

# Teaching Staff Awareness and use of Infographic Technology in the School of Engineering, Computer and Mathematical Sciences

by

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# Declaration of Originality

This is to certify that this research solely was undertaken by myself and that to the best of my knowledge and that no help was provided from other. All chapters of this thesis that use quotes or describe an argument or concept by another author have been referenced, including all secondary literature used, to show that this material has been adopted to support my thesis. This study has not been submitted for any degree or diploma of a university or other institution of higher learning.

Signed \_\_\_\_\_

\_\_\_\_\_ Date\_\_13 /12 /2018\_\_\_\_\_

# Abstract

Teachers are probably the most important factor in the educational process because of their role in organising students' learning experiences. Future teachers require high levels of information, knowledge and skills to enable them to perform successfully in a teaching role. Further, they are expected to demonstrate an understanding of theory in addition to practical skills and attitudes to keep abreast of technological advances in this era of constant technological evolution.

Infographic technology is an example of new technology in the education sector that has a significant role in the teaching process. The infographic technique uses graphic pictures to effectively display data, information and knowledge. This technology has proven to be effective in the teaching process because of its ability and reliability in helping learners in interpreting and explaining visual knowledge, also providing a broad body of learning and comprehension in education, as well as enhancing students' learning process skills.

The purpose of this research was to explore the existing infographic technology in education, as well as the awareness and skill levels of teaching staff who use infographic technology at the School of Engineering, Computer and Mathematical Sciences at the Auckland University of Technology. Additionally, the aim was to determine whether there are statistically significant differences in the awareness and skill levels of teachers concerning infographic technology using the variables of teachers' academic qualification and years of experience.

This research includes a literature review and data gathered from a questionnaire designed to evaluate the awareness and skill levels of teaching staff who use infographic technology. The main findings of the survey indicate that the teaching staff at the School of Engineering, Computer and Mathematical Sciences have a medium level of awareness of the concept of infographic technology, but their skills are quite weak. Further, there are statistically significant differences in the teachers' awareness and skill levels regarding the concept of infographic technology using the variables of academic qualification and years of experience.

This study concludes by making recommendations to help teachers in educational teaching and training purposes, to improve their ability to use infographic technology.

# Dedication

*This thesis is dedicated to a number of people to whom I am extremely indebted. My beloved father Ahmed, My beloved mother Kalthom, My dear husband Mohammed for their patience, kindness, and for their emotional, and financial endless support.*

*My siblings for their words of encouragement during this journey.*

*My wonderful son Aser for being my source of inspiration.*

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# List of Abbreviations and Acronyms

ANOVA	Analysis of variance
AUT	Auckland University of Technology
ELI	Educause Learning Initiative
GIS	Geographic Information System
ICT	Information and Communications Technology
MACCC	Mastering Calculus Computer Courseware
SPSS	Statistical Package for the Social Sciences

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# Chapter 1

## Introduction

Information graphics, or infographics, are defined as visualising data in such a way that audiences can learn complicated data easily and consume the data rapidly. Data visualisation has recently increased importance in education sector, and because of the ability of infographics in showing data and information clearly, considered an important tool in instruction. Therefore, helping individuals who suffering learning difficulties by using infographics technology became a substantial research topic. Infographic technology works better when learning difficulties are presented [1]. The results of this study prove that infographic technology facilitates learning and improves the quality of learning. Infographic technology is a modern educational technology that plays an important part in the teaching process. It is believed that the use of infographic technology in education and training may be more effective because it contains visual elements and can be interactive [2].

An infographic is a visual representation of data, information and knowledge that integrates images, graphics and drawings. It aims to transform or provide complex information in easy and understandable form at a glance. Nowadays, many examples of infographics technology are presented on social media networks such as Twitter, Facebook and Instagram. However, infographics technology is not limited to social media; it has already been used in fields such as guidance counselling, instruction and education. For instance, Microsoft PowerPoint is used extensively in teaching and learning, but many people do not realise that it is a type of infographic technology. Encouraging the use of infographic technology in learning may have a significant effect on educational techniques. According to Godwin-Jones [1], it can extend knowledge production and increase the creation of learner communities [2] and learner diversity. However, implementing or integrating new educational techniques may be challenging because the development of infographic teaching content may not always be easier. Thus, it is important to determine teacher's knowledge of infographic skills, as well as their awareness of infographics technology.

Infographics and their different designs work to change the way people think about complex data and information. They also use a modern visual form to collect and present information or data in a manner that is attractive to the reader [3]. In addition, infographics are considered an art form that helps those in the educational sector to present the curriculum in a new and interesting manner. Studies regarding infographic technologies have focused on the use of infographics

technology in the education process. Davidson [4] concluded that using representational thinking is an important skill for students and can be developed with lessons that involve creating infographics.

Infographic technology facilitates faster learning for students. Thus, educational researchers continuously try to improve infographic technology to cope with new demands in learning and teaching to help learners to catch the lesson in an easy way. MacQuarrie [5] agreed that the possibility of using infographics in the classroom for students has a significant effect on learning. However, it is important to understand the awareness and skill levels required for the conceptual understanding, collaboration and engagement of learners when using infographics.

Infographic technology in education often uses audio visual elements together with graphic content. An infographic is a combination of graphic content and media in the form of software. Approximately 65% of people understand an idea better in a presentation when it is depicted with graphic content instead of text only. A human brain can process information 60,000 times faster when it is presented with graphic content [6]. For instance, Facebook is popular because it presents text and images together to make the message more readable. Given that readability is an important factor in learning, audiovisual technology with infographics may be incorporated into the instruction and education environment to improve learning. Microsoft PowerPoint is an effective tool in teaching because it offers interactive text and media integration. Other infographic tools, such as Adobe Photoshop, Adobe Illustrator and CorelDRAW, offer more or better features than Microsoft PowerPoint [7].

## **1.1 Motivation**

It is important to observe the awareness of teaching staff when introducing new technology or applying existing technology in the teaching system [8]. Changes in technology in the education sector have been observed over the past few decades, with a variety of new infographic technologies being adapted in higher learning institutions [9], [10], [11]. Hence, infographic technology has had a significant effect on the educational process and its importance as a source of learning. Teachers must have knowledge and skills to use the technology. Thus, this study sought to examine the awareness and skill levels of teaching staff at the School of Engineering, Computer and Mathematical Sciences at the Auckland University of Technology (AUT) regarding the concept of infographic technology.

Programs and courses should be provided to develop teachers' skills in the field of infographic technology as a preliminary step for employment in education. At present, to the best of the author's knowledge, there is little or no literature regarding teaching staff's awareness of infographic technology at AUT. Thus, this study explored the awareness and capability levels of teaching staff using infographic technology at the School of Engineering, Computer and

Mathematical Sciences at AUT. It includes a comprehensive literature review and a questionnaire distributed to the teaching staff at AUT to evaluate this research topic. The questionnaire includes a section for the teachers and lecturers to express their views.

This research will help teaching staff to improve their knowledge of applying technology in their teaching practice, and it will help students in their future learning. Further, this research will help those who prepare teacher training programs to understand the importance of including technological topics generally, and infographics in particular, in the academic plan.

## **1.2 Research Objective**

It is impossible for students to adapt to new technological changes unless their teachers have previously obtained knowledge of the topic. In recent years, research has revealed the ability of infographics to communicate to large groups of people, suggesting that infographics can support teaching and learning in education institutions. Therefore, it is important to understand teachers' awareness of the concept of infographics to identify the extent of their ability to employ it in education to expedite learning processes.

Different factors can affect the teachers' awareness and skills regarding infographic technology such as teachers' years of experience, teachers' qualifications and teachers' way of teaching or style of teaching. This study will focus on two factors, which are teachers' years of experience and teachers' qualifications.

This study sought to examine the awareness and skill levels of teaching staff at the School of Engineering, Computer and Mathematical Sciences at AUT regarding the concept of infographic technology. The study aimed to:

1. determine whether there are statistically significant differences in the awareness and skill levels of teachers concerning infographic technology using the variable of years of experience
2. determine whether there are statistically significant differences in the awareness and skill levels of teachers concerning infographic technology using the variable of academic qualification.

## **1.3 Research Questions**

In line with the research objectives presented above, this study sought to answer two research questions:

1. What awareness and skill levels of infographic technology are possessed by teachers in terms of years of experience and academic qualification?

2. How can we measure the awareness and skill levels of infographic technology possessed by teachers in terms of years of experience and academic qualification?

## **1.4 Research Contribution**

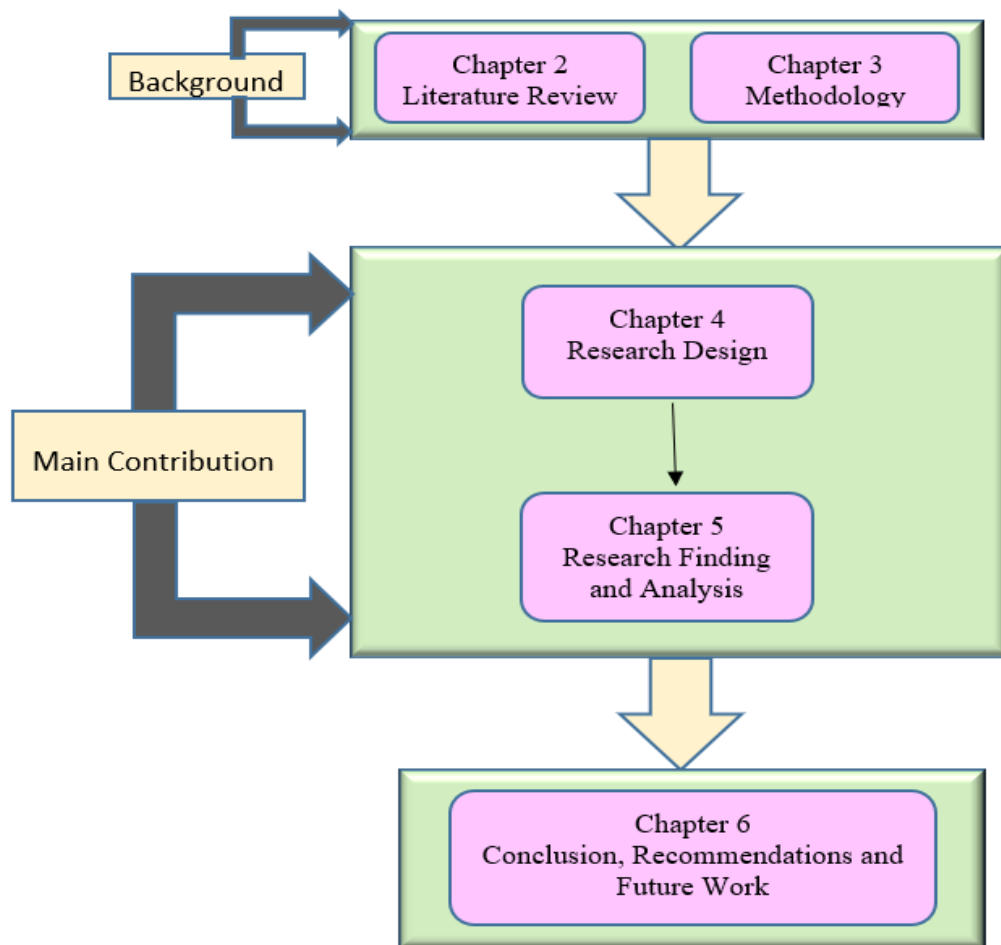
The aim of this study is to help education institutions adapt technology to facilitate faster and easier learning among students. The significance of this research is threefold:

1. I developed a survey questionnaire to collect sample data from the teaching staff at the School of Engineering, Computer and Mathematical Sciences within AUT. Name of participants was kept confidential by marking them anonymous and their identity was not be revealed in the report. Data collected from the participants stored on a USB flash drive and securely stored in the supervisor's office at AUT premises. Those data destroyed by deleting emails and information from the USB flash drive.
2. I analysed data using a statistical method to identify the relation between years of teaching experience and awareness and skills regarding infographic technology.
3. I analysed data using a statistical method to identify the relation between teachers' qualifications and awareness and skills regarding infographic technology.

## **1.5 Research Structure**

This thesis contains six chapters. Chapter 1 introduces the topic, describes the background of and motivation for the study and underlines the research problems, aims and contributions. Chapter 2 presents a literature review that explores different issues regarding the objectives of the thesis, including infographic technology, infographic technology in education and significance of infographic in supporting learning processes. Further, the literature review describes the awareness and skills in infographic technology, features of infographic technology and its use in education, and it concludes with a summary of the literature review. Chapter 3 presents and justifies the process, approach and methodology that were used to conduct the study. Further, it outlines the statistical methods used in the research. Chapter 4 provides a design of the study and survey description. Chapter 5 presents the research findings and analysis, including the discussion section. The thesis concludes with Chapter 6, which provides a summary, recommendations and ideas for future study directions.





**Figure 1.1:** Structure of the thesis.

# Chapter 2

## Literature review

### 2.1 Introduction

The process of learning and instruction is considered one of the most substantial educational processes, that comprehensively care from fulfilling academic purposes of the students all the way up to the end of their study journey. Learning processes are extremely complex, and each individual has a unique learning style that they use to gain knowledge from the educational experiences presented to them. These different styles should be considered by teachers, students and parents because they are crucial for improving the means of instructing learners. Vermunt and Donche [12] concluded that recognising the most skilful learning patterns makes learning easier, effective, proficient and continuous. Teachers can use these patterns to provide educational experiences using methods that are preferred by students. The visual pattern in the education domain is considered one of the most significant learning methods' at schools and universities [13] because it leads to general improvements in students' progress.

Matrix and Hodson [14] explained that students can retain material effectively if it is presented with illustrations and photos or other graphic forms. Thus, pictures can help visual learners to process material. However, contemporary techniques and technological innovations such as infographics have appeared in the field of education and are playing a significant role.

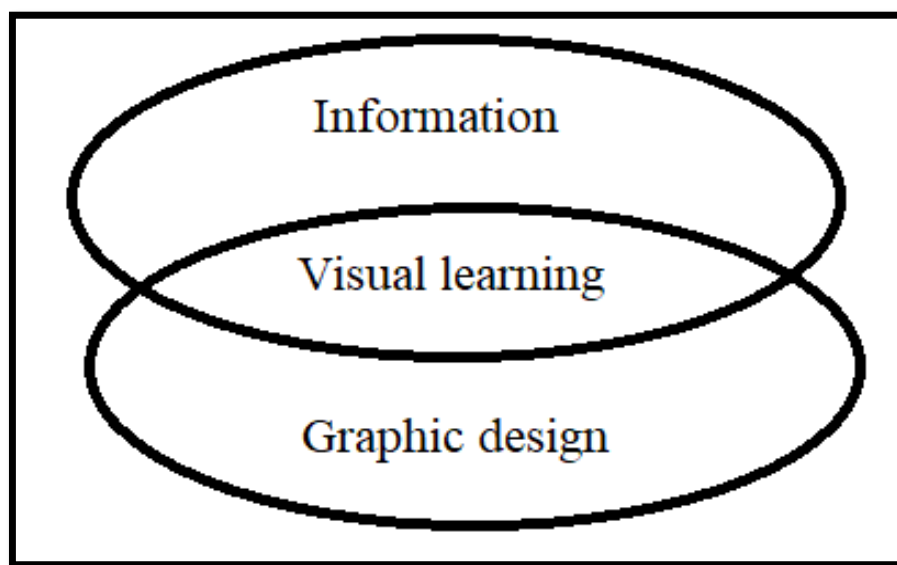
In recent years, some researchers have revealed the strengths of infographics in communicating with the public [15], which suggests that the education sector should integrate infographics into teaching and learning. A study by Islamoglu et al. [16] showed that there is an urgent need for teachers to understand the concept of infographics and to gain skills to produce and use them.

### 2.2 Infographic Technology

Infographics have become popular in the media and communication industries, where they are used in political campaigns, the news, marketing and health communications. Further, they are used as a form of self-promotion and as a modern type of résumé. In general, designers and educators have embraced infographics to help audiences grasp their intent in a swifter and smarter way.

Infographics are defined as visual representations of data, information and knowledge that are usually accompanied by text [17]. According to Yildirim [18], they contain information that is

presented in a certain flow with the help of several visual elements and text, and they can include components such as pictures, graphs, charts, flow diagrams and text. Naparin and Saad [19] described infographics as data visualisations that contain maps, graphics, photos and charts to display intricate information quickly and clearly. They also indicated that infographics are visual clarifications that merge information from data and graphics to convey a message, and these visualisations are frequently used to assist in data interpretation. Krum [20] defined infographics as ‘graphic design that combines data visualisations, illustrations, text, and images together into a format that tells a complete story’ (p. 6). Further, Niebaum, Cunningham-Sabo, Carroll and Bellows [17] showed that infographics are visualisations of ideas or data that attempt to convey complex information to an audience in a way that can be easily and quickly understood. Figure 2.1 shows that infographics combine data with design to enable visual learning.



**Figure 2.1:** Anatomy of an infographic [21].

A variety of different-sized organisations, including teaching and learning organisations, use infographics because they quickly deliver information and the audience can understand it easily. In addition, computer software enables the fast design of infographics using a variety of techniques [21]. One of the most significant trends that has resulted from interactions between teachers and learners is that of visual aids. Visual aids are instructional aids that are applied and used in the classroom to promote students’ learning. Shabiralyani, Hasan, Hamad and Iqbal [22] described visual aids as sensory images or objects that stimulate and support learning. They further stated that visual aids are tools that assist in making a lesson clearer or easier to understand and know (e.g., pictures, models, maps, videos, real objects). Several studies have identified that visual aids promote learning in many different situations [22], [23]. Some researchers believe that visual aids are any devices that can be used to make the learning experience more accurate, more

real and more active. Many visual aids are now available, including charts, slides, pictures, maps, flannel board and chalkboard.

### ***Infographic history***

Some observers might believe that infographics are a recent phenomenon that has been rising in popularity in conjunction with the growth of the internet. However, history shows that humans have always used icons, images and graphics to narrate stories, share information and construct knowledge [21]. For example, in the Later Stone Age, around 30,000 years ago, humans painted the first infographic samples (portraits of animals) on the walls of the Chauvet Cave in southern France. Smiciklas [21] and Shafipoor, Sarayloo and Shafipoor [6] outlined the history of infographic technology from ancient times to the present, as summarised below.

- In 1350 AD, Nicole Oresme, who was a philosopher in the Middle Ages, demonstrated a method of measuring the motion of objects by drawing graphs.
- In 1510 AD, Leonardo da Vinci first presented scientific illustrations, which were used in training inscriptions and pictures, especially in the field of human anatomy.
- In 1786, Scottish engineer William Playfair became a visual data pioneer when he explained numerical data in his book, *Political Business Atlas*, using linear, pie and bar charts.
- In 1850–1870, French civil engineer Charles Joseph Minard used a combination of maps and flowcharts to present geographical statistics.
- In 1878, James Joseph Sylvester used a group of charts to show the relationship between chemical bonds and mathematical properties. These charts were presented in the scientific journal *Nature*.
- In 1930–1940 AD, Austrian philosopher Otto Neurath created the Isotype visual language as a method of visual communication that used images and icons to teach ideas and concepts.
- During 1970–1990 AD, infographics became popular in periodicals such as *Time Magazine*, *USA Today* and *Sunday Times*, which used infographics to simplify data and promote an understanding of complicated issues.
- In 1975, American statistician Edward Tufte introduced visual data with a contemporary style. He held seminars and published several books about information design and is considered a pioneer of infographics and visual data.
- Since 2000, infographics have become widely used on the internet.

Today's learning process involves a more efficient presentation of one-dimensional information using infographics, with new materials providing the information to fit within a certain scope. Creating and using infographics in the learning approach contributes to developing visual skills, which will help teachers to teach students to make sense of and assess visual information. Further, infographics are an innovative way to display new concepts and information to students and to start meaningful discussions about the material when they have had time to digest and analyse the details. They present complex information more clearly by using words, numbers, symbols and colours to transfer a key message to students rather than through text alone. Additionally, through the activity of designing a visual representation of complex ideas, students will engage with the content in a sustained manner, possibly deepening their grasp of it.

### **2.3 Data Visualization**

In various contexts, people consider infographic technology and data visualization as synonymous. However, infographic designers, deem them as different things.

Data visualizations are visual representations of numerical values [20]. According to [24], visualization is the "mechanism by which humans perceive, interpret, use and communicate visual information". The major purpose of visualization is to transfer information in a clear and effective way by using graphical means [24]. Another definition of data visualization is the conversion of the information of raw data into visual presentations [25]. Numerical values are represented as charts, graphics, and tables. Friendly [26] defined data visualization as data visual representation, that has been abstracted in some schematic form, including variables for the units of information.

The efficiency of data visualizations lies in visualizing a huge set of numbers in a small space by designing a visualization format showing the data within the readers' field of view, enabling them to view the whole data set with minimal eye movement [20].

The aim of infographics technology and data visualization is to provide a visual presentation of irregular and complicated data and information in an understandable and planned style [25]. Both terms have different concepts despite this joint aim. It can be said that infographics technology includes a visual story like a presentation of a particular subject, which provides several data in a simultaneous method, which sometimes includes processes. This visual story can use different formats, such as maps, illustrations, typography, and visualization. "In this use of the word, data visualizations by themselves are no longer considered to be complete infographics but are a powerful tool that designers often use to help tell their story visually in an infographic" [20].

Data visualizations are considered to be one of the strongest elements found in infographics. This has a clear impact on the credibility of infographics as it offers objective and obvious information based on numeric data. Data visualizations are within the scope of statistics and data analysis

fields. Specialists of these fields use their own methods to study data visualization and state that graphics might sometimes become speculative when designers are involved [25].

## **2.4 Why Infographic Technology?**

This section examines how various studies have defined the benefits and features of infographic technology [21], [27], [28], [10] and [29].

Infographics make it easy to communicate complex and large amounts of information in a visual way. Infographic technology integrates texts and graphics to reveal information, patterns and trends, making them easier to understand than text on its own. Converting information and data from tedious figures and characters into interesting images and graphics enhances the user's ability to think critically and develop and organise ideas. The ease of disseminating infographics via social media networks has increased the popularity of infographic technology. Infographics improve people's retention and recall of information. They are not only beneficial to teaching, but also in business because of the possibility of using infographics to communicate to others who speak a different language. For example, Kos and Sims's [27] study at the Atlas Institute, University of Colorado, demonstrated the effectiveness of using infographic technology in writing articles for non-English speakers. In short, it enhances one's ability to think, connect and organise information, which in turn improves one's comprehension of information, ideas and concepts. It also increases the focus on learning and enhances creativity to work effectively.

Infographic technology supports the teaching and learning processes. A study by Hussain [30] illustrated that approximately 40% of people respond better to pictures than to text. Further, pictures on Facebook are more effective than text, video and links, and the brain processes information in the form of pictures around 60,000 times faster than textual information.

Naparin and Saad [19] illustrated that using and creating infographics for education purposes will develop visual skills, which will help teachers to teach students to make sense of and assess visual information. Additionally, by designing a visual representation of complicated ideas, students will engage with the content in a sustained manner, perhaps deepening their understanding of it.

Shafipoor *et al.* [6] indicated that traditional methods and instructional media might be ineffective because today's students have been born into a visual and kinaesthetic world. The use of modern technologies in classrooms is important because it gives learners the opportunity to learn faster with more satisfaction from attending class. Teachers also need to have sufficient information about educational technology and new educational media and how to deal with them. Infographics enable learners to process a considerable amount of data and information at a glance, thereby making it easier to understand and preserve the information.

The implementation of infographics in education is not new, but it is improving because of a combination of technology and infographics [31]. Many educators believe that education should be based on the reality of the learner, and the reality is that technology is an important element in the educational process. The role of technology is that of a continuous learning tool. In addition, an evolution in the theories of learning and behavioural psychology have brought about change in education and teaching methods, as well as methods of evaluation.

The key points from the above literature review are summarised in Table 2.1, which explains why infographic technology in education is necessary.

**Table 2.1:** Summary of the literature regarding the reasons behind the need for infographic technology.

Author	Contribution/ Method	Finding
Schrock [29]	Infographic technology	Infographics made the complex and large information easy because it uses visual effects to communicate information.
Naparin and Saad [19]	Infographics for education	Using and creating infographics for education purposes will develop visual skills, which will help teachers.
Shafipoor, Sarayloo, and Shafipoor [6]	Traditional method v. infographic technology	Using traditional methods and instructional media in teaching might be ineffective.

## 2.5 Infographic Technology in Education

Technology in education, or educational technology, is an intricate concept and a phenomenon of the twenty-first century. However, history shows that it dates back to ancient civilisations, which used knives and pointed sticks to carve inscriptions and symbols on the bark and leaves of trees. Philosophers, educators and scientists throughout history have defined educational technology as an integrated, multifaceted process that involves people, thoughts, procedures, devices and organisations. Educators borrow technology from various sciences to implement, evaluate and manage solutions to issues relating to all aspects of human learning.

Infographics technology can be adopted as a learning tool in instruction to clarify complex data and information in a compact form. It has multiple benefits for students, including enhancing the interpretation of concepts and ideas, improving information recall and retention, and improving one's ability to think. Teachers can use infographics in warm-up lectures and learning activities and to summarise subject units to increase students' engagement with the course content and enhance teacher–student interactions [32]. Further, infographics require visual knowledge and skills such as expression, learning and thinking, which can increase students' visual communication skills. Hence, infographics can be applied as a tool and can help students reach

their highest achievement in education [29]. Thus, instructors seek to merge applications and tools to satisfy visual learners' needs by using infographics in the classroom. Educators are moving away from reading text and interpreting data towards using infographics as a method of communication. Smiciklas [21] explained that infographics enhance the speed at which information is grasped, thereby increasing the number of opportunities to share data widely through digital channels.

Thus, graphics are extremely important in the educational process. They play a prominent role in facilitating the transfer of information, and they have a long-term effect on learning. Naparin and Saad [19] stated that infographics can assist the teacher to help students learn faster, while Bicen and Beheshti [32] found that infographics encourage students to engage with their course content in the classroom. Further, Schrock [29] revealed that infographics can help learners to achieve their goals in education. Krauss [33] stated that the use of graphics to visualise data and ideas involves many parts of the brain and enables one to examine problems from multiple angles, which is important when it is difficult to convey complex relationships with words. Carney and Levin [34] reported that students tend to understand more from text with illustrations than from text alone, and more recent research has confirmed this finding such as studies conducted by [35] and [23]. Additionally, the major tenet of the multimedia principle, which has been supported in experimental research in [36] and [37], is that people mostly have a better memory for pictures than for corresponding words. Further, research on the multimedia effect supports the idea that using instructional graphics that are relevant to the text can improve students' learning [38] and [39].

Infographic technologies also work perfectly with the concept of a flipped classroom. [40] Bergmann & Sams, and Evseev & Solozhenko [41] explained the flipped classroom as reverse the idea of learning and teaching process, which mean theoretical materials are studied by students individually by viewing videos lectures recorded by the teachers or downloaded from the Internet websites. While classroom activities are devoted to fulfilling practical tasks and discussing the main issues with the teachers.

The key points from the above literature review are summarised in Table 2.2, which explains the necessity of infographic technology in education.



**Table2.2:** Summary of the literature regarding implementing infographic technology in education.

Author	Contribution/ Method	Finding
Bicen and Beheshti [32]	Using infographics in teaching	Teachers can use infographics in warm-up lectures to provide more chances for interactions.
Sung and Mayer [35]	Adding graphics to text for student learning	Graphics can affects positively learning outcomes
Naparin and Saad [19]	Infographic technology	Infographics can assist the teacher and help students to learn faster.

## 2.6 Importance of Infographic in Supporting Teaching and Learning Processes

Davidson [4] showed that infographics help to successfully engage students in education, not only by implementing research projects within the classroom, but also by presenting their research findings to their peers. Kibar and Akkoyunlu [42] confirmed the importance of using infographics as an educational resource. Dunlap and Lowenthal [43] illustrated that in the educational setting, efficacious infographics might be used as mind maps, job aids, study tools, organisers and content summaries. In 2013, the Educause Learning Initiative (ELI) stated that efficient infographics can transfer the essence of a message without requiring the associated text to be read thoroughly, so that a reader or viewer can understand and determine the topic of the infographic at a glance. A number of studies have recommended introducing new methods and techniques for the use of infographics in education to help make information more concise, to accelerate students' learning time and to help students retain information in the long term [8], [44], and [45].

Vanichvasin [46] investigated the views of university students on the use of infographics as a tool of visual communication, and the results showed that infographics are effective for evaluation, understanding and permanence.

Ozdamli and Ozdal [47] evaluated the opinions for the teacher candidates on designing infographic learning material. They identified that the participants had positive opinions on infographics and accepted infographics as effective tools that presented information in an integrated and organised manner, included high visuality and proved to be an attractive learning tool. However, the participants also had difficulty organising the information to be used in the design of an infographic, which was related to the necessity of being knowledgeable in teaching content preparation at an expert level.

Ru and Ming [31] explored the relationship between infographics and design education. The finding from their study shows that the use of infographics made a positive impact to design education, and they recommended infographics to improve this field, which currently faces many challenges.

Rezaei and Sayadian [48] studied the impact on infographic technology in grammar education and focused on exploring the efficiency of employment. In this research, which was constructed using an experimental pattern, courses that used infographics were delivered to a test group, and traditional methods were used in a control group. The results reported that employment the infographic technology had a positive impact on grammar learning.

Yildirim [18] evaluated the option to use infographic technology for teaching staff in education faculties. The results showed that infographics have a more didactic structure compared with textual content; therefore, they may be an effective alternative to visual elements and plain text materials in books. Further, in the opinion of the teacher candidates, infographics were the most recommended tools among other visual teaching materials.

Alshehri and Ebaid [49] discussed the usefulness of interactive infographic usage in elementary school mathematics classes. In the study, noteworthy differences were detected in favour of the experimental group in which the infographic usage was realised. Students in the experimental group that used interactive infographics were higher compared with the grades of the students in the control group.

Pisarenko and Bondarev [50] conducted a study to identify the effect of infographic usage on foreign language courses and found that it had a positive effect on foreign language teaching and education technologies because infographics were found to be more interesting and useful by the students.

Bradshaw and Porter [44] studied the uses of infographics as a new teaching and learning tool in nursing education. The study concluded that the basis of infographic development has to be comprehended by nursing educators and should use them during classes to explain synthesised data. Another finding was that for patient education, infographics technology could be used.

Al-Mohammadi [51] examined the effect of the usage of infographic technology for high school students in teaching programming languages to improve their analytical thinking abilities. The study founded that the use of infographic technology had a positive effect on teaching the fundamental of programming languages and improving students' analytical thinking capabilities.

The key points from the above literature review are summarised in Table 2.3, which explains the importance of infographic technology in education.

**Table 2.3:** Summary of the literature regarding the importance of infographic technology in education.

Author	Contribution/ Method	Finding
Davidson [4]	Infographics in education	Infographics helped the students to concentrate during teaching and learning.
Kibar and Akkoyunlu [42]	Infographics in education	Infographics technology could be an educational resource.
Rezaei and Sayadian [48]	Infographics in grammar learning	Infographic technology proved to be effective in grammar education.
Yildirim [18]	Evaluated the possibilities to use infographic technology for those who wants to be a teacher in future	The visual teaching materials are recommended in the education process.
Bradshaw and Porter [44]	Infographic technology in nursing education	The ability to use infographics technology as a new tool in nursing education.
Al-Mohammadi [51]	Infographics in programming lessons	The effect of infographics technology has a promising approach in teaching programming to improve learning.

## 2.7 Awareness and Skills in Infographic Technology

Islamoglu *et al.* [16] aimed to increase awareness of the opportunities provided by infographics technology for education, and to propose ways to help integrate infographics knowledge and skill development into teachers' education. They also illustrated the importance of pre-service teachers as emerging professionals who are responsible for developing, enriching and promoting learners' knowledge and skills. However, these goals are not likely to be realised if teachers have insufficient knowledge and skills. Thus, to achieve these objectives, teachers should follow developments in the use of audiovisual technology in learning and education and be aware of emerging visualisation methods and tools, such as infographics technology [16]. Islamoglu *et al.* [16] revealed that twenty-first-century teacher education could contain infographics technology training to a large extent. They also suggested some practical methods for using infographics during instruction and considered solutions that might help in course-based training for teachers' education. Further, they suggested future research activities that could examine and increase the efficiency of infographics technology in an educational context.

Amutha and Kennedy [52] explored the awareness of technology-based education among student teachers. They reported that technology-based education is a pressing need, and that the current education system aims to enable teachers and learners to be educated regarding technology. This is because technology can facilitate learning through doing, directed instruction, self-learning, critical thinking, problem-solving, information-seeking and analysis, and the ability to

communicate, collaborate and learn. The study also reported that teachers require technology knowledge to perform the teaching and learning processes smoothly. In addition, to improve the pedagogy, teachers require technology training to motivate themselves and their students. Technology has the ability to contribute to extending teachers' subject knowledge, where it can enhance their capabilities, knowledge, and skills, thereby enabling planning and teaching preparation to be more effective [52]. The research showed that if student teachers are aware of the technology, they will guide their learners, which will help the students to learn faster.

Minor, Losike-Sedimo, Reglin and Royster [53] investigated a teacher technology integration development model that focused on using the Smart Board to improve pre-algebra grades. The research showed that teachers need to be experts in using the latest technologies in classrooms to make the learning environment come alive. Teachers also have to feel convenient when dealing with technology, able to apply it appropriately and are conversant with new technological tools and approaches. Additionally, they must understand how to effectively use technology in the classroom. The study concluded that Smart Board training helped the teachers to be more expert in using that technology in pre-algebra instruction classrooms.

Further, Noh *et al.* [28] explored the effect of infographic technology on the education and learning processes. The study concluded that all infographic features, including the use of symbols, good design, attractive colours, concise texts and diagrams, encourage learners to understand better. Higher learning institutions are recommended to introduce infographic technology as a teaching tool to enhance learners' creativity and productivity and ease their problems.

**Table 2.4:** Summary of the literature regarding awareness and skills in infographic technology.

Author	Contribution/ Method	Finding
Islamoglu <i>et al.</i> [16]	Raising the awareness and introducing the infographics knowledge in teacher education	Pre-service teachers should increase their knowledge in using some audiovisual technology such as infographics to enriching and promoting the learning process.
Amutha and Kennedy [52]	Student teachers awareness of technology	Student teachers require technology knowledge and training to improve and perform the teaching processes smoothly.
Minor, Losike-Sedimo, Reglin and Royster [53]	Integration some professional development model to improve pre-algebra achievement	Teachers need to be experts in using the latest technologies in classrooms to make the learning environment come alive.

The key points from section 2.6 literature review are summarised above in Table 2.4, which explains the awareness and skills in infographic technology.

## 2.8 Infographics Architecture

Infographic technology can be divided into three parts: based on implementation, based on utility and based on the component. These parts are outlined below.

### 2.8.1 Based on implementation

Some researchers have classified infographic types depending on how they can be implemented in four major classes [54], [55], [6] and [56]:

1. **Static:** A static infographic is an image such as a snapshot that freezes a story at a fixed moment. In this type, information is shown as one image at one glance.
2. **Dynamic:** A motion infographic uses multimedia and multimodal animations such as music, voices and short movies to cut a story. In this type, information is given in a linear sequence as animations.
3. **Interactive:** An interactive infographic allows a story to display and update by changing some parameters continuously. In this type, information is generally web-based and according to the user's choice.
4. **Physical:** In this type, information is shown in a three-dimensional volume.

### 2.8.2 Based on usability

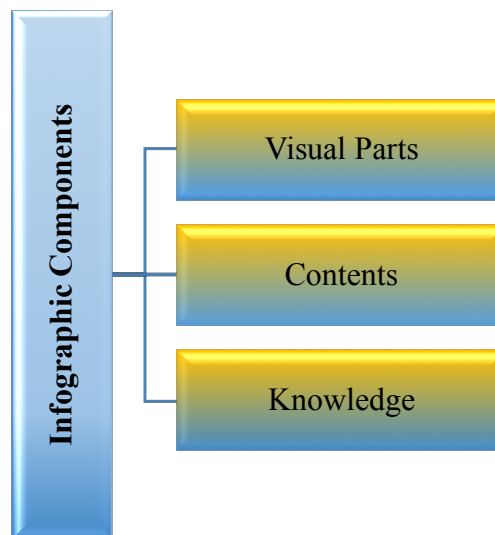
Some researchers have classified infographic types based on their usability [57], [24] and [58]:

1. **Statistical-based:** This type is composed of area diagrams, graphs, tables and lists, as well as pie, bar and curve charts. It explains and compares quantities—especially large and complex groups of numbers and relations.
2. **Timeline-based:** This type presents the sequence of events according to the time at which each event occurred. Occasionally, it is presented in tabular or year-by-year paragraphs. It helps audiences to understand a chronological relationship very quickly.
3. **Process-based:** This type can be used to illustrate the workspaces of any organisations. It can also make readers understand its practices in limited space.
4. **Geography-based:** According to the Geographic Information System (GIS), maps can be the best way to show geography-based infographics. Various GIS notations are used in maps to identify highways, streets and facilities. These maps include symbols, icons, graphs, tables and arrows. Different types of maps belongs to this type of infographic, including topic maps, event space maps and weather maps.

### 2.8.3 Based on components

Despite the diversity of infographics, they share a number of main components, and the details vary between them according to the taste and creativity of the designer. Many researchers, such as Szołtysik [59], agree that there are three main components of infographics (see **Error! Reference source not found.**):

1. **Visual Parts:** This component includes the use of colours, fonts and graphics depending on the type of data, such as arrows, shapes, graphs and images.
2. **Contents:** This component includes written texts that should be authentic, concise and linked to the previous elements. It also contains a timeframe, statistics and references.
3. **Knowledge:** This component distinguishes infographics by making them more than a text and image, whereby the method of presenting the infographic in a certain way represents the concept or knowledge to be delivered, such as chronology or branches. It includes facts and deductions.



**Figure 2.2:** Infographic components.

## 2.9 Mental Maps and Infographic

Mind mapping (or mental mapping) is defined as the visual, non-linear representations of ideas, tasks, words, concepts or items and their relationships [60]. Mind maps are an easy way to organise and brainstorm thoughts organically—especially for visual learners—without worrying about order and structure. They allow learners to visually structure their ideas to help with analysis and recall. Mind maps can be drawn by hand or by using special software such as iMindMap. Several elements to consider when creating a mind map include the map's central image, colours, keywords and images. Mind mapping can transform a list of monotonous information into a colourful, memorable diagram that works in line with the human brain's way of doing things. Mind maps have the following advantages:

- They are characterised by their fast construction and are much easier to review and remember because of their visual quality.
- Associations between ideas are easily demonstrated, and they stimulate brain creativity.
- The organisation of a mind map reflects the way the brain organises thoughts.
- They operate in the same way as the human mind.
- When reducing ideas to one or two words, the human brain actively thinks about and processes these ideas, which in turn aids memory.

People can benefit from using mind maps in many ways:

- They can be used to organise ideas or assist in understanding important conceptual issues in a study.
- Students can use mind maps for note-taking or planning chapters or sections of their theses or assignments.
- Mind maps can help students remember the information required and provide an overall review of their course during exam time.
- Mind maps help to structure, comprehend, synthesise, recall and generate new ideas.

Mind maps and infographic technology both consist of lines, shapes, colours and information. They also aim to summarise and present a large amount of data and information in a simple and focused manner. The mind map, as presented by Tony Buzan (who popularised the idea of mind mapping), works on both sides of the brain, so the learning becomes more structured and coherent, thus facilitating remembering and recalling. Mind maps and their educational benefits are well known in the field of education; thus, this study will compare them with infographics to help visualise their use in the education sector [61], [62], [63]:

- What is their job? Mind maps present ideas and subtopics in a creative and smooth way for a particular field, whereas infographics display ideas and subtopics and their relation to the main theme through a sequence of events in a detailed manner.
- Who prepares it? Mind maps are drawn by the learner, and anyone can draw them because they do not need specific skills. In contrast, infographics are prepared by designers who specialise in, or who have experience in, using design software related to that technology.
- Who can read it? Mind maps are often read by the owner and can be difficult to understand by other people. In contrast, successful infographics should be able to be understood by a large number of people easily and quickly.

- What are they based on? Users draw and prepare mind maps based on their understanding of things and the relations between them. The owner presents ideas, concepts and relationships as they perceive them, and they use their own symbols, colours and abbreviations. In contrast, designers of infographics must consider that they need to be read by a large number of people, and they must apply theories and principles of visual design to meet the different abilities of people to receive and interpret these visual data.
- What is their educational value? Mind maps are an active learning tool in which the learner imparts their own meanings to the drawing. In contrast, ready-made infographics are a learning resource.
- What types of skills are required? Mind maps can be produced by hand with paper and a pencil and perhaps coloured pens, as well as information as seen by the learner. Programs such as Snagit and Microsoft PowerPoint can be used if the owner knows how to use them. In contrast, designers of infographics require visual message design skills and professional design tools.

Thus, mind maps and infographics are both composed of lines, shapes, colours and information, and they aim to summarise and simplify a large amount of information. Table 2.5 summarises the differences between them.

**Table 2.5:** Summary of the differences between mind maps and infographics.

Questions	Mental Map	Infographic
<b>What is their job?</b>	Presents ideas in a creative and easy way	Presents ideas through a sequence of events in detail
<b>Who prepares it?</b>	Learner	Specialist designer
<b>Who can read it?</b>	Often read by the owner and difficult for others to understand	Successful infographic read by many people
<b>What are they based on?</b>	Learners draw on their understanding of things and relations between them, and they use their own symbols, colours and abbreviations	It is necessary to employ the theories and principles of visual design to meet the different abilities of people in receiving and interpreting visual data
<b>What is their educational value?</b>	Active learning tool; the learner imparts their own meanings to the drawing	Learning resource
<b>What types of skills are required?</b>	By hand; requires only paper and pencil and perhaps coloured pens or a special program such as Snagit	Requires visual message design skills and professional design tools



Studies have shown that the educational value of infographics outweighs that of the mind map because, in addition to cognitive achievement, students will learn visual communication skills, which will lead them to acquire high skills in acquiring new ways of thinking.

## **2.10 Infographic Design Theory Considered in Questionnaire Preparation**

The researcher was aware of several principles and theories while designing the infographic questionnaire for this study, as outlined below.

### **2.10.1 Gestalt theory**

This theory is descended from a school of Gestalt psychology, which is a school of thought that examines the human mind and behaviour as a whole. This school of thought played the main role in the study of the modern development of human perception and sensation.

Gestalt theory aims to describe how people organise visual elements into groups or unified wholes when applying certain principles. The theory indicates that humans do not concentrate on every small component; instead, the brain tends to perceive objects as elements of more complex systems. Gestalt theory contains the following important principles that must be understood by infographic designers:

1. **Law of proximity:** This law states that elements that are placed close to one another appear to form groups, even if the shapes and sizes of the elements are radically different.
2. **Law of similarity:** This law states that people often perceive things that share visual characteristics such as size, value, shape, texture and colour as a group or a pattern, or as belonging together.
3. **Law of closure:** This is the most significant law and the fundamental principle behind the functioning of our mind. This law states that objects can be seen as a whole when they are incomplete or when space is not completely enclosed because the brain tends to fill in the missing information to create shapes and images.
4. **Law of continuity:** According to this law, the eye is compelled to move through an object and continue to another. Learners tend to continue images beyond their end point.
5. **Figure and ground:** People's often tend to perceptual differentiate forms from areas that surround them, that what the figure and ground principle explains. Where a form recognizes and perceived as a figure, while the surrounding area is perceived as the ground.
6. **Law of Prägnanz:** Complex images are organised to their simplest possible form. People tend to perceive and interpret complex images and shapes as the simplest form(s) possible.

### 2.10.2 Communication and data processing theory

Communication is a two-way process of exchanging opinions, ideas and facts through any number of channels. The function of communication theory is how to send and receive messages. Data processing theory explores how individuals handle the information they receive for the purpose of learning and conservation. Psychologists have described how the human mind receives information, and how it is processed and moderated by learners. Data processing theory concentrates heavily on three main memory stores that are involved in cognitive processes: sensory memory, working memory and long-term memory (see Table 2.6).

**Table 2.6:** Types of memory.

Memory Store	Definition	Ability	Duration of Stored Memories
<b>Sensory Memory</b>	Very brief memory that permits the brain to retain sensory information after the original stimulus has ceased	Can carry an unlimited amount of information	Milliseconds, up to a second
<b>Working Memory</b>	A dedicated memory store information temporarily, also it is the place where the complicated cognitive tasks occur.	Can carry a very limited amount of information	15–30 seconds
<b>Long-term Memory</b>	Memory that can store and recall information over a long period	Can carry an unlimited amount of information	From a few minutes to several, or for a lifetime

As shown in the table, sensory memory saves an unlimited amount of information and directs and briefly focuses attention on relevant details. The information that is focused on is sent to the working memory and is temporarily stored, but it is lost if the learner does not actively repeat or does not provide in such a way that the learner can remember.

Attieh [64] revealed that infographics involve the processing and fragmentation of information for very small steps, which are probably in the form of pictures, images, arrows or fixed texts. They are explicitly supported by one of the basic principles of information processing theory—namely, the thesaurus concept and its relationship to short-term memory capacity. Thesaurus is the process of dividing information into small units or parts called thesauri, which include numbers, letters, pictures and images.

Short-term memory is limited in capacity and can only maintain a number (9–5) of information thesauri. This capacity can be increased, and the process of remembering can be expedited by using information thesaurus.

Thus, infographics adopt the theory of information processing by focusing on the principle of the information thesaurus, where information is divided into small units and parts.

## **2.11 Teaching and Learning Process**

Teaching is a complicated and multidimensional process that demands deep understanding and knowledge in an extensive range of areas, as well as the ability to merge, synthesise and apply this knowledge in different statuses, under varying conditions and with a broad range of individuals and groups. As Hollins [65] stated, in quality teaching, this knowledge is applied in ways that provide opportunities and equitable access to expand what learners previously knew to simplify the ability to construct, obtain and create new knowledge [66].

Fenstermacher and Richardson [66] defined successful teaching as ‘teaching that yields the intended learning’ and good teaching as ‘teaching that comports with morally defensible and rationally sound principles of instructional practice’. For Hénard and Roseveare [67], quality teaching means employing educational techniques to produce learning outcomes for learners and students, that involves the effective planning of the course content and using feedback, effective assessment of learning results and student support services. Several factors affect teachers’ quality of teaching, including their personality, beliefs, values that motivate them and their preparation for the teaching profession.

It is a widely held view that teachers are the linchpin in education in all types. Kindergarten teachers introduce young minds to the basic tools of learning, which students will use throughout their life. Instil a passion for academia in teenagers consider as a challenge for middle school teachers as their minds are largely concentrated on their social life. Teachers in high schools are charged with educating intellectual content to near-adults students whose worlds are often tumultuous. University professors are charged with inspiring adults and teaching them the nuts-and-bolts of technical content. Thus, many teachers contribute to shaping how an individual comprehends the world and their place within it. Idris *et al.* [68] believed that teachers are invaluable resources that countries count upon to nurture and develop young minds. They are at the heart of the educational operation. Further, da Luz [69] considered that educational programs are successfully performed by managing and organising learning environments and experiences.

However, despite the growing consensus on teachers’ importance, there are several debates about how and why they are important and how they should be prepared, recruited and retained in teaching [70]. Over the past two decades, the issue of teachers’ preparation and education has received much attention from education experts’ who want to improve learning outcomes for students in light of their important role in the implementation of educational policies in all philosophies. In addition, teachers play a major role in building civilisations to influence the education process, because learners interact with them and acquire experiences, knowledge and

values through these interactions. Darling-Hammond, Chung and Frelow [71] stated that preparation makes a difference in teachers' practice, entry, effectiveness and retention in teaching. According to Katitia [72], 'teacher education is ostensibly designed, developed and administered to produce school teachers for the established system of education'. Loughran [73] examined teachers' education as pre-service and in-service teacher preparation where the (new learning) teachers seek to improve teaching knowledge and skills, and also learn applying them competently in practice.

Preparation is a continuous process; it is characterised by permanence and does not end with graduation from university or college. Where teacher's preparation intended to provide special courses for the development of skills, trends and information necessary to help learners perform their duties. Some researchers who have investigated the importance of teachers' preparation have concluded that preparation gives teachers knowledge and experience and helps them face many challenges. Additionally, teachers will be able to understand, avoid burnout and find and apply successful benchmarks for student achievement. Education is considered the driving force for social development. Thus, in this thesis, teachers' education is deemed to include the pre-service and in-service training and education of all those participating in the dissemination of knowledge at all levels of education to expose them to new practices and ideas that continuously develop their capability to educate. Improved ability to educate is a significant factor in sustainable development.

Various teacher preparation programs have been designed for both undergraduate and graduate students to become licensed teachers. These programs give students specialised coursework in subjects at the grade level at which they are interested in teaching, and they contain a practical teaching experience, which is required in most regions for licensing.

To teach others, one needs to be prepared and educated and possessed a spacious background of cultural training that offers a wide liberal education and learning. Working as an expert demands practical abilities and knowledge to work in complex states. Isopahkala-Bouret [74] stated that teachers require self-confidence to perform their duties in urgent and unique cases, and they must execute their expertise in such a way that their stakeholders, customers and colleagues trust them. They need research-informed, research-based knowledge, and they must be open to evaluating and acquiring local evidence [75].

## **2.12 Tools used to Identify the Impact of Infographic Technology in Education**

Bicen and Beheshti [32] sought awareness of opportunities for infographics to cater to education, and they investigated students' perceptions of infographics in their learning process. Yildirim [18] presented the views of learners who read infographics for educational purposes and discussed the

place of infographics among learning preferences. Alshehri and Ebaid [49] developed an instructional design model to teach mathematics at elementary schools using interactive infographics to explore their effectiveness. Rueda [76] agreed that technology opens new opportunities to plan and implement various teaching strategies in virtual environments to enable the efficient development of competence in students. Therefore, universities face the challenge of implementing innovative technological tools in the education process to facilitate the assimilation and use of knowledge. Ayub *et al.* [77] discussed the effectiveness of using two different types of computer technology on the achievement of students in calculus. Specifically, the study discussed the effectiveness of SAGE software, MACCC and the traditional tutorial approach on the achievement of diploma students in the topic under discussion. Most authors use statistical tools for analysis such as analysis of variance (ANOVA) and t-test.

In this study, the collected quantitative data are analysed using the Statistical Package for the Social Sciences (SPSS) program, version 23. Calculations are based on an independent sample t-test to evaluate the statistically significant differences in teachers' awareness and skill levels regarding infographic technology in relation to their years of experience. ANOVA is employed to understand the statistically significant differences in teachers' awareness and skill levels in relation to their academic qualification. Moreover, standard deviation and arithmetic means are employed to identify the awareness and skill levels of teachers at the School of Engineering, Computer and Mathematical Sciences at AUT regarding the concept of infographic technology. Scheffe's test has been employed to identify the difference between the variables.

The key points from section 2.11 literature review are summarised in Table 2.7, which shows some tools used in identifying the impact of the infographic in learning

**Table 2.7:** Summary of the tools used in identifying the impact of the infographic in learning.

Tools	Significance
SAGE software	This mathematics software has the ability to perform symbolic, algebraic, and numerical computations.
MACCC	This tutoring courseware was developed to help students to master difficult concepts in calculus.
(SPSS) program	This statistical analysis and data management software can help researchers process critical and complex data (analyze, manipulate, transform, and produce a characteristic pattern between several data variables) in simple steps.

## **2.13 Summary**

This chapter discussed the main areas related to the research topic and its subpoints, which are infographic technology, infographic technology in education, awareness and skills in infographic technology, and teaching and learning processes. Technology is such an integral part of the twenty-first-century workplace that has come to reshape the world in all parts of human effort with its stronghold in the offer of instruction for all.

Educators are fundamental in providing instruction for all who have to be prepared professionally to teach, extemporise and integrate technologies into the model of education. Thus, they need to be trained to use modern technology, such as infographic technology, inside the classroom.

Many studies have explored the effect of infographic technology on students' achievements, with most strongly supporting using the technology in the teaching process because of its benefits for both teachers and students. They found that infographic technology helps students to build their own ideas and find their own answers to their questions. Teachers should be given preparation and training to instil abilities related to using infographic technology for mindfulness. If educators are mindful and aware of the technology, they will have the capacity to control their students for the future. The next chapter discusses the research methodology used in this study.

# Chapter 3

## Research Methodology

### 3.1 Introduction

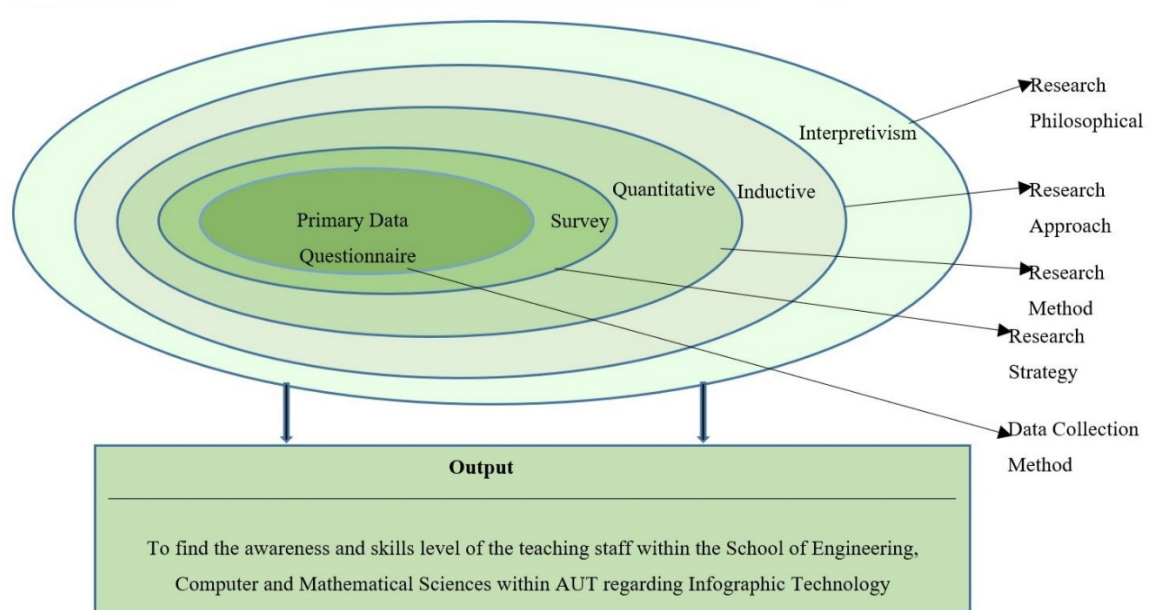
To gain a deeper understanding of the research problem, Chapter 2 presents a literature review on infographic technology and infographics and their importance in education. The chapter also discusses awareness and skill levels in infographic technology and the teaching process, as well as the architecture, components and design theory of infographic technology.

This section details the research methodology used to identify the awareness and skill levels of teaching staff at the School of Engineering, Computer and Mathematical Sciences at AUT regarding infographic technology. Section 3.2 outlines the process followed by the current research and discusses the research approach and the justification of the chosen methodology. Section 3.4 presents the research methods and the justification of the research method. Section 3.5 explains the research sample size and scope. Section 3.6 describes the statistical methods used to analyse the primary data collected from the target sample. Section 3.7 outlines the ethical considerations, and Section 3.8 summarises the chapter.

### 3.2 Research Process

This study adopted the ‘modified onion’ of Saunders, Lewis and Thornhill [78] because the research process consists of a range of paradigms, steps and strategies. The several layers of the onion serve as a foundation from which to consider the research philosophy, the research approach adopted, suitable research strategies and data collection methods employed by the researcher.

Figure 3.1 shows the ‘modified onion’ process used in the current research to obtain quantitative analysis/findings and the final output of this study. The initial phase is research philosophy, which is the problem and objectives of this study, as outlined in Chapter 1. To quantify the outcome, an inductive approach was adopted. A survey questionnaire was distributed through the SurveyMonkey platform to collect research data for this study.



**Figure 3.1:** Modified onion process.

Table 3.1 briefly explain the elements that listed in the modified onion process (Figure 3.1) as below:

**Table 3.1:** Description of the modified onion process elements.

Phases	Elements	Description
Research Philosophical	Interpretivism	Depending on the type of knowledge being investigated in the research, interpretivism philosophy was chosen for the current research.
Research Approach	Inductive	One type of research approach was chosen in this research, which is the inductive approach.
Research Method	Quantitative	This research adopts the quantitative technique as a method of research.
Research Strategy	Survey	The researcher has carried out the research by conducting the survey.
Data Collection Method	Primary Data/ Questionnaire	The type of data collected for the current research is primary data, derived from the respondents in the survey questionnaire.

### 3.3 Research Approach

Researchers often use two research approaches: deductive and inductive. The deductive approach starts with the more general and ends with the more specific. Zalaghi and Khazaei [79] referred to the deductive research as a top-down approach that works from a theory to postulate data to contradict or add to the theory. In this approach, the researcher studies what others have done, reads present theories and then tests hypotheses that are produced from those theories [80]. In



contrast, the inductive approach moves from specific observations to wider theories and generalisations. The inductive approach is a bottom-up approach that uses participants' visions to build broader themes and create a theory that interconnects them [81]. In this approach, the researcher seeks patterns in the data and works to develop a theory that demonstrates those patterns [80]. In addition, exploration is a characteristic of the inductive approach particularly at the beginning. However, the deductive approach is more narrow and is interested in supporting or examining hypotheses. The inductive approach has been adopted for this research.

### **3.3.1 Justification for the research approach**

The inductive approach is associated more with the interpretivism philosophy. For example, interpretism is better when interpreting awareness and skill levels in teaching with infographic technology. The above approach permits the researchers providing subjective reasoning with different real-life examples [80], whereas the deductive approach is connected with the positivism philosophy [81], that includes hypotheses used to confirm assumptions [77]. Collecting and analysing valid, adequate and delicate data contributes to the success of a research project, which is substantial for both the deductive and inductive approaches. The inductive approach is chosen for ongoing research because it enables the researcher to review and analyse the data via interpretism, and pertinent literature supports its use for exploring the awareness and skill levels of the teaching staff at the School of Engineering, Computer and Mathematical Sciences, as well as their use of infographic technology. In this research, the inductive approach was considered more appropriate because the objectives of the research were to identify the awareness and skill levels, which helped to create right and clear connections between the current study purposes and the synopsis findings derived from the raw data. This type of research method not only involves collecting and tabulating facts, but it also includes appropriate analyses, comparisons, interpretation and identification of trends and relationships.

## **3.4 Research Method**

Research methods are the methods/techniques applied to conduct research. Two research methods or approaches—namely, qualitative and quantitative—are used to conduct research [82]. For obtaining a comprehension of underlying views, reasons, and motivations, qualitative research method is ideal to use. Where through the qualitative method insight into particular issues or developing hypotheses/ideas can offer for potential quantitative research. Additionally, it can benefit from that method in revealing trends in intellect and opinions, also in diving deeper into the problems. Fossey *et al.* [83] revealed that the objective of the qualitative research that managing questions interested in improving the meaning and humans' lives and social worlds experience understanding. Data collection methods in qualitative research use two techniques, unstructured or semi-structured techniques. Common methods include diary accounts, focus groups, interviews and participation/observations.

Quantitative methods assert objective measurements and data statistical analysis that is gathered via questionnaires or by manipulating pre-existing data using computational methods. That quantitative method concentrates on collecting and generalising numerical data and exhibiting the view of a relationship between theory and research as deductive, or to explain a phenomenon that can be expressed in terms of quantity. There are four types of quantitative research are descriptive, correlational, comparative/quasi-experimental and experimental researches [84]. The purpose of using descriptive research is to describe the present situations of a specified variable. Where the correlational research use when a study seeks to define the scope of a relationship between two or more variables using statistical data. A cause-and-effect connection between independent and dependent variables in very controlled conditions is considered via the experimental research. Participants are randomly assigned to the specific group or the control group. Quasi-experimental research examines cause-and-effect relationships between or among independent and dependent variables. However, participants are not assigned randomly.

Several researchers have used both qualitative and quantitative approaches, which include gathering, analysing and clarifying both quantitative and qualitative data in a single or group of concatenation studies that discuss the same underlying phenomenon [85]. This study provides systematic information from collected data about the awareness and skill levels of the teaching staff of infographic technology, and it attempts to determine the extent of the relationship between variables using statistical data. Thus, the quantitative method using a survey questionnaire (with modified onion methodology) was selected for a better understanding of the research issue.

#### **3.4.1 Justification of research method**

This research aimed to explore the awareness and skill levels of the teaching staff at the School of Engineering, Computer and Mathematical Sciences at AUT regarding infographic technology, as well as their actual use of infographic technology. The quantitative method with a survey questionnaire was selected because it was appropriate for achieving the aims of the study for the following reasons:

- This study used the statistical approach to measure participants' awareness and skill levels. Specific scales (i.e., the Likert scale) were assigned to all responses. The data collected were numeric and enabled data to be collected from all sample sizes.
- The inductive method is better for plotting results in charts, graphs, tables and other formats for better interpretation to understand the data.
- Numerical data may be viewed as more meaningful in quantitative analysis.
- The survey questionnaire method has been successfully used in other similar research. For example, Amutha and Kennedy [52] distributed a survey questionnaire

containing closed-ended questions to 91 student teachers in a college of education to collect similar data to that obtained in the current research [52].

### 3.5 Survey Sample Size and Scope

The researcher collected survey data from 20 participants from the School of Engineering, Computer and Mathematical Sciences at the AUT city campus through the SurveyMonkey platform. Given the research scope, the sample size is 20. Due to the time constraints and a limited number of the respondents' respondent to the survey that the researcher sent through the Survey Monkey, the researcher conducted the study according to available data.

This study was implemented according to the following steps:

- Ethical approval was sought before conducting the study.
- The survey questions were prepared.
- The pilot test was conducted.
- Twenty teachers from the School of Engineering, Computer and Mathematical Sciences at AUT comprised the study sample.
- The questionnaire was distributed through SurveyMonkey, and the responses were compiled and analysed to achieve the research goal.
- Data were entered into SPSS to conduct the analysis.
- The researcher drew conclusions and discussed them.
- Draw conclusions and discuss them.

### 3.6 Tools for This Study

To achieve the objectives of this study, statistical methods were chosen (e.g., mean, standard deviation, independent t-test, ANOVA and Scheffe test) using statistical software like SPSS, which used for rational batched and non-batched statistical analyses, produced by SPSS and obtained by IBM. Mean and standard deviation are popular statistical methods used to identify the variance. To validate the findings t-test, ANOVA and Scheffe test were employed. A t-test finds the significant difference between the means of two groups, but not among the groups. Therefore, ANOVA was conducted to estimate the variation among and between the groups. A Scheffe test was used to identify whether the differences occurred between the groups. The statistical methods used were:

- **Percentage:** used to describe the characteristics of the sample and identify individual responses towards the questionnaire sections.

- **Mean:** used to arrange quantifications according to the importance of the study results.
- **Standard deviation:** used to measure variability to illustrate the dispersion of sample responses.
- **Independent t-test:** also called the student's t-test, two sample t-test or independent samples t-test, used to find differences of statistical significance according to the bilateral study. It is applied to compare the means of two variables:
  - The t-test was used in this research to achieve two research objectives—namely, discovering whether there are any statistically significant differences in either the awareness or skill levels of teachers concerning infographic technology using the variable of years of experience. Teachers' years of experience were divided into two groups (1–9 years) and (10 years and more). For the first objective, the t-test compared teachers' awareness values and their years of experience. In the second objective, the t-test compared teachers' skill values and their years of experience.
- **One-way ANOVA:** to find differences in statistical significance according to the multilateral study and more:
  - One-way ANOVA was used in this research to achieve two of the research objectives—namely, discovering whether there are any statistically significant differences in either the awareness or skill levels of teachers concerning infographic technology using the variable of academic qualification. Teachers' academic qualification was divided into four groups: bachelor's degree, master's degree, PhD and other. For the first objective, the one-way ANOVA compared the teachers' awareness values and their academic qualification. In the second objective, the one-way ANOVA compared teachers' skill values and their academic qualification.
- **Scheffe test:** to determine the trends of differences between variables (if there are any differences) in the ANOVA test, as this test uses just with the ANOVA test.

### 3.7 Ethical Considerations

The survey to collect data for the current research was approved by the AUT Ethics Committee (Ethics Application Number 17/193). Ethical considerations in the ethics application involved the research title and summary, the research instruments and the applicant's information under the project information section. The primary researcher provided general information such as name, qualifications and contact details. The application also consisted of partnership, participation and protection sections to ensure that the study implemented the principle of participation and protection in the interaction between the researcher and other participants. Further, it contained sections regarding the respect for participants' right to privacy and confidentiality. The minimisation of risk section debates risks that participants, researchers and AUT may face. The

ethical form also addressed copyright matters for literary materials and documents used in the research as secondary resources. The researcher also properly referenced and cited the resources and data used in the study. A copy of the ethical approval attached at Appendix **B**.

### **3.8 Summary**

This chapter discussed the research methodology for the research framework, including research approaches, research methods and statistical methods that were used to analyse the data. The research study involved distributing a survey questionnaire to the teaching staff at the School of Engineering, Computer and Mathematical Sciences at AUT regarding infographic technology. The data collected from the sample were analysed using several statistical techniques, and the results are outlined in Chapter 5. Further, using data collected via the survey questionnaire with the teaching staff, the awareness and skill levels regarding infographic technology were explored. Chapter 4 discusses the research design and the survey description.

# Chapter 4

## Research Design

### 4.1 Introduction

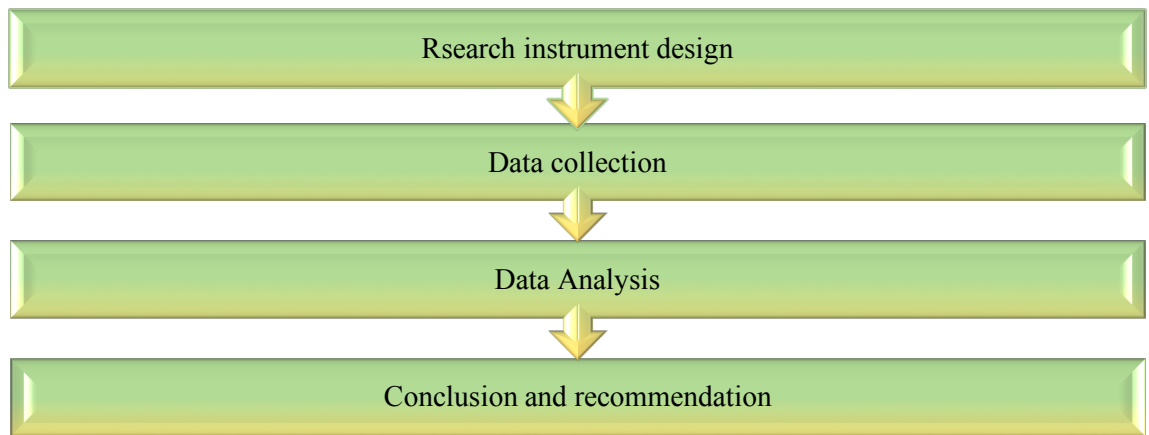
Chapter 3 presented a detailed discussion of the research method. This chapter discusses the research design and describes the survey. Section 4.2 describes the research design, including data collection methods, study tool preparation, description of the research questionnaire and the validity and reliability of the questionnaire. Section 4.3 describes the survey, and Section 4.4 summarises the chapter.

This study sought to explore the awareness and skill levels of teaching staff at the School of Engineering, Computer and Mathematical Sciences regarding infographic technology. To achieve this goal, an online survey was sent to teaching staff at the school. The researcher gathered survey data from 20 teaching staff. This sample size was selected because it was deemed appropriate to provide the information required.

The questionnaire, which included closed-ended questions, was carefully prepared to help guide the research in a steady direction. The data for this study approach were collected using the quantitative method, which uses one source (in this case, the online survey). The design and content of the survey questionnaire generally included closed-ended questions. However, the first question in the demographic questions contained an ‘Other’ field that prompted participants to provide answers other than those offered as the question choices.

### 4.2 Research Design

A research design is an overall plan for conducting a research study [86]. It guides a researcher to plan, perform and monitor the study, and it is beneficial in clarifying the instruments used for collecting data for the research. Common research methods are derived from experiments, online surveys, discussions, observations and case studies. Given that the quantitative (inductive approach) research method is used for ongoing research, it is imperative to obtain pertinent and precise data from the survey. Using the quantitative research strategy enabled the student researcher to gather data from several available data resources, such as survey questionnaires distributed among the teaching staff at the School of Engineering, Computer and Mathematical Sciences. Figure 4.1 illustrates the steps in the research design. In this chapter, the first two phases are discussed, and the other two steps are discussed in the next chapter.



**Figure 4.1:** Research design.

#### **4.2.1 Research instrument design**

A study tool is the tool that the researcher uses to collect the required information. In this study, the questionnaire is the study tool. Abawi [87] defined a questionnaire as a data collection instrument consisting of a series of questions and other prompts for gathering information from respondents. It is also known as a document that consists of questions and other items designed to solicit appropriate information for analysis [88]. Questionnaires are used in survey research, experiments and other modes of observation. The questions, which can be in a closed or open format, scaled questions or in pictures, are firmly constructed to obtain answers associated with the chosen variables for analysis. When questionnaires are ready to distribute, they are given to respondents either in hard copy form, in an email or via a face-to-face interview. The researcher chose the questionnaire as a data collection instrument because:

7. there was a lack of required information related to the study at AUT
8. the information could be collected within a short period and in a cost-effective way
9. it was quick and easy to quantify the outcomes of the questionnaire
10. quantified data could be used to compare and observe the desired goal.

In this research, the desired goal was to measure the awareness of AUT's teaching staff regarding the concept of infographic technology and their skill level in using that technology. Hence, the questionnaire as a study tool was required. During the identification and selection of the study tool, the researcher considered that the questionnaire had to be designed to cover each objective and question of the study according to the available possibilities and the period specified.

### **a. Questionnaire description**

The questionnaire was constructed using the following steps:

1. Review scientific journals and previous studies that discussed the awareness of a concept to identify the questions related to the research objective.
2. Design questions based on the concept of infographic technology and what skills teachers require to use and produce infographics.

While identifying the pattern of the questionnaire, the questions were divided into two sections:

Section one aimed to collect the demographic data, which contains the level of educational qualification. Figure 4.2 provides an example of the demographic questions in the survey.

**Q1 Your Educational Qualification:**

☐ Bachelor's degree

☐ Master's degree

☐ Ph.D.

☐ Other (please specify)

**Figure 4.2:** An example of the questions in part one of the survey.

Section 2 aimed to measure the awareness level of the teaching staff at the School of Engineering, Computer and Mathematical Sciences regarding the concept of infographics and their skill level. The questionnaire consisted of six questions with 32 different quantifications distributed into two subsections. These quantifications are presented in Appendix A.

Figure 4.3 shows an example of one question in section two of the survey.



1) Analysis and study skills:  
Your degree of usage of the following skills:

	High	Intermediate	Low	I do not use it
Clearly analyze objectives and formulate them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Analysis and identification of educational needs through analysis of reality and desirable and the difference between them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Analysis of educational content into micro modules.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Figure 4.3:** An example of the questions in part two of the survey.

### ***b. Validity and reliability of the questionnaire***

Since pilot tests are beneficial in detecting problems or issues that might arise during research, this research conducted a pilot test. Before initiating the distribution of the final version of the questionnaire through SurveyMonkey, it was tested by teaching staff in a pilot test to ensure that the questionnaire was clear and understandable. The start and end times to answer the questions were around 15–20 minutes. The initial questionnaire was sent to several teaching staff at the School of Engineering, Computer and Mathematical Sciences at AUT to participate in the pilot test. When the respondents finished, the researcher asked them if they had understood each question and its choices. The researcher received some comments to improve the survey questionnaire, which are as follows:

1. Providing a definition of infographic technology so the participants can have general information about the technology.
2. Using Likert scale with more specific differences such as weak, low, medium and high.
3. Adding more options so the participants can have a variety of choices.
4. About the section 3 (production skill) in the second part of the survey which study (the degree of having infographic skills), a suggestion to add more types of programs rather than limiting them to Adobe products were provided.
5. Improving the invitation message.

### **4.2.2 Data collection procedure**

The dataset used in this study was collected by the researcher via SurveyMonkey and was based on a questionnaire that was developed based on a literature review. The questionnaire was

distributed to the teaching staff at the School of Engineering, Computer and Mathematical Sciences at AUT because of its focus on infographic technology adaptation and usage at AUT. The collected data would help to identify the awareness and skill levels in infographic technology for the targeted domain.

### 4.3 Survey Description

The previous section mentioned two main questions that were used as the basis for the data collection. The questionnaire used for the online survey consisted of two sections, as follows.

**Section one:** initial data that state: years of experience and qualification of the participants.

**1) Your Educational Qualification:**

Bachelor's degree

Master's degree

PhD

Other.....

**2) Years of Experience:**

1–9 years

10 years and more

**Section 2:** the awareness level of the teaching staff at the School of Engineering, Computer and Mathematical Sciences regarding the concept of infographic technology and their skill level.

The final version of the questionnaire formed 32 quantifications distributed into two subsections:

**First subsection:** This subsection examined awareness of the concept of infographic technology and consisted of 12 quantifications. The measures used for the first axis were Agree—Disagree—I do not know, where the following grades were given: 1 = right for the correct answer, 0 = wrong for the wrong and I do not know answers. Additionally, the triple Likert scale was used for the first section, with the scales Low—Medium—High, as described below:

- The awareness of the teaching staff was measured on a triple Likert scale (Low, Medium and High).
- The weighted average was produced from the scores 0 and 1, as follows:
  1. Step 1: subtracting the highest number of the lowest number where the highest is 1 and the lowest is 0 statistically.

2. Step 2: finding the arithmetic average by dividing the highest by a total number of scales, which are Low, Medium and High. Therefore, the mean distance between the scale is 0.33. For example, in measuring awareness:

$$P = \frac{1}{N} \dots \dots \dots (1)$$

$$P = \frac{1}{3} = 0.33 \dots \dots \dots (2)$$

Where, N = number of occurrences.

The smallest number and distance is the first low interval of 0.0–0.33, medium is 0.34–0.67 and the highest interval is 0.67–1. Table 4.1 shows that if the average value is between 0 and 0.33, the degree of possession of the skill is low. If the average value is between 0.34 and –0.67, the degree of possession of the skill is medium. If the average value is between 0.67 and 1, the degree of possession of the skill is high. Table 4.1 shows the triple Likert scale measurement for this study.

**Table 4.1:** Triple point Likert scale.

Opinion	Weighted Average
Low	0-0.33
Medium	0.34-0.67
High	0.67-1

The quantifications/questions were adapted from previous studies. The references for this questionnaire are attached to Appendix A. The quantification of the first subsection is below:

1. Infographic is the process of transforming complex data, information and concepts into photos and drawings.
2. Infographic is visual representations of data, information or knowledge.
3. Infographic aims to provide complex information in an in-depth manner.
4. Infographic integrates images and graphics for the purpose of revealing information, patterns or trends.
5. There is no difference between the significance of infographics and mind maps. They have the same meaning.
6. Infographic is a process that helps the educational process in providing the curriculum in a new and interesting manner.
7. Only a few specialised persons can read infographics.
8. Infographic is an effective tool for exchanging messages and expectations.

9. It is difficult to publish and spread infographics through social networks for technical reasons.
10. An advantage of infographics is that it helps to keep the information for a longer time.
11. Infographic can be used in different fields like guidance, counselling, instruction and education.
12. Social networks contain many examples of infographics.

**Second subsection:** This subsection examined the level of teachers' possession of skills regarding infographic technology and consists of 22 quantifications. The measures used for this section were High—Medium—Low. There was another grade added—'I do not know'—because some may not have understood or wanted to reveal this information. The following grades were given: 4 for the high answer, 3 for the medium answer, 2 for the low answer and 1 for the 'I do not know' answer. A four-point Likert scale was used in this section, taking into account that the scales used in the study were as follows: High—Medium—Low—Weak:

- The possession of skills among the teaching staff measured on a four-point Likert scale were High—Medium—Low—Weak.
- The weighted average would be produced from the scores 1, 2, 3 and 4, as follows:

To develop the range in the Likert scale, the range of numbers needed to be identified. The range of a set of numbers is the highest number minus the lowest number:

1. First: Subtract the lowest number from the highest number:  $4 - 1 = 3$ .
2. Second: Divide the result (3) by the number of options used for measuring the skill level (4):  $3/4 = 0.75$ . Thus, the mean distance between periods is 0.75.
3. The first period is 1–1.75.

Table 4.2 shows the four-point Likert scale, which starts explaining the skills in the ranges: from weak, low, medium and high.

**Table 4.2:** Four-point Likert scale.

Weight	Opinion	Weighted Average
1	Weak	1-1.75
2	Low	1.76- 2.51
3	Medium	2.52-3.27
4	High	3.28-4

Where:

If the average value is between 1 and 1.75, the degree of possession of the skill is weak.

If the average value is between 1.76 and 2.5, the degree of possession of the skill is low.

If the average value is between 2.52 and 3.27, the degree of possession of the skill is medium.

If the average value is between 3.28 and 4, the degree of possession of the skill is high.

The second subsection consisted of three parts. The first part attempted to discover the degree of usage of some analysis and study skills, which are given below with a similar number as the questionnaire to keep it readable:

1. Clearly analyse objectives and formulate them.
2. Analysis and identification of educational needs through analysis of reality and desirable and the difference between them.
3. Analysis of educational content into micromodules.

The second part attempted to discover the degree of usage of some design skills and laws, which are:

1. **Closure law:** Closed or semi-enclosed figures are easier to understand than opened or missing figures. That is, the whole or closed objects are more fixed than the missing or open ones because the latter tend to complement themselves.
2. **Law of continuity:** Continuous figures in one direction are more easily understood than figures that are periodically interrupted. That is, elements that are placed to appear as a straight line or a curve or in their contiguity together are subject to a particular concept shall be organised cognitively and formulate a certain set (one formula).
3. **Law of similarity:** The collecting of similar figures in an integrated unit of cognition by similar characteristics such as colour, size or shape to make it easier to recognise.
4. **Multimedia rule:** Students learn by words and figures better than they learn by words only.
5. **Spatial alignment rule:** students better learn when words and images are displayed together than from words by themselves.
6. **Rule of management:** Students learn better when exotic words, images and sounds are hidden than when displayed in the presentation.

7. **Hierarchy of information:** Information is organised into groups that are gradually related to each other.
8. **Attention:** Increase attention by using unusual colours.
9. **Achievement of the movement element:** Repeating different colour grades achieves the movement element.
10. **Achieving the lighting element:** Colour gradient achieves lighting element.
11. **Search skill:** Use search engines (e.g., Google, Yahoo) to reach the largest number of data and information.
12. **Configuration skills:** Use of software (e.g., Excel, PowerPoint, Word and other programs) that is available on the internet or on computers to help build coordinated and organised content.
13. **Composing content skill:** Composition of content in a way that makes it easily represented visually.
14. **Separation:** Helping learners to distinguish and recognise the shape through the contrast between the figure and the ground (background).
15. **Skill of revision:** To ensure the validity of the drawings used and their integration, and to ensure that they are free of spelling errors.

The last part of the questionnaire aimed to measure teachers' production skills. It is important for teachers to have the ability to produce effective graphics and use design programs to help them in the teaching process. Using visual elements has become more common in the learning process [89] because of its benefits in supporting students' learning. Using graphics improves students' engagement, problem-solving skills and outcomes [90]. Thus, it was important to study teachers' production skills by using design programs in this research because it can affect the design of the infographics. This part contained four choices of different programs:

- design programs such as Adobe Illustrator and Adobe Photoshop.
- Adobe After Effects or Motion program
- Inkscape
- Tableau.

The researcher chose these programs because they are the most popular of the design programs.

#### 4.4 Summary

The research attempted to explore the awareness and skill levels of teaching staff at the School of Engineering, Computer and Mathematical Sciences regarding infographic technology. To

investigate and analyse the findings, this study employed a questionnaire as a research tool. For analysis, a Likert scale was introduced with a range of 3 for the first section and 4 for the second section of the questionnaire. The research design and survey description were detailed in this chapter. The research analysis and findings are presented in Chapter 5.

# Chapter 5

## Research Finding and Analysis

### 5.1 Introduction

Chapter 4 presented a detailed description of the study design. This chapter presents the findings of the research, which are presented using tables and figures. The tabular representation of the data collected, along with their implications, are followed by descriptive analyses of the results. The results have been interpreted to achieve the goals of this study. One of the main goals was to identify the level of awareness among teachers at the School of Engineering, Computer and Mathematical Sciences at AUT regarding the concept of infographic technology. Standard deviation and mean analysis were conducted to achieve this goal. To achieve this main goal, two other questions needed to be answered:

- Are there any statistically significant differences in the awareness level of teachers concerning infographic technology relating to the variable of years of experience? For this question, a t-test was conducted because only two variables were used.
- Are there any statistically significant differences in the awareness level of teachers concerning infographic technology relating to the variable of academic qualification? For this question, ANOVA was conducted because it had three variables.

The second main goal was to identify the level of skills possessed by these teachers regarding infographic technology. In this section, mean and standard deviation were applied. To satisfy this goal, two other questions needed to be answered:

- Are there any statistically significant differences in the level of skills possessed by teachers concerning infographic technology relating to the variable of years of experience? A t-test was conducted for this question.
- Are there any statistically significant differences in the level of skills possessed by teachers concerning infographic technology relating to the variable of academic qualification? An ANOVA test was conducted for this question.

### 5.2 Research Findings

Twenty completed questionnaires were received from teachers at the School of Engineering, Computer and Mathematical Sciences at AUT. It was practical to conduct this study with these



teachers because the researcher studied at that school and could access and gather all teaching staff emails.

Two demographic questions were asked in the survey regarding the teachers' educational qualification and their years of teaching experience. The researcher believes in the importance of asking questions to obtain information about the characteristics of the measurable teacher, such as their degrees and grades in standard tests to measure their competence in general or their abilities in certain aspects, which can help in gaining accurate information in this type of research. The student researcher sought to obtain information related to teachers' educational qualification and years of teaching experience, which were considered to have a potentially strong influence on the level of awareness and skills of the teaching staff regarding the concept of infographic technology.

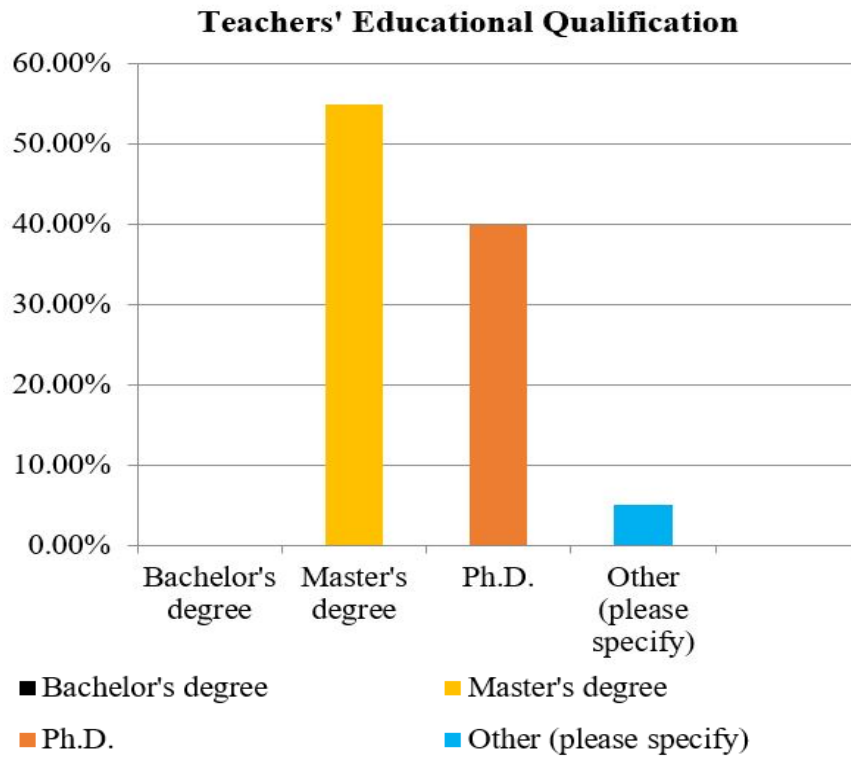
This section discusses the findings based on education level and years of experience and analyses the awareness of the teachers in infographic technology.

### **5.2.1 Education level of teachers**

The first demographic question aimed to find the type of educational qualification held by the faculty teachers. Teachers' qualifications that are deemed to be related to their ability to use technologies have become targets of education reform. Some researchers believe that 'higher qualifications lead to higher quality teachers with an ability to understand and use technologies'. This study explored whether there is a relationship between teachers' qualification and their level of awareness and skills of infographic technology.

Figure 5.1 outlines the participants' education level, which included bachelor's degree, master's degree and PhD. An 'Other' choice was provided for teachers with different qualifications, and the participants could specify their educational qualification.

Table 5.1: Educational qualification. shows that all 20 respondents answered the question. As shown, most respondents (11) held a master's degree. Eight teachers held a PhD and one participant chose the 'Other' option, specifying that they held a 'bachelor's degree (Hons)', 'BSc (Hons)' and 'PhD degree'.



**Figure 5.1:** Educational qualification.

**Table 5.1:** Educational qualification.

Answer Choices	Responses Rate (%)	Number of People
Bachelor's degree	0	0
Master's degree	55	11
Ph.D.	40	8
Other (please specify)	5	1
Number of respondent answer the questions		20

### 5.2.2 Years of experience of a teacher

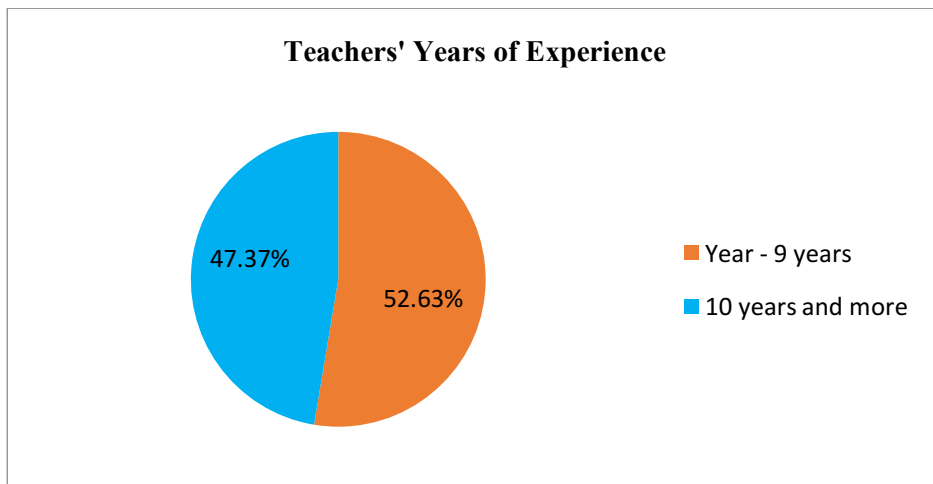
The second demographic question aimed to find the number of years of experience of the teachers. Table 5.2 illustrates the percentage of the years of experience. Of the 20 respondents, one missed the question, while 19 answered. This shows that the data collection was conducted efficiently.

The survey results show that most teachers (52.63%) at the school have served in the field of teaching for 1–9 years and most of the rest (47.37%) have taught for 10 or more years (see Figure 5.2). The questionnaire had no specific target to identify the number of teaching years for each

respondent, while a base finding of the length of teaching experience may be involved with infographic awareness and skills.

**Table 5.2:** Years of experience.

Answer Choices	Responses Rate (%)	Number of People
1 to 9 years	52.63	10
10 years and more	47.37	9
Number of respondent		19
Missed		1



**Figure 5.2:** Years of experience.

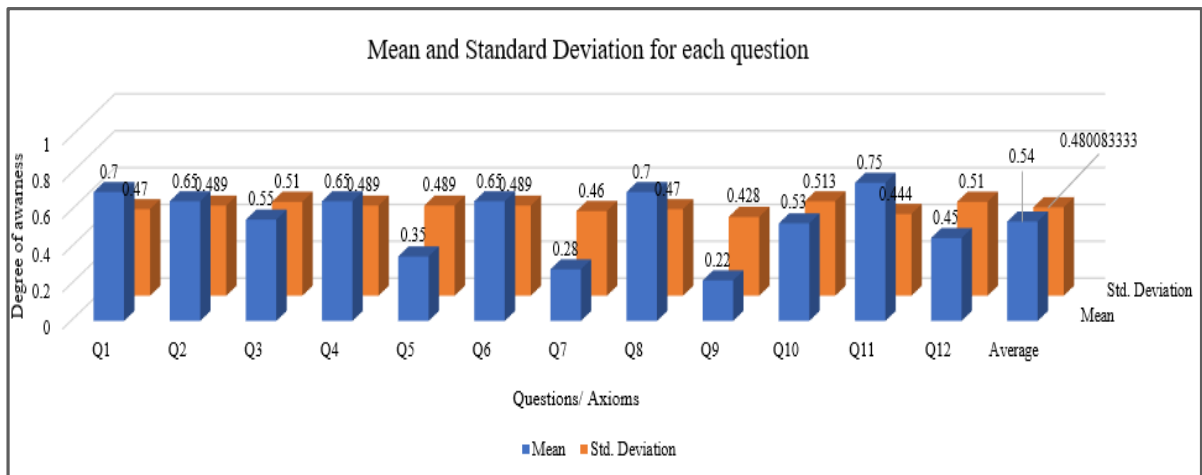
In education, teachers' years of experience is probably the key factor in personnel policies to improve the quality of education. The underlying assumption is that the number of experience years promotes effectiveness and teachers do better as they gain experience. In addition, assumption says that experienced teachers more effective in raising student achievement than their less experienced counterparts, also they strengthen education in other ways. But is this really the case? Do teachers gain more technology skills when they spend more years in the educational field? that's what will discover and find by analyzing the rest of the current research survey results.

### 5.2.3 Finding awareness of infographic technology based on mean and standard deviation

The first research question asked: What is the level of awareness of teachers at the School of Engineering, Computer and Mathematical Sciences at AUT regarding the concept of infographic technology?

The first section examined awareness of the infographic technology (see Figure 5.3). A mean of 0.67–1 is considered high, a mean of 0.34–0.67 is considered medium and a mean that is less than

or equal to 0.33 is considered low (see Section 4.3). The bar chart in Figure 5.3 shows that the highest mean is 0.75 (scored by quantification number 11) and the highest standard deviation is 0.51 for quantification numbers 3, 10 and 12, while the lowest mean is 0.22 (scored by quantification number 9) and the lowest standard deviation is 0.42 for quantification number 9. This analysis shows that most of the quantifications derived from this question are closely related, because none of them scored less than 0.22 in mean and 0.42 in standard deviation. This means that most of the question was understandable to the participants at least medium in average, as the average mean is 0.54 and the average standard deviation is 0.48, which validates the Likert scale rule.



**Figure 5.3:** Awareness of the infographic technology.

Table 5.3 explains the rank based on mean and standard deviation. The highest mean was expected to be 1, but none of them reached that level. Therefore, a Likert scale was required to clarify the range of rank between highest (0.67–1), medium (0.34–0.67) and lowest (0–0.33). Table 5.3 also displays the level of awareness among the teaching staff of infographic technology. Based on the answers to this question, the level of awareness based on the Likert scale is medium, whereby the general mean is 0.54 and the general standard deviation is 0.027.

The degree of awareness varied between high, medium and low. However, most achieved at least a medium level, with six quantifications obtaining the medium level. The ranks for the 12 quantifications are described from 1 to 9 because some of the quantifications obtained the same mean and standard deviation. Most quantifications obtained either high or medium, except for quantification numbers 5, 7 and 9, which are at the low level.

**Table 5.3:** Results of the teachers' awareness level at the School of Engineering, Computer and Mathematical Sciences at AUT regarding the concept of infographic technology.

Serial no.	Quantifications	Mean	Std Dev.	Awareness Average (Likert scale)	Rank
1	Infographic is the process of transforming complex data, information and concepts into photos and drawings.	0.7	0.47	High	2
2	Infographic is visual representations of data, information or knowledge.	0.65	0.489	Medium	3
3	Infographic aims to provide complex information in an in-depth manner.	0.55	0.51	Medium	4
4	Infographic integrates images and graphics for the purpose of revealing information, patterns or trends.	0.65	0.489	Medium	3
5	There is no difference between the significance of infographic and mind maps, they have the same meaning.	0.35	0.489	Low	7
6	Infographic is process that helps the educational process in providing the curriculum in a new and interesting manner.	0.65	0.489	Medium	3
7	Only few specialized persons can read infographic.	0.28	0.46	Low	8
8	Infographic is an effective tool for exchanging messages and expectations between teachers and students.	0.7	0.47	High	2
9	It is difficult to publish and spread the infographic through social networks for technical reasons.	0.22	0.428	Low	9
10	An advantage of infographic helps to keep the information for longer time.	0.53	0.513	Medium	5
11	Infographic can be used in different fields like guidance, counseling, instruction and education.	0.75	0.444	High	1
12	Social networks contain many examples of infographic.	0.45	0.51	Medium	6
<b>Average Mean and Standard Deviation</b>		<b>0.54</b>	<b>0.480083</b>		

- Quantification numbers 2, 4 and 6 are ranked third:
  - Quantification number 2: 'Infographic is a visual representation of data, information or knowledge', with mean 0.65 and standard deviation 0.489.
  - Quantification number 4: 'Infographic integrates images and graphics for the purpose of revealing information', with mean 0.65 and standard deviation 0.489.

3. Quantification number 6: ‘Infographic is a process that helps the educational process in providing the curriculum in a new and interesting manner’, with mean 0.65 and standard deviation 0.489.
- The fourth rank is quantification number 3, which states: ‘Infographic aims to provide complex information in an in-depth manner’, with mean 0.55 and standard deviation 0.510.
  - The fifth rank is quantification number 10, which states: ‘An advantage of infographic helps to keep the information for a longer time’, with mean 0.53 and standard deviation 0.513.
  - The sixth rank is quantification number 12, which states: ‘Social networks contain many examples of infographic’, with mean 0.45, and standard deviation 0.510.

Three quantifications gained a high level of awareness:

- The first rank is quantification number 11, which states that: ‘Infographic can be used in different fields like guidance, counselling, instruction, and education’, with mean 0.75 and standard deviation 0.444.
- The second rank is quantification numbers 1 and 8, which state that:
  1. ‘Infographic is the process of transforming complex data, information, and concepts into photos and drawings’, with mean 0.70 and standard deviation 0.470.
  2. ‘Infographic is an effective tool for exchanging messages and expectations between teachers and students’, with mean 0.70 and standard deviation 0.470.

#### **5.2.4 Findings the awareness level in infographic technology based on t-test**

The second research question asked: Are there any statistically significant differences in the awareness level of teachers concerning infographic technology relating to the variable of years of experience?

An independent t-test was applied to determine whether any statistically significant differences exist in the level of awareness among teaching staff at the School of Engineering, Computer and Mathematical Sciences at AUT regarding infographic technology relating to the variable of years of experience. The t-test is a special type of ANOVA that can be used when there are only two populations to compare. Table 5.4 shows that the Sig. P of the t-test is a null hypothesis and that the difference between the two responses measured are 0 on the same statistical unit.

The standard benchmark is:

$$P\text{-value} \leq \alpha \quad (1)$$

Where  $\alpha \geq 0.05$ .

Table 5.4 shows that the years of experience were divided into two groups: 1–9 years (10 participants) and 10 years or more (nine participants). From the table, it is obvious that there were statistically significant differences in the awareness levels of teaching staff regarding the concept of infographic technology relating to the variable of years of experience, where the P value < 0.001, which means that  $P < 0.05$ . These differences are in favour of the teachers (participant's teaching experience in years) who has obtained the higher arithmetic mean, which they are the participants whose teaching experience is 1–9 years with mean = 10.30 and standard deviation = 0.67. Thus, the awareness level of the concept of infographics was higher among teachers with 1–9 years of experience compared with teachers with 10 years or more experience.

**Table 5.4:** Differences between the averages of teachers' level of awareness regarding the concept of infographic technology in relation to their years of experience by using a t-test.

Group	Number	Mean	Std Dev.	t	Sig. (P)	Comment
1–9 years	10	10.30	0.67	6.975	0.000	<b>There is a difference</b>
10 years and more	9	2.78	3.34			

### 5.2.5 Finding the awareness level in infographic technology using an ANOVA test

Are there any statistically significant differences in the awareness level of teachers concerning infographic technology relating to the variable of academic qualification? To avoid receiving an error when more than two variables were involved, a one-way ANOVA test was used to answer this question.

Table 5.5 shows the results of the one-way ANOVA test and examines whether there are differences between the averages of teachers' awareness level of the concept of infographic technology relating to the academic qualification variable. The table describes the source of variation in the first column. Because not all means of the different groups are the same (between group) or is it because not all values within each group are the same (within groups)? the sum of squares column shows the sum of the squares of the deviations from the means. The term 'df' refers to degrees of freedom. Mean square is a type of average deviation and is produced by dividing the variation by the degrees of freedom F is an F variable, which is the amount that gained from the ratio of the variance calculated among the sample and the variance within the samples. Finally, the comment column states whether there is a difference.



**Table 5.5:** One-way ANOVA test for differences between the averages of teachers' awareness level of the concept of infographic technology relating to their academic qualification.

Source	Sum of Squares	df	Mean Square	F	Sig.	Comment
<b>Between Groups</b>	342.177	2	171.088	46.444	0.000	<b>There is a difference</b>
<b>Within Groups</b>	62.623	17	3.684			
<b>Total</b>	404.800	19				

A deeper analysis of Table 5.5 shows that there were statistically significant differences between the averages of the teachers' awareness level regarding infographic technology because of the academic qualification variable, as specified by the one-way ANOVA test ( $P\text{-value} \leq \alpha$ ,  $\alpha \geq 0.05$ ). The significance value ( $P$ ) = 0.000, which means  $P\text{-value} < 0.001$ , which is below 0.05. However, it is not clear which of the specific groups differed. To find this, a post-hoc test (Scheffe test) was used, as shown below.

**Table 5.6:** Comparisons between the averages of the educational qualification categories using the Scheffe test.

Qualification	Mean Difference	Master's degree	Ph.D.	Other
<b>Master's degree</b>	10.09	-	7.66*	10.09*
<b>Ph.D.</b>	2.43	-7.66*	-	2.43
<b>Other</b>	0.00	-10.09*	-2.43	-

\*There are statistical differences.

Scheffe Test in Table 5.6 above has detected statistically significant differences between teachers who have Master's degree and Ph.D. for the favor who have the Master's degree. Another statistically significant difference existed between teachers who have Master's degree and who have other qualifications for the favor who they have the Master's degree. In other words, teachers who hold the "Master's degree" qualification are more likely to be aware of the infographic technology than teachers who hold the Ph.D. and any others qualification.

### 5.2.6 Finding the skill level in infographic technology based on the mean and standard deviation

What is the skill level of teaching staff at the School of Engineering, Computer and Mathematical Sciences at AUT regarding infographic technology? This question examined the levels of three types of skills among teachers who have to be infographic designers. These skills include analysis and study skills, design skills and production skills. Arithmetic mean, standard deviation and rank were used to answer this question in terms of analysis and study skills, design skills and production skills, as outlined in Tables 5.7–5.9.

### a. Analysis and Study Skills

**Table 5.7** explains the teaching staffs' levels of analysis and study skills. The responses to the quantifications of the first part of the question show that the level of analysis and study skills was medium in general. The general arithmetic mean of 2.57 is considered medium according to the Likert scale used for the second part. Two quantifications in the table received the medium level and one quantification received the low level. The order is as follows:

1. The first rank is quantification number 1, which states: 'Clearly analyse objectives and formulate them', with mean 2.80, which means that teachers have a medium ability to analyse and formulate objectives, and the standard deviation is 1.005.
2. The second rank is quantification number 2, which states: 'Analysis and identification of educational needs through analysis of reality and desirable and the difference between them', with mean 2.70, which means that teachers have a medium level of analysing and identifying educational needs by analysing the reality and the desirable, and the standard deviation is 0.923.
3. The third rank is quantification number 3, which states: 'Analysis of educational content into micro modules', with mean 2.20, which means that teachers have a low level of analysing educational content into micromodules, and the standard deviation is 1.152.

**Table 5.7:** Degree of having infographic skills, analysis and study skills.

Serial Numbers	Quantification	Mean	Std Dev.	Degree Possession of Skills	Rank
1	Clearly analyze objectives and formulate them.	2.80	1.005	Medium	1
2	Analysis and identification of educational needs through analysis of reality and desirable and the difference between them.	2.70	0.923	Medium	2
3	Analysis of educational content into micro modules.	2.20	1.152	Low	3
Average Mean and Standard Deviation		2.57	1.02	Medium	

### b. Design Skills

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Table 5.8 illustrates the teachers' level of design skills. As shown, the level of design skills among teaching staff was medium. The general arithmetic mean was 2.77, which is considered medium according to the Likert scale applied for the second axis.

The teachers' level of design skills varied most between medium and low according to their answers to the quantifications given to measure the skill. However, one quantification or skill attained the high level (quantification number 14); thus, this was determined as the most skilful among the design skills possessed by the teachers. The skill rankings are as follows:

- The first rank is quantification number 14, which states: 'Search Skill: Use search engines like (Google, Yahoo) to reach the largest number of data and information', with mean 3.40, which shows that the teachers have a high level of search skill using search engines, with the standard deviation 0.940.

**Table 5.8:** Degree of having infographic skills, design skills.

Serial Numbers	Quantification	Mean	Std Dev.	Degree Possession of Skills	Rank
4	Closure Law	2.45	1.099	Low	10
5	The Law of Continuity	2.35	1.039	Low	12
6	The Law of Similarity	3.05	1.099	Medium	3
7	Multi-Media Rule	2.80	1.196	Medium	7
8	Spatial Alignment Rule	2.85	1.089	Medium	6
9	Rule of Managements	2.60	1.095	Medium	9
10	Hierarchy of Information	2.90	1.071	Medium	5
11	Attention	2.65	1.182	Medium	8
12	Achievement of the Movement element	2.37	1.116	Low	11
13	Achieving Lighting Element	2.25	1.118	Low	13
14	Search Skill	3.40	0.940	High	1
15	Configuration Skills	3.25	1.118	Medium	2
16	Composing Content Skill	2.95	1.177	Medium	4
17	Separation	2.65	1.182	Medium	8
18	Skill of Revision	3.05	1.276	Medium	3
<b>Average Mean and Standard Deviation</b>		<b>2.77</b>	<b>1.119</b>	<b>Medium</b>	

The lowest skills possessed by teachers are as follows:

- The tenth rank is quantification number 4, which states: ‘Closure law: Closed or semi-enclosed figures are easier to understand than opened or missing figures. That is, the whole or closed objects are more fixed than the missing or open ones because the latter tend to complement themselves’, with mean 2.45, which means that teachers’ level of using the closure law is low, and the standard deviation is 1.099.
- The eleventh rank is quantification number 2, which states: ‘Achievement of the movement element: repeating different colour grades achieves the movement element’, with mean 2.37, which means that teachers’ level of using the achievement of the movement element rule is low, and the standard deviation is 1.116.
- The twelfth rank is quantification number 5, which states: ‘The law of continuity: The continuous figures in one direction are more easily understood than figures that are periodically interrupted. That is, elements those are placed to appear as a straight line or a curve or in their contiguity together are subject to a particular concept shall be organised cognitively and formulate a certain set (one formula)’, with mean 2.35, which means that teachers’ level of using the law of continuity is low, and the standard deviation is 1.039.
- The thirteenth rank is quantification number 13, which states: ‘Achieving Lighting Element: Colour gradient achieves lighting element’, with mean 2.25, which means that teachers’ level of using the achieving lighting element role is low, and the standard deviation is 1.118.

The rest of the quantifications or skills (numbers 6–11 and 15–18) receive the medium level.

### **c. Production Skills**

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Table 5.9 reveals the teachers’ level of production skills, which is considered low. The general arithmetic mean of the table quantifications is 2.77, which is considered low according to the Likert scales used for the second axis. One quantification received the medium level, two achieved the low level and one obtained the weak level. The skill rankings are as follows:

- The first rank is quantification number 19, which states: ‘Design programs Adobe Illustrator or Adobe Photoshop’, with mean 2.55, which shows that the teachers’ level of knowing or using the design programs Adobe Illustrator and Adobe Photoshop is medium, and the standard deviation is 1.050.

- The second rank is quantification number 20, which states: ‘Adobe After Effects or Motion program’, with mean 1.95, which shows that the teachers’ level of knowing or using Adobe After Effects or Motion program is low, and the standard deviation is 0.999.
- The third rank is quantification number 22, which is ‘Tableau’, with mean 1.67, which shows that teachers’ level of knowing or using the Tableau tool is low, and the standard deviation is 1.029.
- The fourth rank is quantification number 21, which is ‘Inkscape’, with mean 1.39, which shows that the teachers’ level of knowing or using the Inkscape tool is weak, and the standard deviation is 0.916.

**Table 5.9:** Degree of having infographic skills, production skills.

Serial Numbers	Quantifications	Mean	Std Dev.	Degree Possession of Skills	Rank
19	Design programs Adobe Illustrator or Adobe Photoshop.	2.55	1.050	Medium	1
20	Adobe after effects or motion program.	1.95	0.999	Low	2
21	Inkscape.	1.39	0.916	weak	4
22	Tableau	1.67	1.029	Low	3
<b>Average Mean and Standard Deviation</b>		<b>1.89</b>	<b>0.9985</b>	<b>Low</b>	

### 5.2.7 Findings of skill level in infographic technology based on t-test

Are there statistically significant differences in the level of skills among teachers regarding infographic technology relating to years of experience? An independent t-test was conducted to answer this question.

Table 5.10 shows that there were statistically significant differences in the level of skills among the teachers regarding infographic technology relating to the variable of years of experience, where the significance value ( $P$ ) = 0.000, mean ( $P$ -value < 0.001), which means  $P < 0.05$ . These differences favoured those who obtained the higher arithmetic mean—that is, participants with 1–9 years of teaching experience, with mean = 69.50 and standard deviation = 6.22. Thus, the level of infographic technology skills among teachers who have taught for 1–9 years is higher than for teachers with teaching experience of 10 years or more.

**Table 5.10:** Differences between the average level of teachers’ possession of skills regarding infographic technology relating to their years of experience by using a t-test.

Group	Number of Participants	Mean	Std Dev.	t	Sig.	Comment
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<b>1–9 years</b>	10	69.50	6.22	5.003	0.000	<b>There is difference</b>
<b>10 years and more</b>	9	45.11	13.97			

### 5.2.8 Findings skill level in infographic technology based on the ANOVA test

Are there statistically significant differences in the level of skills among teachers regarding infographic technology relating to the variable of academic qualification?

Table 5.11 shows the output of the one-way ANOVA analysis and whether there were statistically significant differences in the level of skills among teachers relating to the variable of academic qualification. It can be seen that the significance value (P) = 0.000, which means that P value < 0.001, which is below 0.05.

**Table 5.11:** One-way ANOVA test for the differences between the averages in the level of skills among teachers regarding infographic technology relating to their qualification variable.

Source	Sum of Squares	df	Mean Square	F	Sig.	Comment
<b>Between Groups</b>	4338.966	2	2169.483	24.806	0.000	<b>There is a difference</b>
<b>Within Groups</b>	1486.784	17	87.458			
<b>Total</b>	5825.750	19				

Therefore, there were statistically significant differences in the level of the teachers' skills they possess about the infographic technology due to the variable of academic qualification. To explore which of the specific groups differed, post hoc tests (Scheffe Test) were used as below.

Table 5.12 depicts the Scheffe test, which revealed statistically significant differences between the three groups (master's degree, PhD and Other) favoured those who had a master's degree. In other words, teachers who hold a 'master's degree' are more likely to possess the infographic technology skills than teachers who hold a PhD or any other qualification.

**Table 5.12:** Comparisons between the averages of the educational qualification categories by Scheffe Test.

Qualification	Mean Difference	Master's degree	Ph.D.	Other
<b>Master's degree</b>	69.1	-	24.23*	43.59*
<b>Ph.D.</b>	44.8	-24.23*	-	19.36*
<b>Other</b>	25.5	-43.59*	-19.36*	-

\*There are statistical differences.

### 5.3 Discussion

To identify the awareness level of teachers regarding infographic technology, this research used the average mean and standard deviation. Depending on the average mean and standard deviation of the quantification, the teachers' awareness level of infographic technology was medium. Thus, the results of this question agreed with the findings in [91], indicating that teachers need training that focuses on achieving better practical skills for information technology and communication. Further, existing training for teachers does not adequately support, create and use information (static text/graphical) and communication technology (ICT) in student education. The present study has identified that most teachers understand and have a good knowledge of the meaning and definition of infographics. Additionally, they understand the fields in which infographics can be introduced. However, a couple of factors can affect the level of awareness among teachers regarding the concept of infographics:

- There is a lack of training courses for teachers on how to use infographics in education.
- Several studies have considered the importance of using infographic technology in the education sector for students' performance and achievements. However, few or no studies have examined how to train teachers and educate them about using this technology and developing their skills.

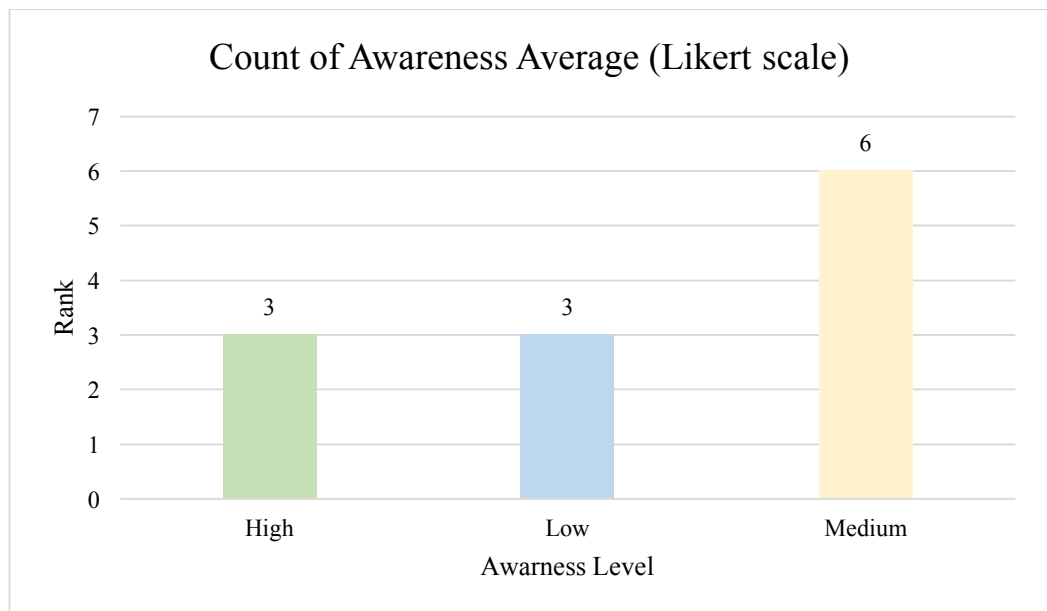
This study used a t-test to identify statistically significant differences in the awareness level of teachers concerning infographic technology relating to the variable of years of experience. A t-test was also used to identify statistically significant differences in the level of skills among teachers relating to years of experience. The findings showed that teachers who served in education for 1–9 years possessed more knowledge than teachers who taught for 10 years or more. Thus, younger teachers tend to make better use of technology and technological devices than older teachers because they can adjust faster to technological changes and they feel comfortable with new releases of software and hardware. This theory is supported by [92], which examined what and how teachers learn from their older and younger colleagues. The study indicated that young and new teachers learn ICT knowledge and skills and use software to develop lesson materials such as presentations and digital learning environments, as well as using technology devices for educational purposes.

This study used one-way ANOVA and the Scheffe test to identify statistically significant differences in the awareness level of teachers concerning infographic technology relating to the variable of academic qualification. One-way ANOVA and the Scheffe test were also used to identify statistically significant differences in the level of skills possessed by teachers relating to the variable of academic qualification. The analysis revealed that there are statistically significant

differences between the averages of teachers' awareness levels regarding infographic technology due to the academic qualification variable. The Scheffe test was conducted to discover which of the specific groups differed. The results showed that teachers with a master's degree better understood the concept of infographic technology than those with a PhD or 'Other' qualification. This result might be because teachers who hold a master's degree improve their skills and knowledge. Additionally, completing their studies might contribute to developing their professional abilities renewing the information they hold.

To identify the level of skill possessed by teachers, this research used mean and standard deviation tests. The analysis revealed that the teachers' overall infographics skill level was low. Although some of their infographic skills were medium, such as design skills and analysis and study skills, their degree of skill was low in general. This indicates the need to provide training courses for teachers to employ these skills in the use of infographics, and to acquire skills that they do not have. This is consistent with [16], which pointed out that teachers' education should include infographics training to a large extent. The authors also suggested several ways to teach teachers infographics skills, such as supporting and extending existing computer courses to include infographics rather than creating new courses specifically for infographics.

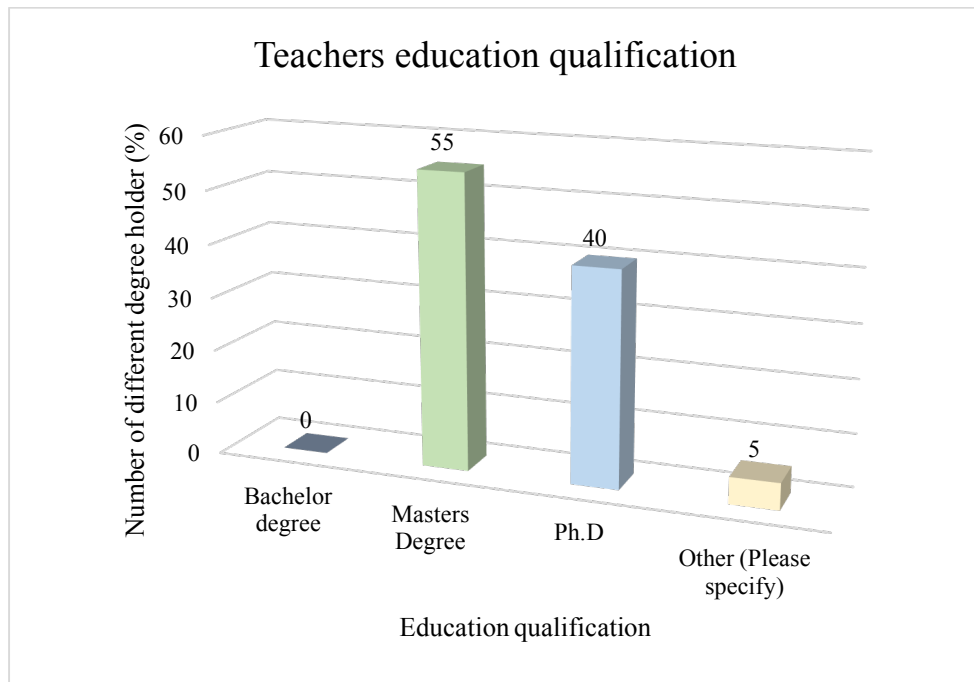
This study concludes that the average awareness level of teachers regarding infographic technology is medium (Figure 5.4).



**Figure 5.4:** Average awareness is medium overall.

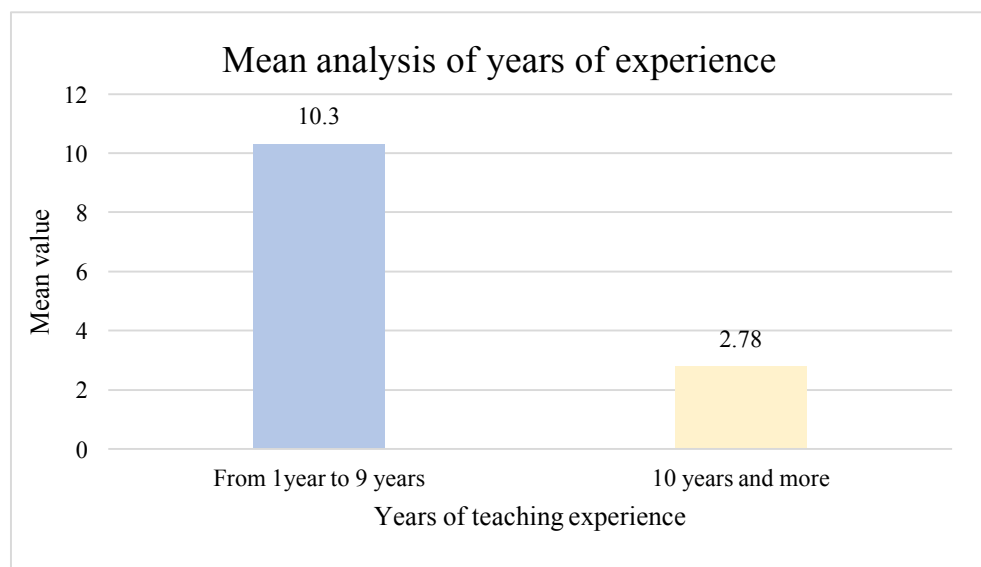
Surprisingly, the research found that most of the participants in this study held a master's degree. This could mean that younger teachers are interested in infographic research, or perhaps the targeted respondents were mostly holders of master's degrees (see Figure 5.5).





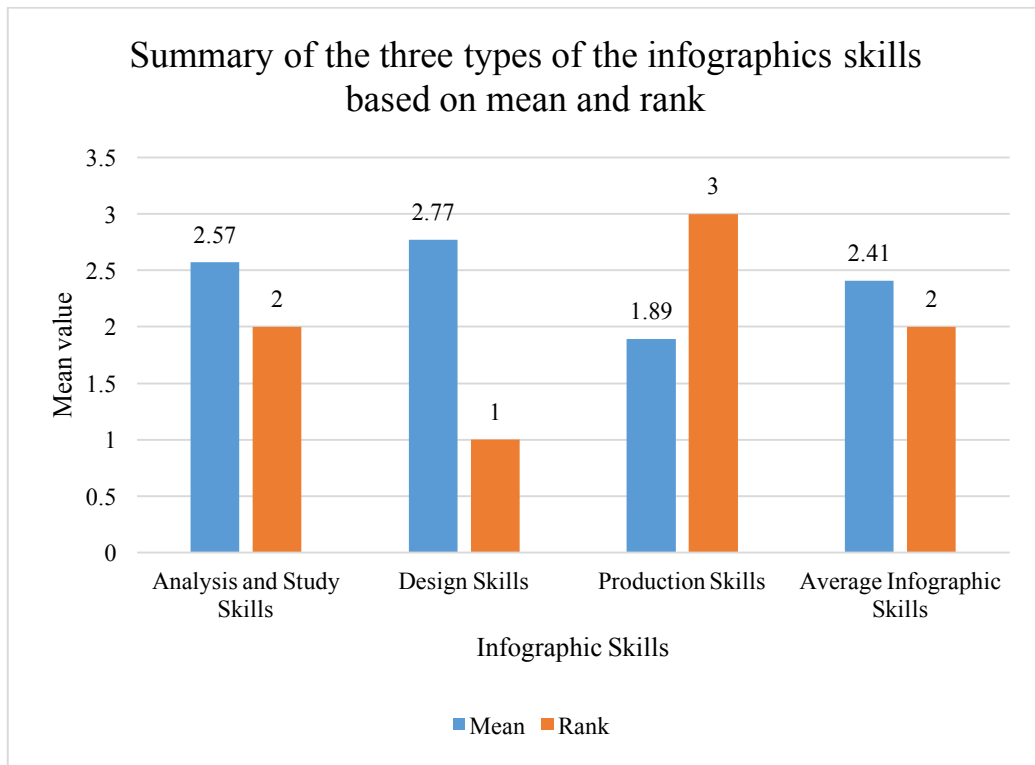
**Figure 5.5:** Education qualification of the participants.

The mean analysis reveals that a smaller number of years of teaching experience have more knowledge about infographic technology (see Figure 5.6).



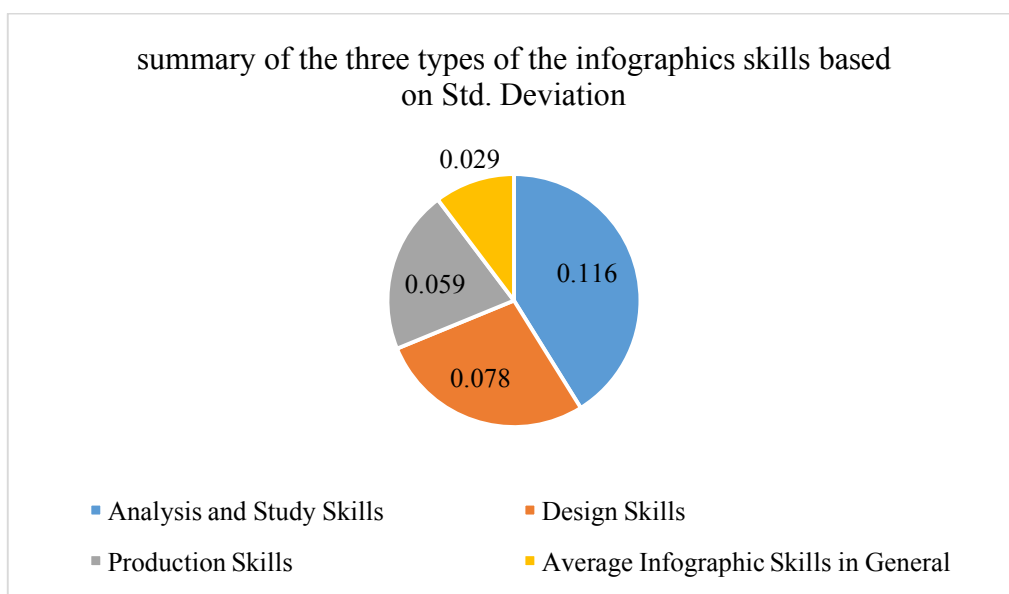
**Figure 5.6:** Years of experience for the participants.

Figure 5.7 summarises the three types of infographics based on mean analysis and rank. It can be concluded that the skill level of teachers regarding infographic technology is low. The mean of all skills together was 2.41, which is considered low according to the Likert scales used. The highest-ranking infographic skill possessed by teachers was design skills, with mean 2.7.



**Figure 5.7:** Summary of the three types of the infographic skills based on mean and rank.

**Figure 5.8** below justifies the findings from Figure 5.7, which used standard deviation to identify three types of infographic skills. The design skills came first with mean 2.77 (see Figure 5.7) and standard deviation 0.078, followed by analysis and study skills, which came second, with mean 2.57 (see Figure 5.7) and standard deviation 0.116. Production skills came third, with mean 1.89 (see Figure 5.7) and standard deviation 0.059.



**Figure 5.8:** Summary of the three types of infographic's skills based on standard deviation (in ratio 1).

## 5.4 Summary

This chapter provided information on the findings made during the research. The questions posed in the survey questionnaire were designed to determine the issues of this research regarding the level of awareness and skills among teachers at the School of Engineering, Computer and Mathematical Sciences at AUT regarding the concept of infographic technology. In addition, it aimed to determine whether there are any statistically significant differences in the awareness and skill levels of teachers concerning infographic technology relating to the variables of years of experience and academic qualification.

This study used the quantitative method as the research method and the survey questionnaire as the data collection method. The findings of the research extracted from the survey questionnaire analysis were presented in this chapter in the form of tables and figures. Descriptive analyses were used to explain and support the tables and figures that represented the data gathered, as well as some of their implications. The results show that the level of awareness among teaching staff regarding the concept of infographic technology is medium, based on the Likert scale. Further, the level of skill possessed by teachers regarding infographic technology is low, also based on the Likert scale.

The findings show that there are statistically significant differences in the awareness and skill level of teachers concerning the concept of infographic technology relating to the variable of years of experience. This was in favour of teachers who taught for 1–9 years, which means that these teachers had a greater understanding of infographic technology than teachers who had 10 years or more of experience. Further, there are statistically significant differences between the averages of teachers' awareness and skill levels regarding infographic technology relating to the variable of academic qualification. This shows that teachers who hold a master's degree qualification are more likely to be aware of, and possess skills relating to, infographic technology than teachers who hold a PhD or 'Other' qualification.

Chapter 6 summarises and concludes the research and draws upon the research analysis and findings to make recommendations for future research.

# Chapter 6

## Conclusion, Recommendations, and Future Work

### 6.1 Summary and Conclusion

This chapter presents the conclusion of this study as well as recommendations and suggestions for future work. Although the technology is advanced and education institutions are adapting it, there is still a need to know how the technology will affect teachers' teaching experience, knowledge, awareness and skills. It is hoped that this study will benefit practitioners, researchers and policymakers in developing better learning environments for learners of the digital age.

Although the term 'infographic' may appear to be new, infographics have been practised for a few decades. However, adaptation in modern education is rapidly growing, which brought the topic to the attention of the researcher. Infographic technology is a new milestone in teaching that enables teachers to present audio and visual elements together. In short, an infographic is defined as information that is presented as a static or dynamic graph. In general, the human body can accept input through the eyes and ears when learning. In traditional teaching, students learn by listening and occasionally from handwriting on the teaching board. When infographic technology is applied, learners use their eyes and ear together; thus, learning seems twice as fast. However, the literature review showed that the human brain can process information 40 times faster when information is presented using infographic technology.

For this study, it was assumed that students should have the knowledge to understand the educational context by infographics, the teachers also can present the instructional information by infographics. The focus of this study was to explore the awareness and skill levels of the teaching staff at the School of Engineering, Computer and Mathematical Sciences at AUT regarding infographic technology. The research identified the influence of years of teaching experience and teaching qualifications on teachers' awareness and skill levels when using infographic technology.

The researcher adopted the inductive approach and the quantitative method with a survey questionnaire as the method and data collection tool for this research to obtain a better understanding of the study's issues. The research showed that the teaching staff have a medium

level of awareness of the concept of infographic technology, but a low level of skills to use the technology.

Regarding statistical differences between the variables, the findings showed that there are statistically significant differences in the teaching staffs' awareness and skill levels regarding the concept of infographic technology relating to the variable of years of experience. Teachers who have 1–9 years of teaching experience are more aware and possess higher infographic skills than those who have been teaching for 10 years or more. Moreover, there are statistically significant differences between the teachers' awareness and skill levels regarding infographic technology relating to their academic qualification. Teachers who hold a master's degree qualification are more likely to be aware and possess skills relating to infographic technology than those who hold a PhD or any other qualification.

## **6.2 Limitations of the Study**

This study focused only on teachers at the School of Engineering, Computer and Mathematical Sciences at AUT regarding the use of infographic technology. Further, it identified only the awareness and skill levels of these teachers regarding the use of infographic technology. Therefore, the outcomes might not be generalizable to the other teaching staff into the other faculties.

## **6.3 Recommendations and Future Works**

Literature reviewed for this study has suggested that Teachers ought to be prepared and more aware to instill abilities regarding using infographic technology, also using the infographic technology in education has a positive impact for both teachers and learners. In addition, The survey findings for this research proposed that regarding the awareness of the infographic, teachers have got a medium level, and low skills level to use the technology. Hence, the following recommendations are made to improve the teaching staff awareness and skills of the infographic technology:

- Raising the awareness of the teaching staff at the School of Engineering, Computer and Mathematical Sciences within AUT in particular and all teachers in general to the concept of the infographic through workshops and seminars.
- This study recommends conducting similar research using a larger sample, such as all teachers at AUT.
- Holding training courses for teachers on the skills of analysis, design and production related to the infographic technology.

- Holding training courses for teachers to train them on how to recruit the infographic while teaching.
- Activate the participation between teachers and education experts in the development and production of the infographic technology in education.

In future, this research might be replicated using participants from different faculties and universities. Further, the awareness and skill levels of teachers should be studied and compared before and after the teachers have received training in infographic technology. In order to identify exactly where the teachers' weaknesses to be focused on and developed. In addition, it would be beneficial to obtain students' feedback about involving infographic technology in their learning sessions.

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# Appendix A

## Survey Questions

The survey question has been generated by support of some literature which are [7], [18], [93], [60], [45], [94], [3], [19], [95], [21], [96], [97], [98], [99], [100] and [101].

### **Part one:**

#### 1) Your Educational Qualification:

Bachelor's degree

Master's degree

Ph.D.

Other.....

#### 2) Years of Experience:

Year - 9 years

10 years and more

**Part two:**

Please put (√) in the column which expresses your opinion:

**First theme: knowing the concept of Infographic:**

<b>Serial no.</b>	<b>Quantification</b>	<b>I agree</b>	<b>I do not agree</b>	<b>I do not know</b>
1	Infographic is the process of transforming complex data, information and concepts into photos and drawings.			
2	Infographic is visual representations of data, information or knowledge.			
3	Infographic aims to provide complex information in an in-depth manner.			
4	Infographic integrates images and graphics for the purpose of revealing information, patterns or trends.			
5	There is no difference between the significance of infographic and mind maps, they have the same meaning.			
6	Infographic is process that helps the educational process in providing the curriculum in a new and interesting manner.			
7	Only few specialized persons can read infographic.			
8	Infographic is an effective tool for exchanging messages and expectations between teachers and students.			
9	It is difficult to publish and spread the infographic through social networks for technical reasons.			
10	An advantage of infographic helps to keep the information for longer time.			
11	Infographic can be used in different fields like guidance, counseling, instruction and education.			
12	Social networks contain many examples of infographic.			

**Second theme: degree of having infographic skills:**

Serial #	Quantification	degree of usage:			
		High	low	Intermediate	I do not use it
<b>Analysis and Study Skills:</b>					
<b>Degree of usage of the following skills:</b>					
1	Clearly analyze objectives and formulate them.				
2	Analysis and identification of educational needs through analysis of reality and desirable and the difference between them.				
3	Analysis of educational content into micro modules.				
<b>Design Skills:</b>					
<b>Your degree of usage of the following skills and laws:</b>					
4	<b>Closure law:</b> Closed or semi-enclosed figures are easier to understand than opened or missing figures. That is, the whole or closed objects are more fixed than the missing or open ones because the latter tend to complement themselves.				
5	<b>The law of continuity:</b> The continuous figures in one direction are more easily understood than figures that are periodically interrupted. That is, elements those are placed to appear as a straight line or a curve or in their contiguity together are subject to a particular concept shall be organized cognitively and formulate a certain set (one formula).				
6	<b>The law of similarity:</b> the collecting of similar figures in an integrated unit of cognition by the similar characteristic like color, size or shape to make it easier to recognize.				
7	<b>Multi-media rule:</b> students learn by words and figures better than they learn by words only.				
8	<b>Spatial alignment rule:</b> Students better learn when words and images are displayed more closely aligned than when they are displayed spaced apart on the page or screen.				
9	<b>Rule of managements:</b> Students learn better when exotic words, images and sounds are hidden than what they when displayed in the presentation.				

10	<b>Hierarchy of information:</b> Information is organized in groups that are gradually related to each other			
11	<b>Attention:</b> Increase attention by using unusual colors.			
12	<b>Achievement of the movement element:</b> repeating different color grades achieves the movement element.			
13	<b>Achieving lighting element:</b> Color gradient achieves lighting element.			
14	<b>Search Skill:</b> Use search engines like (Google, Yahoo, AltaVista) to reach the largest number of data and information			
15	<b>Configuration skills:</b> Usage of free software available either on the Internet or on your computer such as Excel, PowerPoint, Word and other programs that help to build a coordinated and organized content.			
16	<b>Composing content skill:</b> composition of content in a way make it easily represented visually.			
17	<b>Separation:</b> Helping the learner to distinguish and recognize the shape through the contrast between figure and ground (background)			
18	<b>Skill of revision:</b> to ensure the validity of the drawings used and their integration and that they are free of spelling errors.			
<b>Production Skill:</b>				
<b>Degree of usage of the following programs:</b>				
19	Design programs Adobe Illustrator or Adobe Photoshop.			
20	Adobe after effects or motion program.			
21	Inkscape.			
22	Tableau			



# Appendix B

## Ethical Approval Document

Nurul Sarkar  
Faculty of Design and Creative Technologies

Dear Nurul

Re Ethics Application: **17/193 Teaching staff awareness and use of Infographic Technology in the School of Engineering, Computer and Mathematical Sciences**

Thank you for providing evidence as requested, which satisfies the points raised by the Auckland University of Technology Ethics Subcommittee.

Your ethics application has been approved for three years until 22 August 2020.

### Standard Conditions of Approval

1. A progress report is due annually on the anniversary of the approval date, using form EA2, which is available online through <http://www.aut.ac.nz/researchethics>.
2. A final report is due at the expiration of the approval period, or, upon completion of project, using form EA3, which is available online through <http://www.aut.ac.nz/researchethics>.
3. Any amendments to the project must be approved by AUTEK prior to being implemented. Amendments can be requested using the EA2 form: <http://www.aut.ac.nz/researchethics>.
4. Any serious or unexpected adverse events must be reported to AUTEK Secretariat as a matter of priority.
5. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEK Secretariat as a matter of priority.

Non-standard conditions must be completed before commencing your study. Non-standard conditions do not need to be submitted to or reviewed by AUTEK before commencing your study.

Please quote the application number and title on all future correspondence related to this project.

AUTEK grants ethical approval only. If you require management approval for access for your research from another institution or organisation then you are responsible for obtaining it. You are reminded that it is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard.

For any enquiries, please contact [ethics@aut.ac.nz](mailto:ethics@aut.ac.nz)

Yours sincerely,



Kate O'Connor  
Executive Manager  
Auckland University of Technology Ethics Committee