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مجلة الطفولة العربية
المجلد السابع والعشرون – العدد مائة وخمسة
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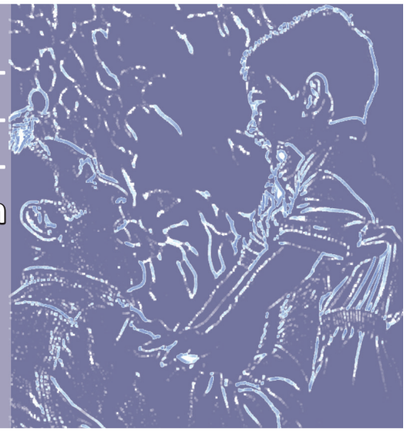
فاعلية برنامج قائم على الأغاني متعددة الثقافات لتعزيز قيم الديمقراطية لدى أطفال الروضة المصرية

مهاراتُ اللَّعبِ الجَماعيِّ لدى الأطفالِ ذوي الإعاقة الذِّهنيَّةِ وعلاقتُه بتعرُّضِهم للتَّنَمُّرِ في الكويت من وجهة نظرِ أولياءِ الأمورِ

تأثير استخدام الإنفوجرافيك في تدريس العلوم على التحصيل الدراسي لطلاب الصف الرابع

The Effectiveness of Multicultural Song-Based Program to Promote Democratic Values among Egyptian kindergarten Children



Group Play Skills Among Children with Intellectual Disabilities and Their Relation to Bullying Exposure in Kuwait from the Perspective of Parents

The Impact of Using Infographics in Teaching Science on the Academic Achievement of 4th Grade Students

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Abstract

The study investigated the impact of integrating infographics into fourth-grade science education on student academic achievement. A quasi-experimental design was employed in the first semester of the 20242025- school year, with 50 students divided intoyan experimental group (using infographics) and a control group (traditional instruction).

A science achievement test was administered to both groups at the end of the first unit «living organisms» of the prescribed subject (science) for the fourth grade. Descriptive and inferential statistical analyses were conducted to analyze the data. The results indicated a significant positive impact of using infographics on student achievement. The experimental group, which received instruction using infographics, outperformed the control group.

The mean score for the experimental group was 4.56, while the mean score for the control group was 2.88. A Mann-Whitney U test confirmed a statistically significant difference at the 0.01 level ($\alpha \leq 0.01$) between the two groups, favoring the experimental group.

Keywords: infographics, visual teaching/learning, visual thinking, students, achievement, academic performance, science subject, primary/elementary schools, Kuwait

تأثير استخدام الإنفوجرافيك في تدريس العلوم على التحصيل الدراسي لطلاب الصف الرابع

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الملخص

هدفت الدراسة إلى استقصاء أثر دمج تقنية الإنفوجرافيك في تدريس العلوم على التحصيل الأكاديمي لطلاب الصف الرابع الابتدائي. اعتمدت الدراسة على تصميم شبه تجريبي خلال الفصل الدراسي الأول من العام الأكاديمي 2024–2025م، حيث تمَّ تقسيم 50 طالبًا إلى مجموعتين: مجموعة تجريبية تلقَّت التعليم باستخدام الإنفوجرافيك، ومجموعة ضابطة استخدمت طرق التدريس التقليدية. في نهاية الوحدة الأولى بعنوان «الكائنات الحية» من منهج العلوم المقرر للصف الرابع، تمَّ تطبيق اختبار تحصيلي على المجموعتين. جرى تحليل البيانات باستخدام التحليلات الإحصائية الوصفية والاستدلالية. كشفت النتائج عن أثر إيجابي ذي دلالة إحصائية لاستخدام الإنفوجرافيك على تحصيل الطلاب. تفوَّقت المجموعة التجريبية على المجموعة الضابطة، حيث بلغ متوسّط درجاتها 4.56 مقارنةً بـ 2.88 للمجموعة الضابطة. وأكَّد اختبار مان ويتني (Mann-Whitney U test) وجود فرق ذي دلالة إحصائية عند مستوى الدلالة 0.01 ($\alpha \leq 0.01$) لصالح المجموعة التجريبية.

الكلمات المفتاحية: الإنفوجرافيك، التعليم والتعلّم البصري، التفكير البصري، الطلاب، التحصيل، الأداء الأكاديمي، مادة العلوم، المدارس الابتدائية، دولة الكويت

استلم البحث في مارس 2025 وأجيز للنشر في ابريل 2025

Introduction

In the current era of rapid technological advancement, characterized by the pervasive influence of Information and Communication Technologies (ICT), societies worldwide are grappling with significant transformations across all sectors, including education. To effectively navigate this digital landscape, it is imperative to equip learners with the necessary knowledge, skills, and competencies to acquire, utilize, and disseminate information efficiently. This necessitates a fundamental overhaul of educational systems to seamlessly integrate ICT tools, services, and resources into the teaching and learning process.

By doing so, we can enhance the quality of educational outcomes and empower learners to thrive in a highly competitive, interconnected world (Safar & Alqadiri, 2024a, 2024b, 2024c, 2024d).

Research has consistently shown that the effective utilization of ICT tools, apps, services, and resources significantly enhances student learning outcomes and facilitates information dissemination. Infographics, in particular, have emerged as a powerful tool for presenting complex information in a visually appealing and engaging manner. By transforming the way learners perceive and process information, infographics can revolutionize teaching and learning methodologies. Educators should prioritize the integration of teaching and learning tools and media that resonate with students' daily lives to maximize long-term impact (Bhat & Alyahya, 2024; Elaldı & Çifçi, 2021; Safar, 2021).

Infographics offer numerous advantages for educational curricula, including increased learner engagement, focus, and comprehension. By visually representing relationships between concepts, infographics can significantly enhance understanding. To maximize their impact, infographics should be strategically incorporated into teaching and learning practices (Alduhaim, 2016; Elaldı & Çifçi, 2021; Safar & Karkari, 2020; Ukpai & Fomsi, 2023). Additionally, infographics can elevate learner awareness by leveraging visual elements like drawings and shapes to stimulate pattern recognition and spatial reasoning. This multifaceted approach can provide learners with a diverse range of knowledge, skills, and experiences (Bhat & Alyahya, 2024; Safar & Qasem, 2022; Siricharoen, 2013).

Visual communication, particularly through infographics, has emerged as a powerful tool for designing and conveying information effectively. Research has consistently

demonstrated the superiority of visual communication over written or oral methods in terms of cognitive impact. Infographics, in particular, excel at simplifying complex concepts into visually engaging and easily digestible formats. By leveraging various shapes and graphics, infographics can quickly and clearly communicate information to learners (Bhat & Alyahya, 2024; Elaldı & Çifçi, 2021; Mursi, 2017; Safar & Karkari, 2020; Safar & Qasem, 2022; Toth, 2013; Ukpai & Fomsi, 2023). As technology continues to evolve, the integration of visual elements like infographics becomes increasingly crucial in meeting the needs of modern learners. This paper aims to investigate the impact of incorporating infographics into science education on the academic achievement of fourth-grade students in Kuwait.

Problem of the Study

Science education requires engaging and stimulating methods to ensure long-lasting learning. Many students, especially those encountering complex concepts, struggle with traditional approaches. Infographics, with their ability to visually represent information, offer a promising solution. By activating both visual and verbal memory, infographics can significantly enhance learning outcomes. Furthermore, in an era dominated by visually appealing media, infographics can make science education more engaging and captivating. By transforming complex concepts into visually appealing formats, teachers can attract and retain students' attention, addressing the limitations of traditional text-heavy methods (Khalifa, 2011; Safar & Karkari, 2020; Ukpai & Fomsi, 2023). Given the scarcity of Arabic-language infographics and their potential to enhance learning (Safar, 2021; Safar & Karkari, 2020), this study aims to investigate the impact of integrating infographics into science education on the academic achievement of fourth-grade students compared to traditional methods.

Research Questions

This study aims to answer the following research questions:

1. Does the use of infographics in science education impact the academic achievement of 4th-grade students?
2. Is there a statistically significant difference in the test scores of 4th-grade students between the infographics group and the traditional group?

Objective of the Study

This study aims to investigate the impact of integrating infographics into science education on students' cognitive achievement compared to traditional teaching methods.

Significance of the Study

The significance of this study can be summarized as follows:

1. Identifying Infographics as an Effective Tool: This research highlights the potential of infographics as a valuable educational tool that can enhance student learning and cognitive achievement.
2. Informing Curriculum Development: The findings of this study can provide valuable insights for curriculum developers and educational leaders to incorporate infographics into their instructional designs, thereby increasing student engagement and motivation.

Assumptions of the Study

This study hypothesizes that the use of infographics in teaching the "living organisms" unit to fourth-grade students will significantly enhance their academic achievement, as measured by their performance on a science test. Specifically, it is expected that the experimental group, which received instruction using infographics, will outperform the control group, which received traditional instruction.

Limitations of the Study

This study is subject to several limitations:

1. Participant Limitations: The study was limited to fourth-grade students in Kuwait.
2. Geographic Limitations: The study was confined to Fatima Bint Al-Hussein Primary School for Girls in the Al-Jahra Educational Area/District.
3. Time Frame Limitations: The study was conducted during a specific semester, the first semester of the 2024-2025 school year, limiting the duration of the intervention.
4. Technological Familiarity Limitations: The students may have lacked prior experience with infographics, potentially impacting the effectiveness of the intervention.
5. Literature Review Limitations: The availability of relevant research on the use of infographics in science education, particularly within Kuwait, the GCC, and the Middle East, was limited. This constraint may have influenced the scope and depth of the study.

Terminologies of the Study

Here are some of the concepts and terms presented in this study, along with detailed definitions and explanations, including:

1. Infographic: A visual representation that simplifies complex information or data, making it easier to understand. It transforms complex concepts into easily digestible visual formats (UAE Infographics, 2014). As Smiciklas (2012, p. 3) defines it, "an infographic is a visualization of data or ideas that conveys complex information to an audience in a manner that can be quickly consumed and easily understood."
2. Infographics Apps: These are software applications designed to help create professional, visually appealing, and innovative infographics with ease (Safar, 2021).
3. Teaching and Learning with Infographics: This approach involves using infographics as a visual tool to simplify complex information and ideas. By presenting information in a visually appealing and engaging manner, infographics can enhance learner understanding, retention, and critical thinking skills (Alhujailan, 2016; Safar & Qasem, 2022).
4. Achievement: This refers to the level of success a learner attains in a specific subject area. It reflects the knowledge and skills acquired through educational experiences (Alshaikh et al., 2017).

Literature Review

The Concept and Essence of Visual Learning and Thinking

Visual learning involves acquiring knowledge through visual aids such as images, diagrams, videos, and charts. It capitalizes on the brain's ability to process visual information efficiently.

Various scholars have defined visual learning in different ways:

- Safar (2021) and Safar and Alqadiri (2024b, 2024c): Visual learning is the ability to apply visual information to achieve desired behavioral changes.
- Moore and Dwyer (2015) and Fatani (2014): Visual learning emphasizes the use of visual elements to enhance the learning experience and interaction.
- Bni Aamir (2013): Visual learning focuses on learning through visual objects.
- Alqahtani (2013): Visual learning emphasizes the role of visual aids in achieving educational objectives.

Visual thinking, a related concept, involves using mental imagery to solve problems and identify patterns. It is the ability to perceive and interpret visual information, as defined by Aamir and Mohammed (2016) and Ellakany and Aljamal (2003).

The Concept and Essence of Infographic

An infographic is a visual representation that simplifies complex information, data, or ideas. It uses images, graphics, and text to convey information in an easily understandable format. Infographics are designed to enhance learning and memory retention by presenting information in a visually appealing and engaging manner.

Different scholars have defined infographics in various ways:

- Safar (2021) and Safar and Alqadiri (2024b): Infographics are visual tools that summarize and represent data, ideas, and plans in a clear and concise manner.
- Shaltout (2016): Infographics transform complex data and information into easily digestible visual representations.
- Drwish and El-dokhny (2015): Infographics utilize still or animated visuals to develop visual learning and thinking skills.
- Aljrawi (2015): Infographics are visual designs that use graphics, illustrations, and images to present information and knowledge.

The Historical Development of Infographics

While infographics may seem like a recent innovation, their roots trace back to ancient times. Shaltout (2016) highlights the historical evolution of infographics:

1. Paleolithic Era (30,000 BC): Early cave paintings represent some of the earliest forms of visual communication.
2. Hieroglyphic Writing (3,000 BC): Hieroglyphs used symbols and pictures to convey meaning.
3. Islamic Golden Age (800-1300 AD): Muslim scholars employed visual aids to explain scientific and mathematical concepts.
4. 14th Century: Nicole d'Oresme used visual models to illustrate the motion of objects.

5. Late 18th Century: William Playfair pioneered the use of visual representations of data.
6. Mid-19th Century: Charles Joseph Minard combined maps and graphs to visualize geographic and statistical data.
7. Early 20th Century: Otto Neurath developed a system of visual language to convey complex ideas.
8. Late 20th Century: Infographics became a prominent tool in international news publications.

The Types of Infographics

Safar (2021) and Shaltout (2016) categorizes infographics into three main types:

1. Static Infographics: These are fixed-image infographics that present information in a visually appealing format. They can be printed or published online.
2. Motion Infographics: These dynamic infographics use motion to convey information. They can be categorized into two types:
    - Video Infographics: These are essentially videos that incorporate infographic elements, often following a scripted narrative.
    - Motion Design Infographics: These use animation techniques to bring data and information to life.
3. Interactive Infographics: These allow viewers to actively engage with the content through interactive elements like buttons, sliders, or clickable links.

The Advantages of Infographics

Infographics enhance cognitive understanding by utilizing visual elements that stimulate comprehension. They simplify complex information, making it easier to process large amounts of data. Aljrawi (2015), Dawood (2015), Elaldı and Çifçi (2021), Safar (2021), Safar and Qasem (2022), and Ukpai and Fomsi (2023) highlight several advantages of infographics:

1. Visual Appeal: Infographics attract attention and engage viewers.
2. Efficient Information Processing: Visual information is processed more quickly than textual information.

3. Enhanced Search Engine Visibility: Infographics can be easily found on search engines.
4. Improved Retention: Visual learners, who make up a significant portion of the population, benefit from the visual nature of infographics.
5. Cognitive Efficiency: The brain processes visual information more efficiently than text and numbers.
6. Simplified Complexity: Infographics present complex information in a clear and concise manner, reducing cognitive load.

The Characteristics and Importance of Infographics

Alves (2022) highlights several key benefits of infographics:

1. Visual Appeal: Infographics use colors, images, and sometimes motion to capture attention.
2. Enhanced Memory: The visual nature of infographics aids in information retention, as the eye can quickly scan and process the information.
3. Increased Engagement: Infographics can be shared and interacted with on websites and social media, fostering engagement and discussion.

Toth (2013) emphasizes the communicative power of infographics, stating that they can convey complex information without requiring additional explanation.

Lamb and Johnson (2014) outline the following purposes of infographics:

1. Organizing Information: Infographics can help structure and organize complex ideas.
2. Visualizing Relationships: They can illustrate connections between different concepts.
3. Comparing Data: Infographics can effectively compare and contrast information.
4. Engaging Storytelling: They can combine images and text to create compelling narratives.
5. Clear Communication: Infographics can simplify complex information, making it easier to understand and remember.

The Steps of Designing and Producing Infographics

Qualey (2014) outlines the following steps for creating effective infographics:

1. Strategic Planning: Clearly define the purpose and target audience of the infographic.
2. Topic Suitability: Ensure the topic is visually representable and aligns with the infographic format.
3. Tool Selection: Choose appropriate software, whether traditional design tools or web-based infographic tools.
4. Design Execution: Create the infographic using the selected tool, focusing on simplicity and clarity.

Shaltout (2016) provides a detailed process for infographic creation:

1. Idea Generation: Develop a clear and concise concept for the infographic.
2. Initial Sketching: Create a basic visual representation of the infographic.
3. Title and Subtitle Development: Clearly define the main topic and subtopics.
4. Visual Coherence: Ensure a visually cohesive design with consistent elements.
5. Color Palette Selection: Choose colors that are visually appealing and enhance the message.
6. Design Refinement: Iterate and refine the design to improve its effectiveness.
7. Comprehensive Content: Include all relevant information in a clear and concise manner.
8. Accuracy Verification: Double-check the accuracy of data and information.
9. Final Output: Produce the final infographic in the desired format.

The Principles of Designing and Producing Infographics

Davis and Quinn (2013), as highlighted by Safar (2021), outline several key principles for effective infographic design:

1. Clear Purpose: The infographic should have a clear objective and convey its message effectively.
2. Visual Consistency: The design elements, such as colors, fonts, and imagery, should be consistent and relevant to the topic.
3. Informative Content: The infographic should present information in a clear and concise manner, using text and data judiciously.

4. Appropriate Format: Consider the intended audience and choose the appropriate format, whether static or interactive.

Pretlow (2014), as highlighted by Safar and Qasem (2022), adds to these principles by emphasizing the importance of:

1. Target Audience Analysis: Understanding the target audience's needs and preferences.
2. Unified Design: Maintaining a consistent visual style throughout the infographic.
3. Clear Information Hierarchy: Prioritizing key information and guiding the viewer's eye.
4. Simplicity and Focus: Avoiding information overload and keeping the design clean and concise.
5. Color and Font Choice: Using a limited color palette and a consistent font style.
6. Source Citation: Acknowledging the sources of information used in the infographic.

Dalton and Design (2014), as emphasized by Safar (2021), further highlight the importance of:

1. Meaningful Content: Ensuring that the infographic provides valuable insights and information.
2. Effective Communication: Clearly conveying the intended message to the audience.
3. Design Mastery: Skillfully utilizing design elements to create a visually appealing and informative infographic.

The Apps for Designing and Producing Infographics

While infographics can be manually created using traditional tools like paper, pens, and drawings, modern technology offers more efficient and visually appealing solutions. Numerous user-friendly software applications, often accessible through Web 2.0/3.0 platforms, have emerged to simplify the infographic creation process. These tools empower users to design professional-quality infographics without requiring advanced technical skills. They provide a vast array of features, including pre-designed templates, image libraries, fonts, and interactive elements. Users can easily drag and drop elements, add audio recordings, hyperlinks, and other interactive features. Many

of these tools support Arabic language and feature intuitive graphical user interfaces, making them accessible to a wide range of users. This ease of use has led to a "Do It Yourself" approach to infographic creation, reducing reliance on specialized expertise (Safar & Qasem, 2022; Siricharoen, 2013).

A Comprehensive Guide to Infographic Creation Tools

This guide, prepared by Safar (2021), offers a breakdown of popular tools for creating both still and motion infographics, catering to various skill levels and project requirements.

Tools for Creating Still Infographics (Web-Based): These user-friendly, web-based tools (Web 2.0/3.0) are ideal for beginners and those seeking a quick and easy solution. They typically offer:

- Pre-designed templates: Save time and effort with pre-designed layouts.
- Extensive libraries: Access a vast collection of images, icons, and fonts to enhance your infographic.
- Drag-and-drop functionality: Easily arrange and manipulate elements for a seamless design process.
- Interactive features (limited): Some tools offer basic interactive elements for a more engaging experience.

Popular web-based infographic creation tools include: Piktochart, Easel.ly, Venngage, Visme, Canva, Genially, Snappa, Infogram, Adioma, Mind the Graph, Creately, Gliffy, and RAWGraphs.

Tools for Creating Still Infographics (Desktop): For advanced users seeking maximum control and professional-grade results, these desktop programs offer extensive editing and customization capabilities:

- Ideal for still infographics
- Require design knowledge
- Extreme flexibility and customization

Popular desktop publishing and graphics editing programs include: Adobe Illustrator, Adobe InDesign, Adobe Photoshop, Inkscape, Tableau, and Sketch.

Tools for Creating Motion Infographics (Web-Based): These web-based tools (Web 2.0/3.0) allow you to create engaging animated infographics. Consider the level of animation complexity you require when choosing a tool. Popular web-based motion infographic creation tools include: Vyond (formerly GoAnimate), Raw Shorts, Animaker, PowToon, Animatron, AnimationStudio, Toonly, Doratoon, Animiz, VideoScribe, Explee, Doodly, Moovly, Focusky, Prezi, Biteable, Renderforest, Animoto, Videze, Ceros, and Vizualize.me.

Tools for Creating Motion Infographics (Desktop): These professional desktop video editing and animation programs offer the highest level of flexibility and control for creating complex and visually stunning motion infographics:

- Extreme flexibility and customization
- Highly skilled users recommended
- Steeper learning curve

Popular desktop video editing and animation software include: Adobe After Effects, Adobe Premiere Pro, Apple Final Cut Pro, and Avid Media Composer.

Choosing the Right Tool: The best tool for you depends on your:

- Skill level: Beginner, intermediate, or advanced
- Desired infographic type: Still or motion
- Project complexity
- Budget: Free or paid tools

By understanding your needs and the capabilities of different tools, you can create compelling and informative infographics that effectively communicate your message.

The Significance of Using Infographics to Support Teaching and Learning

The use of infographics in education has emerged as a valuable approach that leverages visual learning. As highlighted by Matrix and Hodson (2014), Safar and Karkari (2020), and Safar and Qasem (2022), infographics:

- Enhance Visual Understanding: Infographics present information in a visually appealing manner, making it easier for students to grasp and process complex concepts.

- Stimulate Visual Thinking: By engaging visual elements, infographics encourage students to think critically, analyze information, and make connections between ideas.
- Promote Creativity and Innovation: Creating infographics empowers students to express their ideas creatively, fostering innovation and problem-solving skills.
- Develop Visual Communication Skills: Infographics help students develop the ability to read, interpret, and communicate information visually.

Furthermore, when students create their own infographics, they acquire a range of valuable skills, as highlighted by Fredrick (2013), Safar (2021), Safar and Mohammad (2020), and Safar and Qasem (2022), including:

- Information Selection: The ability to identify and select relevant information.
- Analysis and Synthesis: The skill of breaking down complex information and synthesizing it into key points.
- Relationship Building: The capacity to identify and represent relationships between concepts.
- Critical Thinking: The ability to evaluate information critically and make informed judgments.
- Assessment Tool: Infographics can serve as a valuable assessment tool, revealing students' understanding and ability to synthesize information.

By simplifying complex information through the use of graphics and shapes, infographics can stimulate mental imagery, making learning more engaging and effective. This ultimately contributes to increased academic achievement.

The Effect of Using Infographics as an Educational Tool

The concept of infographics has gained significant attention from scholars and academics in recent years, emerging as a prominent topic within the field of education. Numerous studies have explored the educational value of infographics, and several notable examples include:

(1) Aljrawi's (2014) study investigated the effectiveness of a training program designed to enhance pre-service teachers' skills in electronic mind mapping design through infographics and visual culture. The experimental study, conducted with a group of 15 female education students, involved a training program and subsequent assessments. The findings suggest that the program successfully improved participants' knowledge of visual culture and their technical skills in creating infographics-based electronic mind maps for instructional purposes.

(2) Rezaei and Sayadian's (2015) study examined the impact of educational infographics on English grammar learners in Iran. Employing an experimental design, the study involved 60 English language learners in Bushehr, divided into an experimental group (using infographics) and a control group (traditional methods). Both groups were administered pre- and post-tests to assess their English grammar achievement. The results indicated that the experimental group, which utilized infographics, demonstrated significantly higher levels of achievement.

(3) Mansour's (2015) study explored the impact of using infographics based on Marzano's learning dimensions on developing cloud computing concepts and learners' mind habits. The experimental study involved 30 second-year history students at the University of Assiut. The students were taught using the proposed infographic-based model, and pre- and post-tests were administered to assess their understanding of cloud computing concepts and their productive mind habits. The findings revealed significant improvements in both areas, indicating the positive influence of infographics on student learning and cognitive development.

(4) Drwish and El-dokhny's (2015) study investigated the impact of still and motion infographics on the development of visual thinking skills and attitudes among autistic children. The experimental study involved 30 children divided into two groups: one exposed to still infographics and the other to motion infographics. Pre- and post-tests of visual thinking skills and attitudes were administered. The results indicated that the still infographics group demonstrated significantly higher levels of visual thinking skills and more positive attitudes compared to the motion infographics group.

(5) Alshehri and Ebaid's (2016) semi-experimental study, conducted in Saudi Arabia, evaluated the effectiveness of interactive infographics in teaching mathematics to second-grade students. The study involved 32 randomly selected students divided

into experimental and control groups. An achievement test was administered to both groups before and after the intervention. The results demonstrated that the experimental group, which utilized interactive infographics, significantly outperformed the control group on the achievement test.

(6) Alrwele's (2017) quasi-experimental study in Saudi Arabia investigated the impact of infographics on students' academic achievement and their perceptions of infographic-based learning. The study involved 165 female students at Al-Imam Muhammed Ibn Saud Islamic University, divided into experimental and control groups. Both groups were administered an achievement test and a questionnaire. The results indicated that the experimental group, which utilized infographics, significantly outperformed the control group. Additionally, students in the experimental group reported positive perceptions of infographics as a valuable learning tool.

(7) Ozdal and Ozdamli's (2017) qualitative-quantitative study in Cyprus aimed to investigate the impact of infographics on the academic performance and knowledge retention of fifth-grade students, as well as their perceptions of infographic-based learning. The study involved 82 students divided into experimental and control groups. Both groups were administered achievement and retention tests, and the experimental group participants were interviewed. The results demonstrated that infographics positively influenced students' academic performance, knowledge retention, and overall perceptions of learning.

(8) Abdel Aziz's (2018) study aimed to investigate the impact of using infographics on fifth-grade students' science achievement, visual thinking skills, and attitudes towards science in Kuwait. A semi-experimental research design was employed. The sample comprised 64 fifth-grade students, divided into two groups: an experimental group ($n = 34$) and a control group ($n = 30$). The experimental group received instruction using infographics, while the control group received traditional instruction. The study employed an achievement test, a visual thinking test, and a science attitude scale as research instruments. The results indicated a statistically significant difference ($\alpha \leq 0.05$) between the experimental and control groups, favoring the experimental group.

(9) Safar and Karkari's (2020) study aimed to investigate the impact of integrating infographics into science education on the academic achievement of 6th-grade students

in Kuwait. The experimental study involved 52 students divided into experimental and control groups. The experimental group received instruction using infographics, while the control group followed traditional methods. An achievement test was administered to both groups. The results revealed that the experimental group, which utilized infographics, significantly outperformed the control group in terms of academic achievement.

(10) Safar and Mohammad's (2020) study aimed to investigate the impact of infographics on the academic achievement of 8th-grade social studies students. The experimental study involved 56 students divided into experimental and control groups. The experimental group received instruction using infographics, while the control group followed traditional methods. An achievement test was administered to both groups. The results revealed that the experimental group, which utilized infographics, significantly outperformed the control group in terms of academic achievement.

(11) Elaldı and Çifçi's (2021) study aimed to re-evaluate the impact of infographics on academic achievement through a mixed-methods approach. A meta-analysis of 12 studies conducted between 2016 and 2021 was performed, along with a thematic analysis of qualitative data. The meta-analysis revealed a significant positive effect of infographics on academic achievement, with a large effect size (g = 1.599). This suggests that infographics are an effective tool for enhancing student learning. Furthermore, the study found that the impact of infographics varied based on the duration of implementation. The greatest effect was observed in studies with a 4-5 week implementation period (g = 1.343). The thematic analysis identified three key dimensions of infographics' cognitive contributions: attention, memory, and understanding. Additionally, the study highlighted challenges related to the design, implementation, and evaluation of infographics. Based on the findings, the researchers suggest that further research is needed to explore the full potential of infographics and address the identified challenges.

(12) Ukpai and Fomsi's (2023) study aimed to investigate the effectiveness of animation and infographics as teaching methods in biology for secondary school students in Obio-Akpor Local Government Area, Rivers State, Nigeria. A quasi-experimental pre-test post-test design was employed to conduct the research. A sample of 186 senior secondary two biology students was selected. Three instruments were used to collect data: the Biology Performance Test, the Biology Retention Test, and the Biology

Students' Engagement Questionnaire. Data analysis involved the use of ANCOVA and descriptive statistics. The results revealed significant differences in student performance, retention, and engagement among the animation, infographics, and discussion-based teaching methods. Gender also influenced performance and retention. The study recommended that the government encourage teachers to incorporate animation and infographics into biology lessons to enhance student learning and engagement.

Methodology

Research Design

The study employed a quasi-experimental design, utilizing a control group and an experimental group. The experimental group received instruction using infographics, while the control group followed traditional teaching methods.

Variables

The study has one independent variable: the teaching and learning strategy (infographics-based or traditional). The dependent variable is the students' academic achievement in science.

Sample

The study population consisted of all fourth-grade students in Kuwait's primary schools during the first semester of the 2024-2025 school year. The sample included 50 fourth-grade students from Fatima Bint Al-Hussein Primary School for Girls in the Al-Jahra Educational District. Stratified sampling was used to select two fourth-grade classes of equal size, resulting in two groups of 25 students each: an experimental group and a control group.

To ensure the equivalence of the two groups, the researchers considered factors such as:

- School type (government school)
- Student age range (9-10 years)
- Socioeconomic background
- Educational level of parents
- Group size and composition

By controlling these factors, the researchers aimed to minimize the influence of extraneous variables on the study's outcomes.

Instrument

To achieve the research objectives, the researchers developed a post-test to measure students' academic achievement in the first unit (living organisms) of the fourth-grade science curriculum. The test was validated by a panel of experts, including teachers and science supervisors, who provided feedback and suggestions for improvement. The reliability of the test was established through a test-retest method, where a sample of 25 students took the test twice, two weeks apart. The Pearson correlation coefficient was used to calculate the test's reliability.

Data Collection

The post-test was administered during the first semester of the 2024-2025 school year in a traditional manner to the selected sample of 50 students after they completed the first unit (living organisms) of the science curriculum. The students were assured that their responses would be kept confidential and used solely for research purposes.

Methods of Analysis

Following the completion of the study, the collected data were meticulously transferred to Microsoft Excel spreadsheets. Subsequently, the data were imported into IBM SPSS Statistics version 30 for statistical analysis. To analyze the data, both descriptive and inferential statistical methods were employed. Descriptive statistics, including measures of central tendency (mean), dispersion (standard deviation), and Cohen's *d* effect size, were utilized to summarize the data. Inferential statistics, specifically the Mann-Whitney *U* test, was employed to compare the experimental and control groups. The Mann-Whitney *U* test was chosen due to the non-parametric nature of the data, as the sample size did not meet the requirements for parametric tests (Abou-Allam, 2021; Conover, 1999; Creswell & Creswell, 2018; Jackson, 2016; Johnson & Christensen, 2020; Levin, Fox, & Forde, 2016). The significance level for all statistical tests was set at $\alpha = 0.05$. This threshold ensured that any observed differences were unlikely to be due to chance.

Data Analysis: Results and Discussion

The findings of this study align with the results of previous research conducted over the past decade and support the initial hypotheses. The following sections will present and discuss the results obtained in response to the research questions.

Research Question No. 1: Effect

To address the first research question, "Does the use of infographics in science education impact the academic achievement of 4th-grade students?", the researchers calculated Cohen's *d* effect size to determine the magnitude of the difference between the experimental and control groups' test scores. The results of this analysis are presented in Table 1.

Table 1

Descriptive statistics of the experimental and control groups in the test score.

Group/Class	*N*	Min. Score	Max. Score	*M*	*SD*	Cohen's *d* Effect Size
Experimental (Infographics)	25	4.00	5.00	4.56	0.57	1.72
Control (Traditional)	25	1.00	5.00	2.88	1.26	

Table 1 indicates a significant and substantial positive effect (Cohen's $d = 1.72$) of integrating infographics in fourth-grade science education on student academic achievement, as measured by post-test scores. The experimental group, which received instruction using infographics, outperformed the control group, which received traditional instruction. The mean score of the experimental group was 4.56, while the mean score of the control group was 2.88.

This large effect size suggests a strong relationship between the use of infographics and improved academic performance. Infographics likely enhanced student engagement by providing a novel and stimulating learning experience. This increased engagement, in turn, facilitated the development of critical thinking skills and knowledge acquisition.

These findings align with previous research by Ukpai and Fomsi (2023), Elaldı and Çifçi (2021), Safar and Karkari (2020), Safar and Mohammad (2020), Abdel Aziz (2018), Ozdal and Ozdamli (2017), Alrwele (2017), Alshehri and Ebaid (2016), Drwish and El-dokhny (2015), Mansour (2015), Rezaei and Sayadian (2015), Aljrawi (2014), and others, which have demonstrated the positive impact of infographics on student learning outcomes. The novelty and interactive nature of infographics, compared to traditional teaching and learning methods, likely contributed to their effectiveness.

Research Question No. 2: Significance Achievement

To address the second research question, "Is there a statistically significant difference in the test scores of 4th-grade students between the infographics group and the traditional group?", the researchers employed the Mann-Whitney *U* test to compare the two groups. The results of this analysis are presented in Table 2.

Table 2

Results of the Mann-Whitney *U* test for finding differences between the experimental and control groups in the test score.

Group/Class	N	Mean of Ranks	Sum of Ranks	U-Value	Z-Score	Asymp. Sig. (2-tailed)
Experimental (Infographics)	25	35.90	897.50	52.50	5.04	0.000*
Control (Traditional)	25	15.10	377.50			

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

Table 2 indicates a statistically significant difference on the 0.01 level ($\alpha \leq 0.01$) between the experimental and control groups in terms of their science test scores, favoring the experimental group. The average score for the experimental group was 35.90, while the average score for the control group was 15.10. The use of infographics in teaching and learning increased student motivation, engagement, and enjoyment, leading to improved academic achievement. This finding aligns with previous research by Ukpai and Fomsi (2023), Elaldı and Çifçi (2021), Safar and Karkari (2020), Safar and Mohammad (2020), Abdel Aziz (2018), Ozdal and Ozdamli (2017), Alrwele (2017), Alshehri and Ebaid (2016), Drwish and El-dokhny (2015), Mansour (2015), Rezaei and Sayadian (2015), Aljrawi (2014), and others, which demonstrated the positive impact of infographics on student learning outcomes.

Conclusion and Recommendations

Overall, the findings of this research study provide compelling evidence for the significant positive impact of using infographics as a teaching and learning tool on students' academic achievement. The experimental group, which utilized infographics, significantly outperformed the control group, which received traditional instruction. These

findings suggest that incorporating visuals, especially infographics, into the educational process can be a powerful tool for enhancing student learning and achievement.

In light of these findings, the following recommendations are proposed to further advance educational progress:

1. Expand the Use of Infographics: Promote the widespread adoption of infographics across all subjects and grade levels.
2. Teacher Training: Organize training programs to equip teachers with the knowledge and skills to effectively use infographics in their classrooms.
3. Policy Implementation: Encourage the Ministry of Education to embrace visual education principles and practices, recognizing the importance of visual learning and thinking in developing 21st-century skills and competencies.
4. Curriculum Integration: Integrate visual content, including infographics, into the curricula of various subjects to enhance learning outcomes.
5. Further Research: Conduct additional research to investigate the effectiveness of infographics in kindergarten, primary, intermediate, and secondary education, as well as their impact on other subjects.

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