and clear impression of their acceptability among educators. Therefore, this study will mainly focus on the level of acceptance of infographics apps among preservice teachers at Kuwait University.

Research questions

This study attempts to answer two main questions:

(1) To what extent do preservice teachers at Kuwait University accept infographics apps?

(2) Does the level of acceptance of infographics apps among preservice teachers at Kuwait University differ in terms of year of study, academic major, GPA, ICT daily usage, learning style, level of familiarity with infographics, and the extent to which infographics are used?

Objectives of the study

The objectives of the study can be summarized as follows:

(1) To determine the level of acceptance of infographics apps among preservice teachers at Kuwait University.

(2) To examine the effect of year of study, academic major, GPA, ICT daily usage, learning style, level of familiarity with infographics, and the extent to which infographics are used on the level of acceptance of infographics apps among preservice teachers at Kuwait University.

Significance of the study

The significance of the study can be summarized as follows:

(1) This study will provide preservice teachers with comprehensive insight into the various educational aspects of infographics.

(2) The results of the study will help determine the ICT capabilities of preservice teachers to facilitate the design of more efficient training programs that meet their developmental needs.

(3) The findings and recommendations of this study can prompt educators, stakeholders, and decision makers to consider integrating infographics into the educational process.

Limitations of the study

The limitations of the study can be categorized as follows:

(1) Human limitations: The results represent the opinions and attitudes of female preservice teachers (i.e., senior and junior undergraduate students) in the College of Education at Kuwait University.

(2) Spatial limitations: The study was limited to the College of Education at Kuwait University.

(3) Time limitations: The study was conducted in the fall semester of the 2019/2020 academic year.

(4) Technical/literary limitations: The researcher notes that there is an insufficient body of literature addressing this topic in the Gulf region, which could be considered a limitation of this study.

Literature review

In this section, the theoretical framework of infographics will be addressed. First, a brief overview of the concept of visual teaching and learning will be provided, followed by a description of the process of visual thinking and analysis and insight into the features of data visualization. Subsequently, the concept and the various aspects of infographics, including their historical background, types, steps, benefits, and requirements, will be closely examined. Finally, the body of literature on the educational value of infographics will be explored.

Visual teaching and learning

Visual communication has become a prominent feature of modern life. Although it is a relatively new concept, the fundamental process of conveying meaning through visual means has been extensively evident throughout human history (Simonson, 2013). This remarkable and unique form of expression plays a significant role in making human communication highly developed and distinguishable from that of other living organisms (Lester, 2011). Nevertheless, the term visual communication has evolved and expanded over the years to include more recent concepts, such as digital media and virtual reality. Such emerging technologies have dramatically altered the way we interact with one another socially and, more importantly, have opened up a whole new world of possibilities for exchanging information (Tascón, 2019).

Consequently, visual technologies have become more mainstream than ever, and they have, in fact, precipitated a paradigm shift in the way content is designed today. Visual-based content seems to be growing rapidly and largely replacing text-based content in almost every social context (Morra & Smith, 2006), particularly in the world of marketing, where content design plays a crucial role in dictating the success of a business product (Gamble, 2016).

The shift from text-based content to visual-based content is also becoming common in the field of education (Eitel & Scheiter, 2014). It appears that the exponential development of visual tools and technologies over the past few decades has drawn unprecedented attention to the various aspects of visuals, including the concept of visual teaching and learning. This educational approach has become a topic of growing interest among academics and researchers in recent years (Stokes, 2002), and it is generally believed to be capable of making far-reaching changes in the essential process of acquiring knowledge (Lupton & Phillips, 2015). Broadly speaking, there is widespread consensus within the educational community on the instructional value of visuals. They are simply viewed as an indispensable component of the contemporary teaching/learning process (Dewan, 2015).

The considerable emphasis on incorporating and utilizing visual elements in today's classrooms could be attributed to several educational reasons. One of them is the overwhelming preference for visual teaching/learning among students. It has been indicated that the vast majority of students identify themselves as visual learners (Felder & Brent, 2005; Jarvis et al., 2008). In addition to the pervasiveness of visual teaching/learning, visual aids offer a compelling reason for integrating visuals into the teaching/learning process. Interestingly, numerous studies have shown that the proper use of visual aids can help overcome various instructional impediments, including time constraints (Pike, 2003); presentation graphics, for instance, have been demonstrated to reduce teaching time by as much as 28% (Mucciolo & Mucciolo, 1994). While this finding is certainly fascinating, visual aids are expected to become even more effective and convenient over time due to the accelerating pace of technological advancement. In addition to the educational perspective on this matter, there is a scientific argument in favor of visually oriented education. According to recent neurological studies, half of the brain cortex is devoted to visual processing, thereby enabling human beings to remember images far better than

words and process them much faster as well (Grady et al., 1998; Weinschenk, 2009). That being the case, it may well be argued that the implementation of visual teaching/learning strategies will inevitably enrich the teaching/learning experience for students.

It should also be noted that the favorable attitude that educators have towards visual education stems, in part, from a growing understanding and awareness of its contribution to the development of visual literacy, otherwise known as media literacy or critical viewing skills (Flood et al., 2014). Such skills are crucial considering the high level of importance presently placed on visual literacy. The instilling of such skills is recognized as a necessity and a fundamental goal of education (Frey & Fisher, 2008).

Placing a high priority on the development of visual literacy is indubitably imperative, given that we live at a time when images have become an immensely dominant and powerful means of communication, penetrating all parts of social life and influencing people's attitudes, moral values, thoughts, and beliefs (Eilam, 2012). In this respect, learners ought to be equipped with a set of visual skills/competencies that will enable them to create, perceive, comprehend, and interpret visual messages effectively in various environmental contexts (Fransecky & Debes, 1972). Needless to say, such skills/competencies can only be cultivated through the adoption of a more visual approach in teaching and learning.

Visual thinking and analysis

The human brain is arguably the most complex organ ever known to exist. It has an intricate structure and a set of distinctive abilities that make it stand out even from the brains of the most intelligent animals in the world. The incomparable power of the human brain has enabled mankind to dominate planet Earth and unlock the mysteries of the universe (Higgins & George, 2013). Some of the key distinguishing features that separate the human brain from the brains of other species are its advanced reasoning skills and unparalleled processing abilities. Interestingly, the human brain is capable of not only processing a substantial amount of information with relative ease but also visually perceiving and deciphering abstract concepts or ideas, processes commonly known today as visual thinking and analysis (Hoffecker, 2011; Ware, 2010).

Visual thinking and analysis are deemed to be an integral part of any human endeavor (Reed, 2016). They encompass a wide range of skills/competencies, all of which are deeply involved in various cognitive activities, namely, communication, brainstorming, problem-solving, decision-making, logical reasoning, creativity, and learning (Fisher, 2014). In general terms, every mental function, from lower to higher order, depends strongly on these visual processing abilities (Conklin, 2012).

In contrast to verbal processes, which are considered more linear in nature, visual processes are quite holistic, meaning that any given subject matter is viewed and addressed as a whole instead of as separated entities. With such a comprehensive perspective, information is processed in a nonlinear manner, allowing the thought process to expand in multiple directions for the development of a deeper and more thorough understanding of the various aspects of a concept (Baratta et al., 1994).

In a more practical sense, this holistic approach evokes creativity by transcending the boundaries of conventional thinking and by generating and developing innovative ideas around a particular topic through the use of visual patterns, technically known as thinking maps (Hyerle, 2019; Hyerle & Yeager, 2007). Furthermore, this approach helps widen one's perception of conceptual knowledge that may entail a great deal of complexity, making it pivotal for exploring theoretical notions (Brewer et al., 2001; Nadler & Chandon, 2010). Considering the merits of this approach, it is self-evident that the benefits of visual processing abilities can be extended across all disciplines.

From a pedagogical standpoint, these visual abilities have been proven to be invaluable in the teaching/learning process. Indeed, numerous studies have attested to their effectiveness in enabling learners to grasp and internalize abstract information that could be somewhat difficult to explain or may cause some confusion (Mathewson, 1999; Wu & Shah, 2004). Studies have also indicated a strong and positive correlation between visual thinking and students' problem-solving performance (Bodner & McMillen, 1986; Nguyen et al., 2014). It is, therefore, of the utmost importance to create and foster a teaching/learning environment that permits students to tap into their visual processing abilities.

Data visualization

The birth of digital technology has revolutionized the fundamental process of human communication. Today, it has become feasible to reach and influence tens of thousands of people around the globe through social networking platforms. Interestingly, the influential power of digital technology is heavily dependent on the presentation of content or data, which, by today's standards, appears to have become just as important as the quality of the data (Tonidandel et al., 2016).

The art of data presentation has progressed over time as a natural result of technological developments, sociocultural changes, and even artistic diversity, thus giving rise to various colorful and creative forms of display, one of which is data visualization (Friendly, 2008). This trending concept generally refers to a "set of processes via which data are graphically displayed and interpreted with a particular goal in mind to ultimately derive meaning in the form of information and knowledge" (Buckley et al., 2019, p. 95). It should be noted that these processes are scientifically grounded and governed by systematic principles and guidelines (Tufte, 1997, 2006).

Data visualization is commonly known today for the accentuation of aesthetics and for visually pleasing displays that target, engage, and entice a wide range of

audiences. Therefore, visualized content often incorporates an extensive set of graphical representations, including various types of charts, maps, diagrams, and graphs. These are also greatly enriched with beautiful colors, fonts, themes, and images that bring the artistic element into greater focus (Kirk, 2019). This fascinating feature of data visualization has obviously evolved in recent years due to the emergence of innovative visual tools and apps for data interaction, data storytelling/presentation, and data journalism, which have extensively expanded design options and paved the way for boundless artistic creativity (Ponniah, 2010).

In addition to being visually appealing, visualized data are practical in the sense that they simplify complex content and present it in an easy-to-consume format (Iliinsky & Steele, 2011). This remarkable feature is widely demonstrated in business and advertising, in which numerical and statistical data often take the form of simple graphs or diagrams that allow the intended audience to make a convenient transition from numerical reasoning to visual reasoning, which facilitates understanding (Parsaye & Chignell, 1993).

The popularity of data visualization has extended far beyond the world of business in recent years, and the visualization process can be seen in other realms as well, mainly in education. There actually seems to be a growing desire among major educational organizations to reshape/redesign traditional educational content and implement the key principles and practices of data visualization. It is generally assumed that visual content will substantially ease the very process of data communication, analysis, and interpretation (National Forum on Education Statistics, 2016).

Definition of infographics

The term infographic was first coined in the late 1960s, and it is simply a combination of the first part of "information" with the word "graphics" (Merriam-Webster, 2014). Currently, infographic is commonly defined as "a visualization of data or ideas that tries to convey complex [data] to an audience in a manner that can be quickly consumed and easily understood" (Smiciklas, 2012, p. 3). It is also defined as a larger graphic design that combines data visualizations, illustrations, texts, hyperlinks, images (i.e., still and motion pictures), and audio files in a format that tells a complete story (Krum, 2014, p. 6).

The genesis and development of infographics

Although infographics are often thought to be a product of the modern world, the basic notion of visual information exchange can be traced to the early years of human civilization. There is an abundance of archaeological evidence indicating that symbols, signs, drawings, and paintings were, in fact, common forms of communication among ancient civilizations (Sellnow, 2018). Nonetheless, the scientific and technological breakthroughs that have taken place over the past centuries have significantly reshaped the essential process of visual communication and ultimately brought the idea of the infographic to life.

The early forms of infographics were actually restricted to basic maps, graphs, and charts, and they were almost exclusively used in statistics, mathematics, science, and journalism (Blanchard, 1998; Bogost et al., 2010). It was only in the early 1980s that infographics began to flourish and gain widespread popularity (Abrahamson & Prior-Miller, 2018). Since then, infographics have gone through notable stages of development and reached significant milestones. Today, with the rise of the Internet in general and the World Wide Web in particular and the predominance of digital media, infographics apps are becoming increasingly accessible and widely versatile, ranging from basic smartphone apps to professional software tools (Krum, 2014).

The types of info graphics

The recent wave of digital innovation has brought dramatic improvements to the process of planning, designing, and creating infographics; accordingly, various forms and types of infographics have emerged to accommodate the diverse needs and demands of the modern age. In general, there are at least four main types of infographics, which are classified in terms of their functionality and characteristics (Crane, 2015).

The first type of infographic is commonly known as the statistical-based infographic, and, as the name suggests, it communicates statistical data through visual representations, such as bar graphs, pie charts, pictographs, and interactive maps. Statistical infographics are effective in making numerical data both more intelligible and more appealing to the eye (Lester, 2011).

The second type of infographic is the timeline-based infographic. This form of infographic is generally used to visually represent historical events. In a typical timeline infographic, important sequences are plotted on a central line and are labeled with a main title, date, and icon, followed by a brief description. The process of visualizing historical data is generally helpful for summarizing lengthy historical events and adding an element of excitement to the content (Smiciklas, 2012).

The third type of infographic is the process-based infographic. Infographics of this type provide a simple and summarized explanation of the required steps involved in a process. However, unlike the other types of infographics, process infographics usually have a simpler and more straightforward design (Lankow et al., 2012).

The fourth type of infographic is called the location-based infographic, also known as the geography-based infographic. Such an infographic is commonly used for displaying geographical and population-related data; thus, visual forms such as maps or flags often predominate, usually accompanied by important facts and statistics. Location infographics are particularly useful for comparing, analyzing, and interpreting data on a global scale (Beegel, 2014).

Besides these, there are several other types of infographics that have been recently developed by renowned software developers in the graphics design industry, namely, Canva, Venngage, Piktochart, Easel.ly, Visme, and Infogram. Over the years, these developers have collectively created more than 20 unique forms and types of infographics. This rich diversity clearly proves that infographics are highly adaptable to the rapid pace of change in today's world and highly compatible with the various fields of life (Lankow et al., 2012).

The essential benefits of infographics

Infographics are considered invaluable tools for creating visually stunning and informative content. They can remarkably condense large chunks of data and transform them into beautiful works of art. This particular aspect of infographics is extremely convenient in today's world, given that data are rapidly expanding and becoming increasingly complex (Smiciklas, 2012).

In general, the benefits of infographics are prominent and wide-reaching, and they can be summarized as follows: (1) infographics are eye-catching and much more inviting and appealing than textual content; (2) infographics are sharable and easy to create, especially with the user-friendly apps that exist today; (3) infographics can significantly facilitate understanding and promote highly engaging content; and (4) infographics serve a wide range of purposes and uses in modern life (Lankow et al., 2012).

The process of creating infographics

While the basic process of creating infographics is now relatively straightforward and does not necessarily require professional skills or expertise in graphics design, video editing, animation, and multimedia authoring, it nonetheless involves five steps that require careful thought and planning. These steps can be listed as follows: (1) setting goals: specifying the intended purpose of creating the infographic; (2) collecting data: conducting extensive research on the topic and gathering as much data as possible; (3) visualizing data: determining the visuals best suited to represent the data; (4) choosing an appropriate layout: selecting the proper infographic layout for realizing the specified goals; and (5) customizing the layout: using the available tools and features to design the infographic (Nediger, 2020).

Modern infographics tools

Although infographics can be created manually, it is preferable to create them using digital software tools, which, in recent years, have become immensely popular and extremely versatile. From a practical standpoint, modern infographics tools offer a wide range of options and features, including creative layouts, colorful themes, beautiful icons, immersive animation, and different multimedia formats, all of which grant the average user, irrespective of his/her computer skills, the opportunity to professionally plan, design, and produce various types and forms of infographics with relative ease (Siricharoen, 2013).

Today, infographics tools are typically classified into two main groups. The first group specializes in creating static infographics, and some of the popular developers of this group are (1) Piktochart, (2) Easel.ly, (3) Venngage, (4) Visme, (5) Genially, (6) Snappa, (7) Infogram, (8) Adioma, (9) Mind the Graph, (10) Creately, and (11) RAWGraphs. However, the second group specializes in creating motion infographics, and the prominent developers in this group are (1) Vyond, (2) Raw Shorts, (3) Animaker, (4) PowToon, (5) Animatron, (6) AnimationStudio, (7) Animiz, (8) VideoScribe, (9) Explee, (10) Moovly, (11) Focusky, (12) Prezi, (13) Biteable, (14) Renderforest, (15) Animoto, (16) Videze, (17) Ceros, (18) Vizualize.me, (19) Google Charts, (20) StatPlanet, (21) StatPlanet World Bank, (22) StatWorld, (23) StatTrends, (24) Edraw Max, and (25) Edraw Infographic. Interestingly, there are a number of nonprofit and professional platforms, most notably "Visually" and "Tajseed", that provide users with helpful knowledge regarding the various aspects of infographics.

The effects and benefits of using infographics in the classroom

The concept of infographics has clearly generated a great deal of interest among scholars and academics over the past few decades, and it has recently become a prominent topic of discussion in the world of education. Today, there is a growing body of research exploring the educational value of infographics, and the following are a few select examples:

(1) A study by Bicen and Beheshti (2017): A quantitative study was carried out in Turkey to investigate students' perceptions regarding the use of infographics in education. It involved a total of 163 randomly selected undergraduate students from Near East University. Furthermore, a questionnaire with close-ended questions, which was expertly examined to confirm its validity and reliability, was designed and developed for the study. The results showed that the majority of students had a positive attitude towards using infographics in education. It also indicated that students generally found infographics to be much more effective than textual content in facilitating understanding.

(2) A study by Bin Dahmash et al. (2017): A quantitative study was conducted in the Kingdom of Saudi Arabia to determine students' perceptions regarding the use of infographics in linguistics instruction. The participants in this study were 186 female college students from Princess Nourah bint Abdulrahman University. In addition to using a validated and reliable questionnaire, the researchers collected and analyzed a few infographics created by the participants. The results of the study revealed that the majority of students had a positive

attitude towards using infographics to learn linguistics. It also showed that nearly all students found infographics to be highly conducive to the development of higher thinking skills, collaborative skills, and analytical skills.

(3) A study by Papic and Susilovic (2018): A quantitative study was carried out in Croatia to examine the popularity of infographics tools among university students. It also attempted to explore the students' preferences regarding the use of such tools in higher education. The study sample was randomly selected, and it consisted of 100 college students from the University of Osijek. The researchers relied on a reliable and valid online questionnaire that included 10 multiple-choice questions. The findings from the data analysis indicated that the overwhelming majority of students were highly familiar with infographics tools and that Canva, a graphics design website, was the most popular platform used for creating infographics. Moreover, almost all the students involved in the study believed that infographics were highly efficient for transferring various types of data.

(4) A study by Alqudah et al. (2019): An experimental study was conducted in the Hashemite Kingdom of Jordan to evaluate the impact of educational infographics on students' interactions and perceptions in higher education. The study involved 138 randomly selected participants from the IT and business departments at the Applied Sciences Private University. The selected participants were divided into two control groups (58 and 22 students) and two experimental groups (38 and 22 students), and they were given a valid and reliable questionnaire along with a set of quizzes after each lecture to assess their understanding. The results of the study revealed that educational infographics generally had a positive and strong impact on students' interactions and perceptions.

(5) A study by Safar (2021): A quantitative descriptive exploratory quasi-experimental study was carried out using the information and communication technology acceptance model (ICTAM). The study aimed to determine the extent of acceptance of the use of infographics apps among in-service teachers working in the State of Kuwait's public and government general education schools; in addition, it sought to reveal the effects of certain independent variables on the acceptance level. A stratified random sample of 138 in-service teachers from the State of Kuwait's public and government general education schools—from the six educational districts—participated in this study in the first semester of the 2019-2020 academic year. The results generally indicate that the level of acceptance among in-service teachers in Kuwait's public and government general education schools concerning the use of infographics apps is "high" (M = 3.90, SD = 0.63). Although the findings revealed several significant differences among the participants with regard to certain independent variables (i.e., qualification/education and ICT efficacy level), the general analysis of participants' responses indicated a very high degree of consensus among all the teachers in terms of their level of acceptance of infographics apps.

3 Materials and Methods

Research Design

The present study involved an exploratory quasi-experimental descriptive analysis based primarily on a quantitative approach and employed a survey questionnaire technique, a convenience sampling method, and descriptive and inferential statistics. This observational study utilized the ICTAM design. This research model is a revised version of the technology acceptance model (TAM); it investigates, analyzes, and predicts the acceptance of ICT tools and services in organizations in depth. The ICTAM research design is comprehensive and practical and provides rigorous data on the acceptance of any ICT tool or service in an organization. It focuses on investigating the following behavioral variables (issues/dimensions) of a given technology: (1) Awareness of technology (AOT): the level of awareness and knowledge of the technology; (2) Usage of technology (UOT): the actual technology use; (3) Perceived importance (PI): the significance of the technology; (4) Perceived usefulness (PU): the perception of the technology's educational effectiveness; (5) Perceived ease of use (PEOU): the perception of the technology's usability; (6) Satisfaction level (SL): the reaction to or reception of or overall experience with the use of the technology; and (7) Continuance intention (CI): the intention (future attitude/behavior) towards the use of the technology (see Figure 1). The ICTAM also has the ability to measure the correlations between any of the model's seven behavioral variables and the overall acceptance or between the variables themselves. In addition, the framework makes it possible to measure the relationships between these behavioral variables and the external (independent) variables when needed. This research model offers guidelines for making critical decisions about the acceptance of any ICT tool or service in a given organization (Safar, 2020, 2021).

Instrument

An in-depth online survey questionnaire was constructed and administered to the participants. The questionnaire was composed of two main sections. The first section sought information on the sociodemographic profile of the participants, such as their gender, year of study, academic major, GPA, ICT self-efficacy level, ICT daily usage, ICT ownership, learning style, awareness of infographics, usage of infographics, perceived importance of infographics, and perceived usefulness of infographics. The second section sought information to answer the research questions posed by the study, and it was structured around the seven components of the ICTAM (mentioned previously). A total of 74 items (questions/statements) were included in this section. The items were rated (i.e., rank ordered) using a

Likert-type 5-point scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The study's instrument was carefully developed after a review of previous studies. While constructing the data collection tool, extensive efforts were made to include adequate and relevant survey items. The questionnaire was then submitted to a panel of experts in this field for their review and was later pilot tested with a selection of Kuwait University preservice teachers who were not part of the study's sample. The tool was carefully evaluated by the experts with respect to its validity and reliability, and it achieved a 0.880 Cronbach's alpha (α) coefficient value (considered "very good" in most social sciences and humanities studies) (Healey, 2015; Levin et al., 2016). Table 1 provides detailed information about the reliability statistics of the questionnaire's ICTAM domains.

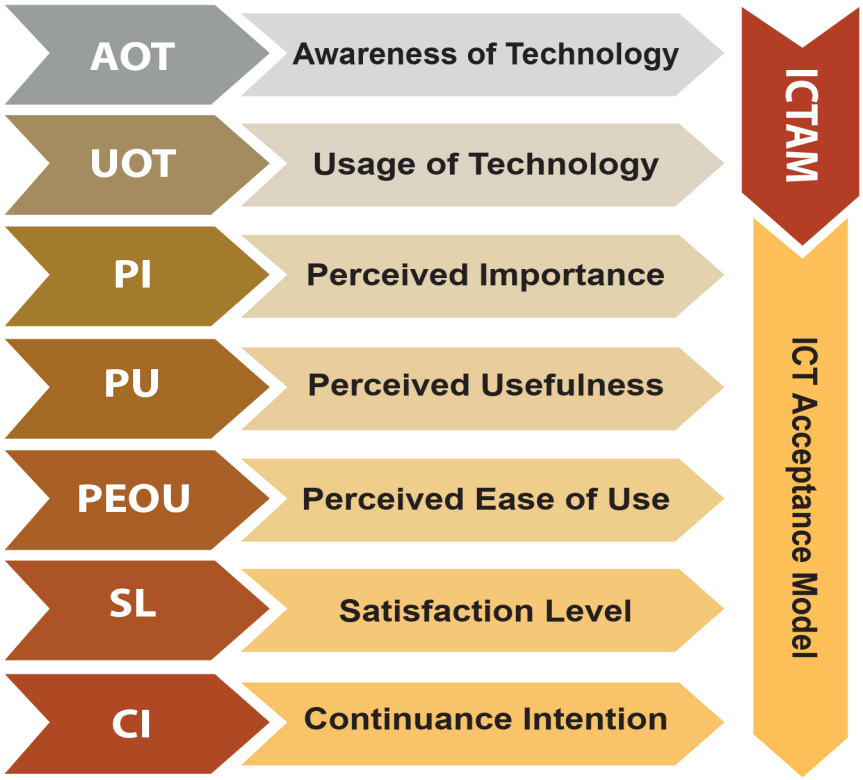

Fig. 1: ICT acceptance model (ICTAM) framework. This figure illustrates the seven domains of the ICTAM that can help policy makers and decision makers as well as education practitioners identify user acceptance of any ICT tool or service.

Table 1: Reliability statistics of the questionnaire's ICT acceptance model domains.

ICTAM Domain/Component	Number of Items	Cronbach's Alpha	Internal Consistency
1. Awareness of Technology (AOT)	3	0.867	Very Good
2. Usage of Technology (UOT)	2	0.856	Very Good
3. Perceived Importance (PI)	5	0.874	Very Good
4. Perceived Usefulness (PU)	26	0.900	Very Good
5. Perceived Ease of Use (PEOU)	12	0.888	Very Good
6. Satisfaction Level (SL)	18	0.894	Very Good
7. Continuance Intention (CI)	8	0.879	Very Good
Overall Consistency/Reliability Coefficient	74	0.880	Very Good

Sample

A stratified sample of 162 preservice female teachers (i.e., senior and junior undergraduate students) from the College of Education at Kuwait University enrolled in four sections (two each) of three-hundred-level undergraduate education

courses entitled "Instructional Media Communication" and "Instructional Media and Technology" in the fall 2019-2020 semester participated in this study. The sample was a representative mix of ethnic and socioeconomic backgrounds and included preservice teachers from a variety of majors. The two courses are mandatory three-credit classes for all undergraduate teacher preparation programs.

Data collection

The data were collected over a four-month period (during the fall 2019-2020 semester). The preservice teachers were introduced to and trained on various infographics apps, namely, Piktochart, Easel.ly, Venngage, and Visme. At the end of the semester, an anonymous questionnaire was administered through an online survey tool, and the preservice teachers were asked to voluntarily participate and complete the survey questionnaire. Participants were assured that their data would be kept confidential and would be used only for statistical analysis purposes.

Methods of analysis

Several methods of statistical analysis were utilized to explore the collected data. These techniques met the basic parametric assumptions required for their implementation. The descriptive analysis procedures applied involved the calculation of the frequency, percentage, mean, and standard deviation. A series of comparisons—independent-samples t-tests, one-way analyses of variance (ANOVAs), Dunnett's C multiple comparisons tests, and Scheffe's multiple comparisons tests—were also employed to assess the differences between/among the groups of preservice teachers in terms of the following independent variables: year of study, academic major, ICT daily usage, awareness of infographics, usage of infographics, GPA, and learning style. An alpha (α) threshold of 0.05 was selected for the inferential tests. Table 2 defines the statistical standard used for interpreting the degree of agreement of the participants' responses to the questionnaire's ICTAM domains.

Table 2: The statistical standard for interpreting the degree of agreement of the participants' responses to the questionnaire's ICT acceptance model domains.

Weight/ Scale	Mean Range	Verbal Interpretation
5	4.50-5.00	Very high
4	3.50-4.49	High
3	2.50-3.49	Moderate
2	1.50-2.49	Low
1	1.00-1.49	Very low

4 Results and Discussion

First: Demographic profile of the respondents

Table 3 outlines the demographic profile of the preservice teachers.

Table 3: Participants' demographic information in frequencies and percentages.

Variable	Category	*N*	%
Year of Study	Junior	84	51.9
	Senior	78	48.1
Type of Major	Arts	102	63.0
	Science	60	37.0
GPA	Below average (1.67 to < 2.67)	34	21.0
	Average (2.67 to < 3.67)	96	59.3
	Above average (3.67 to 4)	32	19.8
ICT Efficacy Level	Low (beginner)	6	3.7
	Moderate (intermediate)	148	91.4
	High (expert)	8	4.9
ICT Daily Usage	1 to < 3 hours	8	4.9
	3 to < 6 hours	58	35.8
	≥ 6 hours	96	59.3
ICT Ownership	Desktop PC	32	19.8
	Laptop PC	128	79.0
	Tablet	70	43.2
	Smartphone	162	100.0
	PDA	42	25.9
	e-Reader	8	4.9
Learning Style	Textual	24	14.8
	Visual/Spatial	70	43.2
	Auditory	10	6.2
	Kinesthetic	40	24.7
	Social	18	11.1
Awareness of Infographics	Aware	72	44.4
	Unaware	90	55.6
Usage of Infographics	Use	86	53.1
	Do not use	76	46.9
Importance of Infographics	Agree	154	95.1
	Disagree	8	4.9
Usefulness of Infographics	Agree	154	95.1
	Disagree	8	4.9

As seen in Table 3, the participants were predominantly seniors and juniors (48.1% and 51.9%, respectively) who, for the most part, had arts-related majors (63.0%) and average GPAs (59.3%). Furthermore, they generally appeared to be heavy ICT users (59.3%)—spending at least six hours a day using ICT—with a somewhat average ICT efficacy level (91.4%). Nearly half of these participants, who favored visual learning (43.2%), were aware of infographics (44.4%) and had used them before (53.1%). Moreover, the overwhelming majority, 95.5% of all participants, found infographics to be quite important and useful in both teaching and learning.

Second: Research question results

The results for research question no. 1

Research question no. 1 was stated as follows: To what extent do preservice teachers at Kuwait University accept infographics apps? The survey included seventy-four items (statements/questions) addressing the overall degree of acceptance of infographics apps. After the answers were submitted, a set of descriptive statistics was used to analyze the data; these are comprehensively displayed in Table 4.

The findings, as shown in Table 4, indicate that the extent of acceptance was overwhelmingly "high" (M = 3.85, SD = 0.668); the participants showed a high degree of agreement in almost all of the ICTAM's domains, namely, the usage of infographics apps, perceptions of the educational importance of using infographics apps, perceptions of the usefulness of using infographics apps for educational purposes, perceptions of the usability (ease of use) of infographics apps, satisfaction with using infographics apps, and continuance intention of using infographics apps for studying, working, or entertainment purposes (i.e., the likelihood of using infographics apps in the future). The exception was the "awareness of technology" domain, which showed moderate agreement. This particular outcome suggests that the majority of these participants are unaware of the broad range of infographics apps existing today.

The findings of this study are, interestingly, consistent with those of Safar (2021), which generally showed a high level of acceptance among in-service teachers regarding the use of infographics apps (M = 3.90, SD = 0.63). Similarly, several other studies have yielded relatively comparable results with respect to the acceptance of infographics apps (Agwa-Ejon & Batchelor, 2016; Bicen & Beheshti, 2017; Bin Dahmash et al., 2017; Fadzil, 2018; Papic & Susilovic, 2018).

Furthermore, the results of the study appear to accord with those of numerous other studies conducted on preservice teachers from the College of Education at Kuwait University. These studies, which used various technology acceptance frameworks, generally demonstrated a high level of acceptance regarding the use of different ICT tools, apps, and services among participants, and the following are a few select examples of these studies: Safar's (2012) study on online training; Safar and Alkhezzi's (2014) study on PKM tools; Safar et al.'s (2014) study on mind maps; Safar's (2015) study on the use of Prezi; Safar and Alkhezzi's (2016) study on streaming media; Safar's (2016) study on e-tests; and Safar's (2018) study on a bring your own device (BYOD) initiative.

The results for research question no. 2

Research question no. 2 was stated as follows: Does the level of acceptance of infographics apps among preservice teachers at Kuwait University differ in terms of year of study, academic major, GPA, ICT daily usage, learning style, level of familiarity with infographics, and the extent to which infographics are used? In this study, several inferential statistics tests were applied to determine whether there were any significant differences among the preservice teachers' responses to the questionnaire (see Tables 5-7). Generally, the results indicate that the sociodemographic profile of the preservice teachers did, to a certain extent, influence the overall degree of acceptance of infographics apps.

According to the data displayed in Tables 5-7, there are no significant differences among the participants with regard to academic major, awareness of infographics, usage of infographics, and learning style. These findings appear to be in line with those of several similar studies that examined the effect of the aforementioned variables on the overall acceptance level, such as Safar (2012, 2015, 2021), Safar and Alkhezzi (2016) and Ali (2017). However, a few studies, such as Safar and Alkhezzi (2014) and Safar (2016), indicated otherwise with respect to academic major, and, interestingly, the significant differences were mainly found to favor science majors.

In regard to year of study, there seems to be a highly significant difference at the $\alpha \leq 0.01$ level (Sig. 2-tailed = 0.002) among the participants in favor of seniors (M = 4.01, SD = 0.485) compared to juniors (M = 3.69, SD = 0.772) based on the calculated t value (t = -3.168) of their overall degree of acceptance of infographics apps. This result can, at least partially, be attributed to the educational disparity between juniors and seniors: senior-level students are academically and professionally more experienced, prepared, and developed than junior-level students. Although this discrepancy may not be evident in some of the previous technology acceptance studies conducted on other types of digital apps, including Safar's (2012) study on online training, Safar et al.'s (2014) study on mind mapping apps, Safar's (2015) study on the use of Prezi, and Safar and Alkhezzi's (2016) study on streaming media, it can be said that infographics apps, for the most part, are designed for advanced users who tend to have high levels of digital literacy.

Regarding ICT daily usage, there was a fairly significant difference at the $\alpha \leq 0.01$ level (Sig. 2-tailed = 0.000) among the participants in favor of those who spent at least six hours a day using ICT (M = 4.00, SD = 0.538) compared to those who spent 1 to < 6 hours (M = 3.62, SD = 0.771) based on the calculated t value (t = -3.716) of their

overall degree of acceptance of infographics apps. A recently published study by Safar (2021) interestingly reported a similar difference among in-service teachers. Overall, these findings logically suggest that heavy ICT users, who are typically technology enthusiasts, are more inclined to embrace new forms of technology than light users. While this assumption may initially seem intuitive, it is, in fact, well-substantiated by an extensive body of literature spanning from the early development of digital technology to recent years. A few select examples from this body of work are Hill et al. (1987), Ajzen (1991), Martocchio (1994), Alenezi et al. (2010), Terzis and Economides (2011), Chen (2017) and Liao et al. (2018). Over the past two decades, numerous technology acceptance studies have found strong and significantly positive bidirectional longitudinal associations between the time spent using technology and the general ICT efficacy level, which, in turn, is positively correlated with the overall technology acceptance level. This widely accepted assumption is well demonstrated in Koivumäki et al.'s (2008) study conducted in northern Finland. The study, which used the unified theory of acceptance and use of technology (UTAUT) as a framework, aimed to explore consumers' acceptance of mobile services. The findings indicated that users' ICT competencies/skills and familiarity with the devices did have an impact on their overall acceptance level.

On a related note, the results of Safar's (2012) study on online training, Safar's (2016) study on e-tests, and Safar and Alkhezzi's (2014) study on PKM tools all confirmed that professional (advanced or expert) ICT users—who have a high ICT self-efficacy level—have a higher technology acceptance level than other subgroups. However, a number of studies indicated otherwise, and these studies include Safar et al.'s (2014) study on the use of mind mapping apps, Safar's (2015) study on the use of Prezi presentation apps, and Safar and Alkhezzi's (2016) study on the use of media streaming services. Essentially, the comparison tests of the aforementioned studies revealed no significant differences among the subgroups regarding the general ICT efficacy level.

In addition to the differences by year of study and ICT daily usage, Tables 6 and 7 clearly show a statistically significant difference by GPA at the $\alpha \leq 0.05$ level (Sig. = 0.023) between the subgroups in favor of those who had average (M = 3.92, SD = 0.543) and above average (M = 3.92, SD = 0.659) GPAs—based on the calculated F value (F = 3.873) of their overall degree of acceptance of infographics apps. A technology acceptance study carried out by Safar and Alkhezzi (2016) on PKM tools revealed comparable results among 100 undergraduate students. Based on these common findings, it would be reasonable to assume that students with relatively high GPAs are more than likely to be drawn towards innovative ideas for the sake of personal growth and professional development. However, it should be noted that while this premise seems rational, it appears to be inconsistent with the findings of several other technology acceptance studies, such as Safar et al. (2014), Safar (2015) and Safar and Alkhezzi (2016).

Table 4: Descriptive statistics of the preservice teachers' responses to the ICT acceptance model domains.

ICTAM Domain/Component	Number of Items	Mean	Std. Deviation	Agreement Degree
1. Awareness of Technology (AOT)	3	2.82	1.090	Moderate
2. Usage of Technology (UOT)	2	3.69	1.091	High
3. Perceived Importance (PI)	5	4.26	1.004	High
4. Perceived Usefulness (PU)	26	4.23	0.831	High
5. Perceived Ease of Use (PEOU)	12	3.90	0.835	High
6. Satisfaction Level (SL)	18	4.02	0.790	High
7. Continuance Intention (CI)	8	3.99	0.846	High
Overall Acceptance Degree of Infographics Apps	74	3.85	0.668	High

Table 5: The inferential statistics of the differences in the preservice teachers' overall acceptance of infographics apps by year of study, academic major, ICT daily usage, awareness of infographics, and usage of infographics.

Variable	Category	N	M	Std. Deviation	t	df	Sig. (2-tailed)
1. Year of Study	Junior	84	3.69	0.772	-3.168	160	0.002**
	Senior	78	4.01	0.485			
2. Academic Major	Arts	102	3.85	0.645	0.101	160	0.919
	Science	60	3.84	0.709			

3. ICT Daily Usage	1 to < 6 hours	66	3.62	0.771	-3.716	160	0.000**
	≥ 6 hours	96	4.00	0.538			
4. Awareness of Infographics	Aware	72	3.87	0.693	0.353	160	0.725
	Unaware	90	3.83	0.650			
5. Usage of Infographics	Use	86	3.79	0.725	-1.165	160	0.246
	Do not use	76	3.91	0.594			

Note. ** = The mean difference is significant at the 0.01 level ($\alpha \leq 0.01$).

Table 6: The descriptive statistics of the differences in the preservice teachers' overall acceptance of infographics apps by GPA and learning style.

Variable	Category	*N*	*M*	Std. Deviation
1. GPA	Below average (1.67 to < 2.67)	34	3.57	0.903
	Average (2.67 to < 3.67)	96	3.92	0.543
	Above average (3.67 to 4)	32	3.92	0.659
2. Learning Style	Textual	24	3.62	0.629
	Visual/Spatial	70	3.83	0.751
	Auditory	10	4.24	0.338
	Kinesthetic	40	3.96	0.636
	Social	18	3.76	0.450

Table 7. The inferential statistics of the differences in the preservice teachers' overall acceptance of infographics apps by GPA and learning style.

Variable		Sum of Squares	*df*	Mean Square	*F*	Sig.
1. GPA	Between Groups	3.332	2	1.666	3.873	0.023*
	Within Groups	68.405	159	0.430		
	Total	71.738	161			
2. Learning Style	Between Groups	3.459	4	0.865	1.988	0.099
	Within Groups	68.279	157	0.435		
	Total	71.738	161			

Note. * = The mean difference is significant at the 0.05 level ($\alpha \leq 0.05$).

5 Conclusion and Recommendations

Overall, the findings of this study constitute irrefutable evidence of a growing desire among the next generation of teachers to introduce meaningful and far-reaching educational reforms.

The overwhelming majority of the preservice teachers involved in the study expressed a strong inclination to embrace and implement the key principles and practices of visual education, which speaks volumes about how visuals are becoming widely recognized as key not only for producing exceptional learning outcomes but also for cultivating the 21st-century skills that are deemed pivotal in

today's ever-changing world. On that basis, incorporating visuals, particularly infographics, into the educational process and exposing students to visual content in a practical manner ought to be viewed as steppingstones towards reaching the ultimate goal of education. In view of the foregoing, the following are several recommendations that could facilitate and accelerate educational progress:

(1) Urging professional development institutes, namely, the College of Education at Kuwait University and the College of Basic Education at the Public Authority for Applied Education and Training, to reevaluate and adapt their teacher preparation programs to meet the needs of today's modern world and keep up with the latest developments in ICT tools, apps, resources, services, and practices.

(2) Conducting training programs to educate in-service teachers at a basic level about the educational value and significance of infographics with respect to both teaching and learning.

(3) Integrating visual content into the curriculum and adopting a visual-based approach to produce fruitful educational outcomes.

(4) Encouraging researchers to thoroughly explore the other educational aspects of infographics to further enrich the educational technology literature and expand the relevant knowledge base.

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Data availability statement

This study relies on confidential data. All the data and its analysis are available from the authors upon request.

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