EDUCATIONE

The Effect of Infographic Usage on Students' Interrogative Learning Skills and Academic Achievements in 4th Class of Science Course Lighting and Sound Technology Unit

4. Sınıf Fen Bilimleri Dersi Aydınlatma ve Ses Teknolojileri Ünitesinde İnfografik Kullanımının Öğrencilerin Sorgulayıcı Öğrenme Becerilerine ve Akademik Başarılarına Etkisi

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Özet

Bu çalışmada, ilkokul 4. sınıf öğrencilerinin Fen Bilimleri dersi "Aydınlatma ve Ses Teknolojileri" ünitesinin öğretiminde İnfografik kullanımının öğrencilerin sorgulayıcı öğrenme becerilerine ve akademik başarılarına olan etkisini ölçmek amaçlanmıştır. İnfografikler, tasarım aşamalarına dikkat edilerek ve 4. sınıf öğrencilerinin seviyeleri doğrultusunda hazırlanmıştır. Araştırma kontrol gruplu öntest-sontest modeline uygun yarı-deneysel bir çalışma olarak yürütülmüştür. Araştırmada deney grubunda hazırlanan infografikler kullanılırken, kontrol grubunda herhangi bir uygulama yapılmamıştır. Araştırma 2022-2023 öğretim yılında Afyonkarahisarda bir ilkokuldaki iki farklı 4. sınıfta yer alan 20 deney, 20 kontrol grubu olmak üzere toplam 40 öğrenci ile gerçekleştirilmiştir. Deney grubunda bahsedilen ünitede program gereği yapılan etkinliklere ek olarak infografikler kullanılırken, kontrol grubunda sadece mevcut öğretim programı uygulanmıştır. İnfografikler ünite kazanımlarına uygun olarak hazırlanmıştır. Araştırmada veri toplama aracı olarak Kara (2016) tarafından hazırlanan "Aydınlatma ve Ses Teknolojileri" ile ilgili sorulardan oluşan akademik başarı testi uygulanmıştır. Başarı testinin 20 maddesine ilişkin ortalama güçlük 0,52'dir. Araştırmada Evrekli (2016) tarafından geliştirilen Sorgulayıcı Öğrenme Becerileri Ölçeğinin tamamına ilişkin güvenirlik değeri ise .85 olarak tespit edilmiştir. Araştırma bulguları, Fen Bilimleri dersinde infografiklerin kullanıldığı deney grubundaki öğrencilerin hem akademik başarılarının hem de sorgulayıcı öğrenme becerilerinin olumlu yönde değiştiğini göstermektedir.

Anahtar Kelimeler: *İnfografik, Sorgulayıcı Öğrenme Becerileri, Akademik Başarı, Fen Bilimleri*

Abstract

In this study, it was aimed to measure the effect of infographic usage on the students' interrogative learning skills and achievements in the teaching of the Science "Lighting and Sound Technologies" unit of elementary school 4th grade students. This study was conducted as a quasi-experimental study according to the pretest-posttest model. While the infographics prepared by researchers were not used in the control group, they were used in the experimental group. The study group of the research included 40 students who were in the 4th grade. 20 of them were in the experimental group and the rest were in the control group. While infographics were used in addition to the activities carried out in the experimental group, only the activities required by the curriculum were applied in the control group. In this research, academic achievement test consisting of questions about "Lighting and Sound Technologies" prepared by Kara (2016) as data collection tool was applied. The average difficulty for 20 items of the achievement test is 0.52. The reliability value for the whole Interregative Learning Skills Scale, developed by Evrekli (2016), was determined as .85. Research findings indicate that both the academic success and interrogative learning skills of the students in the experimental group, where infographics were used in the Science course, changed in favor of the students.

Keywords: *Infographic, Interrogative Learning Skills, Academic Achievement, Science*

GENİŞ ÖZET

Giriş

Görselleştirme, öğrencinin karmaşık bir bilgiyi edinebilmesi için sıkça başvurulan bir yöntemdir. Bilgi görselleştirme ise, bilginin düzenlenmesi, değerlendirilmesi, yapılandırılması ve örgütlendirilmesi yoluyla öğrencinin süreçte öğrendiği bilgiyi anlamlandırarak görünür ve kullanılabilir hale getirilmesidir. Bilgiyi öğrenen öğrenci bilgisine daha fazla bilgi katarak geliştirebilir. Öğrenciler, teknolojik araçları kolaylıkla kullanabilen, anladığı bilgiyi hatırlayabilen bireyin ötesinde aradığı bilgiye ulaşabilen, bilgiyi yapılandırıp kullanabilen, tasarlayabilen ve yayabilen birey olmak durumundadırlar (Nuhoğlu Kibar & Akkoyunlu, 2015). Her geçen gün artan bir hızla gelişim gösteren teknolojinin insan hayatının birçok alanında köklü değişimlere neden olduğu bilinen bir gerçektir. Bu bağlamda değişim gösteren öğrenci profiliyle öğrencilerin bilgiyi hızlı elde etme konusundaki isteğini karşılamak, ders kitaplarında yer alan bilgilerin yoğun oluşu ve buna karşın öğretim süresinin sınırlı olması gibi sorunların çözümüne olanak veren infografikler önemli bir öğretim materyali olarak karşımıza çıkmaktadır (Yeşiltaş & Cevher, 2018).

İnfografiklerin, öğretim sürecinde iletiyi yorumlamaya harcanan enerjiyi azaltıp zaman kazanma, konunun en önemli yerlerine dikkat çekme, öğrencilerin ayırt etme ve yorumlama becerilerini geliştirme ve yoğun bilgileri görselleştirme ve bunları kolay, hızlı ve açıklayıcı bir şekilde sergilenmesine olanak vermesi bakımından fen öğretiminde önemli bir yeri bulunmaktadır (Yeşiltaş & Cevher, 2018). Alan yazın incelendiğinde bilişsel bir strateji olarak görülen ve eğitimde önemli bir yere sahip olduğu ifade edilmesine rağmen infografik kullanımına ilişkin araştırmaların betimsel çalışmalarla sınırlı kaldığı ve deneysel araştırmalarla desteklenmesi gerektiği görülmektedir (Çaka, 2018). Çalışmanın amacı, ilkokul 4. sınıf öğrencilerinin Fen Bilimleri dersi "Aydınlatma ve Ses Teknolojileri" ünitesinde infografiklerin kullanımının öğrenci akademik başarısına ve sorgulayıcı öğrenme becerilerine etkisini ve bu etkinin bazı değişkenler açısından farklılık gösterip göstermediğini belirlemektir.

Yöntem

İnfografiklerin 4. sınıf "Aydınlatma ve Ses Teknolojileri" ünitesinin öğretiminde kullanımının öğrencilerin sorgulayıcı öğrenme becerilerine ve akademik başarılarına etkisini belirlemek amacı ile yapılan bu araştırma, nicel araştırma yöntemlerinden, öntest – sontest kontrol gruplu yarı deneysel desen ile gerçekleştirilmiştir. Yarı deneysel modeller, bilimsel değer bakımından gerçek deneysel modellerden hemen sonra gelir. Gerçek deneysel desenlerin gerektirdiği kontrollerin sağlanamadığı durumlarda kullanılır (Karasar, 2018). Araştırmanın çalışma grubu, Afyonkarahisar ili merkez ilçesinde bulunan bir ilkokuldaki iki farklı 4. sınıfta öğrenim görmekte olan 20'si deney ve yine 20'si kontrol grubunda yer alan toplam 40 öğrenciden oluşmaktadır. Çalışma grubunda 17 erkek ve 23 kız öğrenci mevcuttur.

Araştırmanın amacı ve alt problemleri doğrultusunda veri toplama araçları olarak;

- "Aydınlatma ve Ses Teknolojileri" ünitesinin öğretimine yönelik infografik kullanımının öğrencilerin akademik başarılarına etkisini belirlemek için Kara (2016) tarafından geliştirilen “Başarı Testi”,
- Öğrencilerin Sorgulayıcı öğrenme becerilerini ölçmek amacıyla Evrekli (2016), tarafından uyarlanıp geliştirilen “Sorgulayıcı Öğrenme Becerileri Ölçeği” kullanılmıştır.

Bulgular, Sonuç ve Tartışma

Fen Bilimleri dersinde infografik kullanımının öğrencilerin sorgulayıcı öğrenme becerilerini ve akademik başarılarını etkileyip etkilemediğini ele alan bu çalışma yarı deneysel bir çalışma olarak gerçekleştirilmiştir. Araştırma bulguları Fen Bilimleri dersinde infografik kullanılan deney grubundaki öğrencilerin hem akademik başarılarının hem de sorgulayıcı öğrenme becerilerinin öğrencilerin lehine değişim gösterdiğine işaret etmektedir. Uygulama öncesinde gerçekleştirilen ön-test sonuçları deney ve kontrol grubunun akademik başarılarının ve sorgulayıcı öğrenme becerilerinin birbirine benzer özellikte olduğunu göstermektedir. İnfografik ile işlenen Fen Bilimleri unitelerinden sonra gerçekleştirilen son-testler ise uygulamanın yapıldığı deney grubunda akademik başarının ve sorgulayıcı öğrenme becerilerinin kontrol grubundan farklı bir düzeye geldiğini göstermektedir. Bu farklılık öğrencilerin Fen Bilimleri dersini hem görsel olarak hem de akademik bilgilerin özetlenerek sunulduğu infografiklerden kaynaklanabilir. İnfografik gibi web tabanlı teknoloji araçları öğrenenlere, öğrenme ve öğretme sürecinde geribildirim vermek ve geribildirim almak gibi fırsatlar sağlayarak etkileşimde bulunma, öğretmenlere de bir görevin nasıl gerçekleştirileceğine dair modelleme fırsatları sunmaktadırlar (Kitsantas & Dabbagh, 2011). Bu çalışmada da infografikler öğrencilere öğrendikleri bilgileri modelleme fırsatı sunmuştur.

Sonuç olarak, Fen Bilimleri dersinde infografik kullanımı öğrencilerin hem akademik başarılarını hem de sorgulayıcı öğrenme becerilerini olumlu bir şekilde etkilemiştir. Diğer taraftan infografikler öğrencinin derste aktif bir şekilde yer almasını sağlayarak öğrenme ortamını öğrenci merkezli hale getirmiştir. Böylece öğrenciler öğrenme sorumluluğunu alabilme becerisini elde edebileceklerdir. Bu çalışma özellikle Fen Bilimleri dersi kapsamında ele alınmıştır. Gelecekte yapılacak muhtemel çalışmalarda farklı disiplinlerde infografik kullanımı ele alınabilir.

INTRODUCTION

Visualization is a frequently used method for the student to acquire complex information. Information visualization, on the other hand, is organizing, evaluating, structuring and organizing information and making it visible and usable by making sense of the information learned in the process. The learners can improve the knowledge by adding more information to their knowledge. Beyond the individual who can easily use technological tools and remember the information, students have to be individuals who can reach the information they are looking for, who can structure and use the information, design and disseminate it (Nuhoğlu Kibar & Akkoyunlu, 2015). It is a well-known fact that technology, which develops at an ever-increasing pace, causes radical changes in many areas of human life. In this context, infographics that allow the solution of problems such as meeting the students' desire to obtain information quickly appear as an important teaching material (Yeşiltaş & Cevher, 2018).

Emphasizing the value of visual communication, starting from the expression "a picture is worth a thousand words", an infographic is a type of picture that blends information with design and helps individuals or organizations to share their messages with the people they interact with (Smiciklas, 2012). A figure showing the basic structure of the infographic is given in Figure 1.

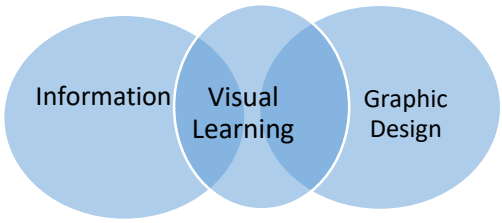

Figure 1. *Anatomy of Infographic (Reference: Smiciklas, 2012).*

As seen in Figure 1, infographics combine information with design to enable visual learning. This communication process helps present complex information faster and easier to understand. In other words, an infographic is defined as a visualization of data or ideas that attempt to convey complex information to an audience in a way that can be quickly consumed and easily understood (Smiciklas, 2012).

An infographic visualizes dense, sometimes complex information and processes related to a particular topic in an easily perceptible way. The word infographic as an

information design tool within the scope of graphic design is a term that originally came from the English word "infographic". This term is formed by the combination of the words info (information) and graphic. Additionally, we see that this term appears in the form of "information graph" (Nuhoğlu Kibar & Akkoyunlu, 2015; Uyan Dur, 2011; Yıldırım, 2018).

Infographics are essentially visual representations of information. They are used to tell stories, convey ideas or explore problems with various graphics. Infographics are widely used in the media to increase individuals' understanding of a particular topic. In addition to traditional media such as newspapers and magazines, infographics are used in many digital broadcasting channels and are increasingly being produced by a number of public and private sector organizations as part of their publishing strategies. The example shown below is taken from the EBA website prepared within the Ministry of National Education (Ferreira, 2014).

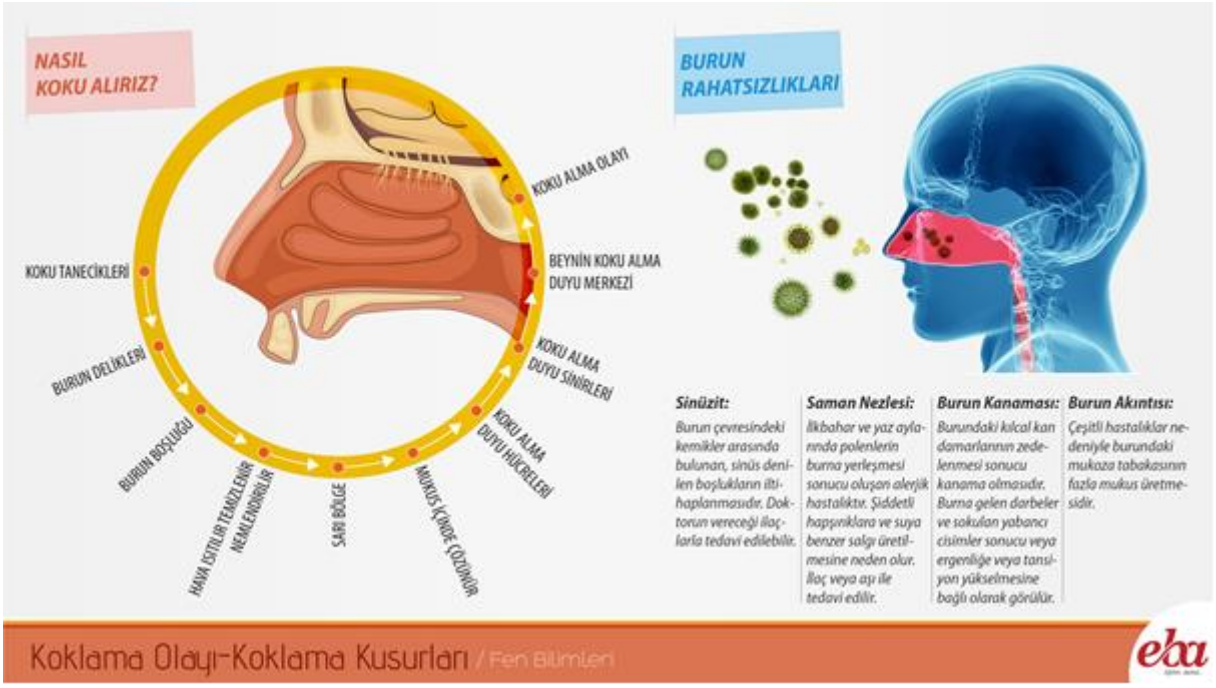

Figure 2. *Science Infographic on olfactory event-smell defects (Reference: EBA, 2019)*

Although infographics may seem like a new phenomenon that developed with the internet, the truth is that throughout history icons, graphics and images have been used to tell and share stories. It can be easily seen in ancient Egyptian hieroglyphs or Leonardo Da Vinci's 16th century examples of human anatomy (Ferreira, 2014).

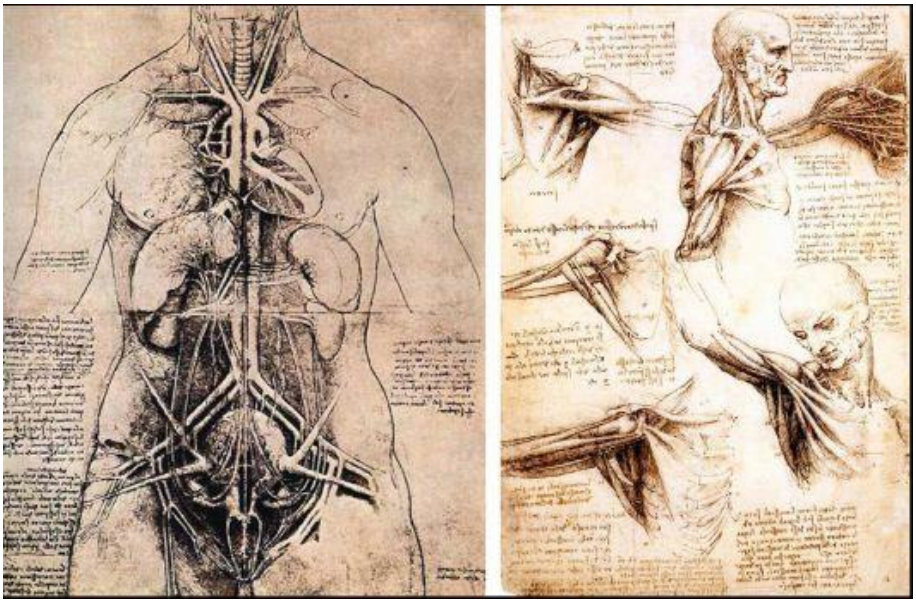

Figure 3. *One of Leonardo Da Vinci's 16th century examples of human anatomy*

(Reference: http://www.acikbilim.com/wp-content/uploads/2012/09/leonardoanatomi.jpg)

Today, infographic and data visualization concepts have become popular topics. It can be quite difficult to say which of these can be considered within the scope of data visualization and which can be considered as an infographic. The differences between these two concepts are still being discussed by experts. In order to answer the question, which features of a visualization can be described as data visualization or infographic, it is necessary to discuss the specific qualities of both concepts (Cemelelioğlu Altın, 2018).

Infographic, which is an effective communication resource all over the world, is the type of graphic design that requires the most effort. Because it has a very intense information content, the creation process alone is impossible. Researching data involves a very lengthy procedure that takes both time and dedication to obtain detailed and accurate information. After the information is researched and clarified, the designer blends the information with logical and general design rules, provides image and text integrity and tries to create a strong effect with the design (Topçu Özçelik, 2017).

It can be thought that the use of visual design principles makes infographics attractive. In order to create an infographic, besides visual design, an effective approach to the presentation of information is required. For this reason, it is important to find, analyze and use information while preparing infographics. It is very important to use instructional design models while preparing infographics.

(Yıldırım, Yıldırım, Çelik, & Aydın, 2014). According to Davis and Quinn (2014), the following points should be considered in order to create a strong infographic design;

- **Purpose:** The individual viewing the infographic should be able to deduce the designer's purpose, draw conclusions based on evidence, and summarize the essence of the infographic.
- **Style:** Graphic components including design, text, symbols and color schemes should appeal to the designer's style.
- **Evidence:** Data and text should be properly integrated into the citations and design to support the understanding of the individual viewing the infographic.
- **Size:** The infographic can be displayed in a static format designed for print or in a dynamic environment that allows interaction.

Since infographics are visually oriented, they can only be seen as a discipline of interest to designers. But it is also associated with many other specialties such as statistics, data mining, data science, motion picture design, animation, software, human-computer interaction, interface design and interaction. This situation can be shown as a clear indicator of the interdisciplinary nature of infographics (Cemelelioğlu Altın, 2018). In this context, infographics contain effective stimuli in the process of structuring visual messages for children. Infographics feed children's visual literacy with a dynamic language. Because infographics are visual narratives that are stylized, visualize meanings and narrate them, provide motivation through effective visualization, lay the groundwork for active participation, present visuals in a detailed holistic way, and direct the individual to think deeply (Odabaşı, 2017).

While infographics can be created with the most used image processing programs (such as PhotoShop, Picasa), there are also software (SmartDraw) developed specifically for creating infographics. In addition, there are also websites where infographics can be created very easily and quickly using ready-made templates and tools (infogr.am, visual.ly, piktochart, etc.). Thanks to these, the time spent on visual design is reduced, and the time devoted to structuring instructional content and more information increases. While preparing an effective infographic, it is necessary to organize the information well and the flow within the infographic should be well organized. In this way, infographics that present information rich in visual elements as desired can be prepared (Yıldırım, Yıldırım, Çelik & Aydın, 2014).

When the basic concepts and definitions related to information architecture and design are examined, the correct planning and implementation of infographic designs that reveal useful and effective information in the information scanning-

access process is intertwined with the correct planning and management of the information architecture process (Gülrenk, 2015). Başgün (2012) listed the points that should be considered in order for the infographic to convey the news or message in the best way;

1. The chosen topic should be a topic that can be presented as an infographic and should be organized in an interesting way.

2. First of all, data should be collected and then the design phase should be started. The quality of the data is examined and the story gains meaning with an appropriate design.

3. In the design of the infographic, it is necessary to avoid unnecessary information visualization. Too many tables and graphs make infographics confusing and incomprehensible. Every item used should have the simplicity to convey the desired message and add meaning to the overall design.

4. Since infographics are used to simplify complex information, simple and basic graphics are included in infographics, because infographics are highly effective and simple visualization tools. Their use makes the infographic more understandable and the message is delivered more effectively.

5. The numerical values presented in the infographic should be readable and understandable. In preparing very ostentatious designs, very ostentatious designs should be avoided as the information is lost and prevents the desired message from reaching the reader.

6. The information to be conveyed must be precise and accurate. This information is obtained as a result of a research (Zedeli, 2014).

According to Denli (2016), in order to use infographic elements correctly, it is necessary to predict in which communication medium the message can be presented effectively. While determining the environment in which communication is desired, the target of the study, the target audience and the desired behavior should be determined. There are 3 different communication environments: static, mobile and interactive.

- Printed publication as a static medium (newspaper, visual communication, poster, brochure, visual communication, annual report, book, billboard);
- Web and television in the mobile environment;
- Computer and mobile phones can be given as examples of interactive media.

Lankow, Ritchie, and Crooks (2012) state that infographics have three main purposes:

- Appeal: The intended message should attract the attention of the target audience.
- Comprehension: The given message should ensure that the information conveyed is presented clearly and effectively. The target audience should easily understand the information presented.
- Retention: The given message should provide permanent information. The target audience should be able to remember the information presented with the infographic. The weight of these purposes varies depending on the purpose of use of the infographic, and their priorities according to the fields are expressed as in Figure 4 (Lankow, Ritchie, & Crooks, 2012).

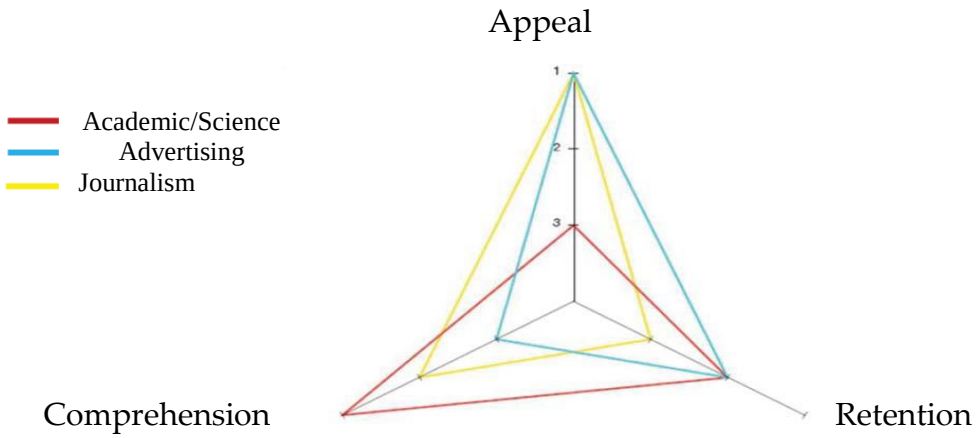

Figure 4. *Infographic usage priorities (Reference: Lankow, Ritchie, & Crooks, 2012: 35)*

Infographics, located at the intersection of verbal and visual elements, offer deeper and more detailed information than a plain text alone. While infographics provide interesting and memorable information and make the content easier to understand, they also have an important power in the field of education in terms of effective transfer of abstract, complex and intensive educational content (Çaka, 2018). In Figure 5, this effect is tried to be explained by the way the brain perceives.

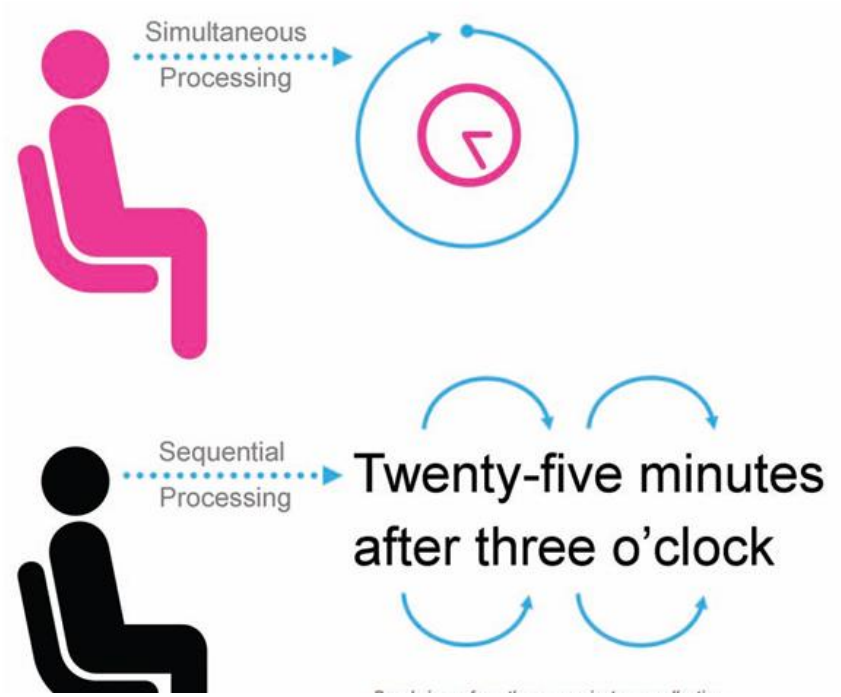

Figure 5. *The Brain's Perception of Text and Visuals (Reference: Smiciklas, 2012).*

As seen in Figure 5, while our brain learns a plain text by chain processing, it learns a visual information by instant processing. This once again shows us the importance of infographics.

When it comes to the structuring of knowledge in the learning process, the purpose of infographics is a cognitive strategy applied in the learning process rather than being focused on conveying a message to the target audience (Nuhoğlu Kibar & Akkoyunlu, 2015). In this sense, infographics can support reading comprehension and writing while strengthening critical thinking and synthesizing skills. They can be useful by combining literacy content with a science lesson, creating a cross-program activity. Teachers can use an infographic that serves as a visual summary of a student's learning experiences. In addition, administrators can use Infographics to understand and analyze the current state of the school for parent presentations or professional development. While infographics focus on reading, knowledge of how to compose these complex texts is equally important. Given the ease with which these texts are shared, a well-designed work can lead to increased collaborative engagement and supportive dialogue (Davis & Quinn, 2014).

When it comes to educational infographics, it comes to mind what kind of balance there should be between the elements of interest, clarity and being remembered, and it can be said that this balance is shaped in line with the design and purpose of the

educational infographic (Nuhoğlu Kibar & Akkoyunlu, 2015). In the context of education, infographic design, the purpose of communication and the roles of the participants in the communication process differ according to the planned learning process. Infographics can be presented to the student by the teacher, can be designed as an information visualization tool to be presented to the teacher and other students by the student, and are used as a visualization method to manage in-group knowledge in a collaborative learning environment. When infographic design is applied to structure knowledge within the learning process, it becomes a cognitive strategy beyond conveying a message to the target audience (Nuhoğlu Kibar, 2016). The fact that infographics are in the learning field necessitates research on their educational use. It is thought that beyond the use of infographics, it will be an effective strategy that will enable learners to gain visual literacy, communication and high-level thinking skills, activate their language expression and visual design skills, and focus on student design. By designing an infographic, it can help students visualize complex information or process, explain, and organize information, and help them to combine and convey the information in their mental image and compiled (Nuhoğlu Kibar & Akkoyunlu, 2015). Although educational infographics have been frequently shared and used on social networks recently, a review of the education-focused literature revealed that there are no studies on infographic design or use.

Yeşiltaş and Cevher (2018) investigated the effect of using interactive infographics in teaching social studies on academic success. The study group of the study, in which a quasi-experimental design with pretest posttest control group was used, consisted of 42 6th grade students. The obtained data were analyzed by means of t-test for independent samples and bidirectional analysis of variance for repeated measurements, and the significance of the data was evaluated at the 0.05 significance level. As a result, it has been determined that the use of interactive infographics in social studies teaching affects academic achievement positively. Social studies teacher candidates and teachers should be informed about the preparation of interactive infographics.

Yıldırım (2018) investigated whether the use of interactive infographics in education has an effect on student academic achievement, attitude towards the course and motivation. In this context, interactive infographics were designed in accordance with the lesson outcomes related to the "Let's Know Our Region" unit of the 5th grade social studies lesson. As a research method, the pretest-posttest control group

design, which is among the experimental research models, was used. The sample of the research is a total of 40 people, 20 experimental and 20 control, studying in the 5th grade of a Secondary School in Istanbul in the 2016-2017 academic year. The Mann Whitney U-Test, which is one of the non-parametric tests, and the independent sample t-test from the parametric tests were used to investigate the hypotheses of the research. The results were analyzed at the .05 significance level. It was concluded that there was a significant difference between the groups.

The purpose of Çaka's (2018) research is to examine the reflections of different infographic designs on success, cognitive load and motivation. The research based on nested experimental mixed design was conducted with 58 pre-service teachers for four weeks in two stages, online and face-to-face. According to the findings obtained from the quantitative and qualitative data of the research, a significant difference in favor of visual intensive infographic was obtained between different material types in terms of achievement, cognitive load and motivation. Visual-intensive infographic, as a simple and tangible teaching material, reduces the cognitive load and time spent, while increasing the level of motivation by providing a remarkable and enjoyable learning experience.

Yildirim et al. (2014) aimed to determine learners' views on creating infographics. The participants of the study, in which the case study model, which is one of the qualitative research methods, was used, consists of CEIT 3rd year students. At the end of the study, which lasted six weeks and participated by 41 students, 10 students were randomly selected and their semi-structured opinions were taken about the infographics they prepared. Before the study, two-week trainings were given about the software used to create infographics and infographic creation methods. Then, students were asked to create infographics about the determined topics for 4 weeks. In the study, data were collected with a semi-structured interview form. The data were analyzed using the content analysis method. As a result of the analysis, students stated that they liked the infographics, they could present the information in a more organized way, and they were more advantageous in terms of both preparation and presentation compared to other visual materials such as posters and banners.

Infographics have an important place in science teaching in terms of reducing the energy spent on interpreting the message in the teaching process, saving time, drawing attention to the most important parts, improving students' distinguishing and interpreting skills, and allowing us to visualize intense information and display

them in an easy, fast and descriptive way (Yeşiltaş & Cevher, 2018). Although it is seen as a cognitive strategy and has an important place in education, research on the use of infographics in education is limited to descriptive studies and should be supported by experimental research (Çaka, 2018). In this context, the aim of the study is to determine the effect of the use of infographics on the academic success and interrogative learning skills of the 4th grade primary school students in the Science course "Lighting and Sound Technologies" unit and whether this effect differs in terms of some variables. In line with this purpose, the problem statement of the research is "What is the effect of using infographics in science lessons on students' interrogative learning skills and achievements?" has been determined. In this context, answers to the following questions will be sought.

1. Is there a statistically significant difference between the achievement test pretest-posttest scores of the experimental group?
2. Is there a statistically significant difference between the achievement test pretest-posttest scores of the control group?
3. Is there a significant difference between the achievement test pretest scores of the experimental and control groups?
4. Is there a significant difference between the achievement test posttest scores of the experimental and control groups?
5. Is there a significant difference between the control and experimental group students according to the achievement test posttest scores in terms of the gender variable?
6. Is there a statistically significant difference between the pretest and posttest scores of the interrogative learning skills of the experimental group?
7. Is there a statistically significant difference between the pretest and posttest scores of the control group's interrogative learning skills?
8. Is there a significant difference between the interrogative learning skills pretest scores of the experimental and control groups? **9.** Is there a significant difference between the interrogative learning skills posttest scores of the experimental and control groups?
10. Is there a significant difference between the control and experimental group students according to the posttest scores of interrogative learning skills in terms of gender?

METHOD

This research, which was conducted with the aim of determining the effect of using infographics in the teaching of the 4th grade "Lighting and Sound Technologies" unit on students' interrogative learning skills and academic achievement, formed the model of quasi-experimental design research with pretest-posttest control group, one of the quantitative research methods. Quasi-experimental models come just after real experimental models in terms of scientific value. It is used when the controls required by real experimental designs cannot be provided (Karasar, 2018). In this design, there are two groups formed by unbiased assignment, and measurements were made before and after the experiment in both groups. Presence of pretests in the design helps to know the degree of similarity of the groups before the experiment and to explain the posttest results accordingly. Accordingly, in the research, first of all, group equivalence was examined and the experimental and control groups were formed from the equivalent groups by unbiased assignment. Both groups were given a pretest before the instruction and a posttest after the instruction.

Study Group of the Research

The study group of the research consists of 40 students, 20 of whom are in the experimental group and 20 of them are in the control group, who are studying in the 4th grade of a primary school in the central district of Afyonkarahisar. There are 17 male and 23 female students in the study group. In Table 1, the descriptive values of the students who make up the study group of the research are presented.

Table 1. *Distribution of Students in Experimental and Control Groups by Gender*

Groups	Gender	N	N(Total)
Experimental group	Female	11	20
	Male	9	
Control group	Female	12	20
	Male	8	

As can be seen from Table 1, the research was carried out on a total of 40 students, 20 in the experimental group and 20 in the control group.

Data collection tool

Achivement Test

The "Achievement Test" developed by Kara (2016) to determine the effect of the use of infographics for the teaching of the "Lighting and Sound Technologies" unit on the academic success of students was used as data collection tool. The item difficulty

index of 10 of the questions in the achievement test consisting of 20 items is less than 0.5, while 10 of them are greater than 0.5. The average difficulty for the 20 items of the test is 0.52. These data show that the test has average difficulty (Kara, 2016).

Interrogative Learning Skills Scale

The "Interrogative Learning Skills Scale", adapted and developed by Evrekli (2016), was used to measure students' interrogative learning skills. Exploratory and confirmatory factor analysis were used together in the analysis of the " Interrogative Learning Skills Scale" developed by Evrekli (2016). Cronbach's alpha value was calculated for the factors in order to calculate the reliability of the structures determined after the exploratory and confirmatory factor analysis. In this context, the reliability value in the dimension of perception towards interrogative learning was .79, the reliability value in the dimension of perception of responsibility in interrogative learning was .75, and the reliability value for the whole scale was .85. In addition, it was observed that the item-total score correlations of the items in the final form of the scale varied between .451 and .556 (Evrekli, 2016). In this study, the reliability of the scale was calculated as .856.

Making the Application

Before starting the study, achievement test and Interrogative Learning Skills Scale were applied to both study groups as a pretest. While science lessons were implemented according to the course curriculum during the "Lighting and Sound Technologies" unit in the experimental and control groups, infographics were additionally used in the experimental group. The application lasted for 5 weeks and at the end of this period, the same achievement test and Interrogative Learning Skills Scale were applied to both groups as a posttest. In both pretest and posttest applications, 40 minutes were given to answer the achievement test consisting of 20 items, and 20 minutes were given for the Interrogative Learning Skills Scale.

Analysis of Data

In the study, the data obtained from the pretest and posttest were transferred to the computer environment for evaluation. In the achievement test consisting of multiple choice questions, the answers students marked as correct were coded as '1' point, and the answers they marked as incorrect were coded as '0'. Normality test was performed to see the distribution of the data obtained from the achievement test. As a result of this evaluation, the p value emerged as .18, and when >.05, it was concluded that the data showed a normal distribution. In the analysis of the data

obtained from the Interrogative Learning Skills Scale, firstly the normality test was performed and then descriptive statistics were used.

Table 2. *Normality Test Results*

Scales	Kolmogorov-smirnov			Shapiro-Wilk		
	Statistics	df	sig	Statistics	df	sig
Achievement test	116	40	.188	.957	40	.133
Interrogative Learning Skills Scale	.123	40	.130	.912	40	.124

According to Table 2, it can be said that there is no statistically significant difference (p>.05), that is, the groups are equivalent to each other. One of the two equal branches was assigned as the experimental group and the other as the control group through impartial assignment.

ASSUMPTIONS

1. Students answered the data collection tools sincerely and accurately.

2. The effects on the students included in the research are the same outside the experimental conditions and there is no significant special effect.

LIMITATIONS

1. This research is limited to 40 students studying in the 4th grade at a secondary school in the Central district of Afyonkarahisar province in the 2022-2023 academic year.

RESULTS

In this section, research findings will be discussed in the context of research sub-problems. In this context, firstly, the first sub-problem of the research is "Is there a statistically significant difference between the achievement test pretest and posttest scores of the experimental group?" The findings regarding the question are included (Table 3).

Table 3. *Experimental Group Achievement Test Pretest-Posttest Scores*

Experimental Group	N	Mean	df	Ss	t	p
Pretest	20	11.30	19	3.68	13.70	.00
Posttest	20	16.40	19	3.28		

According to Table 3, the achievement test average score of the students in the experimental group before the application was calculated as $\bar{x}$ = 11.30. The average achievement test score of the same group after the application was calculated as $\bar{x}$ =

16.40. This shows that there was a positive change in the achievement levels of the students in the experimental group before and after the application. In addition, when the means of pretest and posttest applications are compared, it is seen that the p value is <.05. This can be expressed as the difference being statistically significant.

The second sub-problem of the research is "Is there a statistically significant difference between the achievement test pretest and posttest scores of the control group?" was determined.The data related to this are given in Table 4:

Table 4. *Control Group Achievement Test Pretest-Posttest Scores*

Control Group	N	Mean	df	Ss	t	p
Pretest	20	11.45	19	4.43	11.55	.00
Posttest	20	12.70	19	5.03		

According to Table 4, the pretest mean score of the students in the control group was calculated as $\bar{x}$=11.45, and the posttest results were calculated as $\bar{x}$=12.70. Although the difference between the means of the two groups is statistically significant, p <.00, it is noteworthy that there is no big difference between the means. The students in the control group, who were not subjected to any application, continued the curriculum at their own grade level. It can be said that this difference may be due to the continuation of the learning process.

The third sub-problem of the research is "Is there a significant difference between the achievement test pretest scores of the experimental and control groups?" has been determined. The data related to this are given in Table 5.

Table 5. *Achievement Test Pretest Scores of Experimental and Control Groups*

Groups	N	Mean	df	Ss	t	p
Experimental Pretest	20	11.30	19	3.68	13.70	.38
Control Pretest	20	11.45	19	4.43		

According to Table 5, the achievement test average of the experimental group before the application was calculated as $\bar{x}$=11.30, while the achievement test average of the control group was $\bar{x}$=11.45. Before the application, the success averages of both the experimental group and the control group were very close to each other. In fact, the very small mean difference can be said to be in favor of the control group. The difference is not statistically significant (p>.05). This shows that both groups have similar characteristics in terms of success.

In Table 6, the fourth sub-problem of the research, "Is there a significant difference between the achievement test posttest scores of the experimental and control groups?" Here are the findings regarding the question:

Table 6. *Achievement Test Posttest Scores of Experimental and Control Groups*

Groups	N	Mean	df	Ss	t	p
Experimental Posttest	20	16.40	19	3.28	22.3	.00
Control Posttest	20	12.70	19	5.03		

Table 6 includes comparisons regarding the achievement test applied to the experimental and control groups after the application. Accordingly, after the application, the average of the achievement test applied to the experimental group was $\bar{x}$=16.40, while the average of the achievement test applied to the control group was $\bar{x}$=12.70. The averages appear to be in favor of the experimental group. Additionally, the difference is statistically significant (p<.05).

In Table 7, the fifth sub-problem of the research, "Is there a significant difference between the control and experimental group students according to the achievement test posttest scores in terms of the gender variable?" There are findings regarding the question.

Table 7. *Gender-Related t-test Scores of Experimental and Control Groups*

Groups	Gender	N	Mean	Ss	t	p
Experimental Posttest	Female	10	16.90	2.37	.671	.511
	Male	10	15.90	4.06	.671	
Control Posttest	Female	10	13.40	6.04	.611	.549
	Male	10	12.00	4.00	.611	

Table 7 contains the findings regarding whether the posttest results of the experimental and control groups differ according to the gender variable. While the posttest average of the experimental group was calculated as $\bar{x}$=16.90 for females, it was calculated as $\bar{x}$=15.90 for male participants of the same group. This small difference is not statistically significant (p>.05). The achievement test posttest scores of the participants in the experimental group did not differ according to the gender variable. In the control group, the average of female participants was calculated as $\bar{x}$=13.40, while the average of male participants was calculated as $\bar{x}$=12.00. The difference between the means is not statistically significant (p>.05). Achievement test averages of the students in the control group do not differ significantly according to the gender variable.

In Table 8, the sixth sub-problem of the research, "Is there a statistically significant difference between the pretest and posttest scores of the interrogative learning skills of the experimental group?" There are findings regarding the question.

Table 8. *Experimental Group Interrogative Learning Skills Pretest and Posttest Scores*

Experimental Group	N	Mean	df	Ss	t	p
Pretest	20	52.80	19	11.43	20.65	.00
Posttest	20	59.45	19	4.90		

According to Table 8, while the pre-test mean score of the experimental group's interrogative learning skills was $\bar{x}$=52.80, the post-test mean score of the same group's interrogative learning skills was calculated as $\bar{x}$=59.45. However, the pretest and posttest mean scores of the experimental group show a statistical difference ($p < .05$). This situation can be said that after the application, the interrogative learning skills of the experimental group changed in favor of the group.

In Table 9, the seventh sub-problem of the study, "Is there a statistically significant difference between the pretest and posttest scores of the control group's interrogative learning skills?" There are findings regarding the question.

Table 9. *Control Group Interrogative Learning Skills Pretest and Posttest Scores*

Control Group	N	Mean	df	Ss	t	p
Pretest	20	55.30	19	7.43	33.26	.55
Posttest	20	55.95	19	7.78		

According to Table 9, the pretest mean score of the control group's interrogative learning skills was calculated as $\bar{x}$=55.30, while the posttest mean was calculated as $\bar{x}$=55.95. The pretest and posttest averages of the group do not show a statistically significant difference. It can be thought that this situation may be due to the fact that no application was applied to the control group.

In Table 10, the eighth sub-problem of the research, "Is there a significant difference between the interrogative learning skills pretest scores of the experimental and control groups?" There are findings regarding the question.

Table 10. *Experimental and Control Group Interrogative Learning Skill Pretest Scores*

Groups	N	Mean	df	Ss	t	p
Experimental Pretest	20	52.80	19	11.43	20.65	.37
Control Posttest	20	55.30	19	7.43		

Table 10 includes the scores of the Interrogative Learning Skills Scale applied to both the experimental group and the control group before the application. In this evaluation made before the application, the average of the experimental group was calculated as $\bar{x}$=52.80, while the average of the control group was calculated as $\bar{x}$=55.30. This difference is in favor of the control group, but the difference is not statistically significant ($p > .05$).

In Table 11, the ninth sub-problem of the study, "Is there a significant difference between the interrogative learning skills posttest scores of the experimental and control groups?" There are findings regarding the question.

Table 11. *Interrogative Learning Skill Posttest Scores of the Experimental and Control Group*

Groups	N	Mean	df	Ss	t	p
Experimental Posttest	20	59.45	19	4.90	54.21	.00
Control Posttest	20	55.95	19	7.78		

According to Table 11, the average posttest score of the experimental group's interrogative learning skill after the application is $\bar{x}$=59.45. The average of the control group is $\bar{x}$=55.95. The difference in pretest scores in favor of the control group became in favor of the experimental group after the application. However, this difference is statistically significant ($p<.05$).

In Table 12, the last sub-problem of the research, "Is there a significant difference between the control and experimental group students according to the posttest scores of interrogative learning skills in terms of gender?" There are findings regarding the question.

Table 12. *Gender Related t-test Scores of Experimental and Control Groups*

Groups	Gender	N	Mean	Ss	t	p
Experimental Posttest	Female	11	60.80	4.66	1.249	.228
	Male	9	58.10	4.99		
Control Posttest	Female	12	56.20	6.10	.140	.891
	Male	8	55.70	9.52		

In Table 12, the posttest scores of interrogative learning skills applied to both the experimental group and the control group after the application were evaluated according to the gender variable. Accordingly, the average of women in the experimental group was calculated as $\bar{x}$=60.80, while the average of men was calculated as $\bar{x}$=58.10. While the small difference is in favor of women, this difference is not statistically significant. However, while the average of women in the control group is $\bar{x}$=56.20, the average of men is $\bar{x}$=55.70. Here too, the small difference appears to be in favor of women, but this difference is not statistically significant. This shows that interrogative learning skills do not differ according to gender, both in the experimental group where the application was made and in the control group where no procedure was carried out.

CONCLUSION AND DISCUSSION

This study, which examines whether the use of infographics in the Science course affects students' interrogative learning skills and academic achievement, was carried out as a quasi-experimental study. Research findings indicate that both the academic success and interrogative learning skills of the students in the experimental group, where infographics were used in the Science course, changed in favor of the students. The pretest results conducted before the application show that the academic achievements and interrogative learning skills of the experimental and control groups are similar to each other. Posttests conducted after the Science units covered with infographics show that academic success and interrogative learning skills in the experimental group where the application was carried out reached a different level than the control group. This difference may be due to infographics that present students' Science course both visually and by summarizing academic information. Web-based technology tools such as infographics provide learners with opportunities to interact by providing opportunities such as giving and receiving feedback during the learning and teaching process, and provide modeling opportunities for teachers on how to perform a task (Kitsantas & Dabbagh, 2011). In this study, infographics offered students the opportunity to model the information they learned.

The pretest and posttest scores of the achievement test of students who use infographics in the Science course show a statistically significant change. However, there is no change in the students in the control group. This can be interpreted as students who use infographics in lessons learn the relevant subjects better, especially in Science courses, and therefore their academic success increases. In a study conducted by Haşlaman (2018), infographics were used by teacher candidates. Teacher candidates stated that they adopted using infographics and found it useful. They also stated that the benefits of infographics were much greater than they expected and that it was the best and most effective activity they encountered during the semester and suggested that it be used in other courses. The fact that pre-service teachers were aware of their experiences in their own learning processes played an important role in supporting their permanent learning skills. Participants stated that they would use infographic applications in their teaching lives.

While the posttest scores on the achievement test of students who use infographics in science courses do not differ according to the gender variable, they differ from the control group that is not subject to any application. This can be expressed as the use

of infographics does not make any difference between genders in terms of academic achievement. While the main purpose of infographics is to realize understanding and remembering by using visual metaphor, symbol, iconography and decorative frame, the most basic principle in multimedia learning is that learners have a more effective learning process when words and pictures are used together. In infographic design, visualization is important in terms of providing a more effective comprehension of the content and facilitating understanding, and it is emphasized that the most powerful visualizations are those supported by narrative. Infographics can be considered as a tool in the process of information transfer between instructor-learner, learner-learner, learner-learner, learner group-learner group in the learner's process of structuring knowledge, and in the process of evaluating the learner and the learner group (Nuhoğlu Kibar & Akkoyunlu, 2015).

In Çaka's (2018) study, data to evaluate the effectiveness of different types of materials in terms of academic success were collected through achievement tests administered in the form of pre-test and posttest and weekly participant opinions. According to the data obtained from the pretest and posttests, the effect of material type and measurement time on academic success is significant and there is a significant progress from pretest to posttest in all material types. When all materials are evaluated in the context of academic achievement, according to the majority of the participants, the most effective material is visual intensive infographic, while the weakest material is only text material. Participants emphasized that infographic-based materials should be understandable and eye-catching, and that as visuality increases, concreteness and therefore permanence increases. According to the findings obtained from the quantitative and qualitative data of this research, which was conducted to determine the difference between the academic success, cognitive load and motivation levels of the participants who learned with infographic designs, a significant difference was obtained in the context of all variables. It has been observed that the difference in question is in favor of visually intense infographics in the context of all variables.

In another study conducted by Münchow, Mengelkamp and Bannert (2017), where the effect of multimedia on motivation and success was examined, it was aimed to reveal the effect of a learning environment enriched with design elements such as shape and color on motivation and success. According to the results of the research conducted with 111 university students, the design elements in question affect the learner's motivation positively, and as the motivation increases, the level of success also increases.

Another result of the research is related to students' interrogative learning skills. The Interrogative Learning Skills Scaleapplied to the experimental and control groups after the application was in favor of the experimental group students. In addition, the pretest and posttest results applied to the experimental group show that there is a difference in students' interrogative learning skills after the application. In a study conducted by Yıldırım, Yıldırım, Çelik and Aydın (2014), it was seen that participants who learned infographics for the first time had a high level of appreciation. Participants think that infographics are more effective than other visual materials. This may be due to the fact that infographics provide effective information presentation as well as their superior visual features. Participants think that it is easy to prepare infographics with the help of various programs. This may be due to the fact that the study group has high skills in both instructional material development and computer use.

The study conducted by Schüler (2017) aimed to provide experimental evidence for the multimedia principle. The research was conducted with 96 university students. In the application carried out in two groups, one group was presented with consistent text-image information on a single page, while the other group was presented with two pages of inconsistent text-image information and the eye movements of the participants were recorded. According to the results of the research, participants attempted to integrate text and image content for inconsistent content as well as for consistent content. This situation causes learners to spend more time. In addition, during the process of processing information, learners create two separate models for verbal and visual elements and then integrate them.

The study conducted by Al Hosni (2016) aimed to examine the effect of using infographics as a teaching material in English education on the comprehension and recall levels of learners. The research was conducted with 27 university students. In the application carried out in two groups, a printed material was used as teaching material in one of the groups, while an infographic version of the same content was used in the other group. According to the findings of the research, the use of infographics as a teaching material has a positive effect on learners' recall and comprehension levels.

As a result, the use of infographics in the Science course positively affected both the academic success and interrogative learning skills of the students. On the other hand, infographics made the learning environment student-centered by enabling the student to actively participate in the lesson. Thus, students will be able to acquire the

ability to take responsibility for learning. This study was specifically discussed within the scope of the Science course. Possible future studies can examine the use of infographics in different disciplines.

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