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The Effect of Infographics in Mobile Learning: Case Study in Primary School

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Abstract: This research aims to investigate the effects of infographics as a new method of visualisation tool by focusing on the fifth grade primary school students' academic success, the retention levels of their achieved knowledge and the views of the students about the use of infographics in Maths, Turkish, Social Sciences and Science and Technology courses. Considering this main objective of the study, the research design was a combined quantitative and qualitative research, and the quantitative research was based on the post-test only control group experimental design. The study revealed that the use of infographics in education had a positive impact on the academic success in four courses. Along with that, the achievement tests given also showed that the use of infographics in education had influenced the retention levels of the students' achieved knowledge positively in three courses: Turkish, Social Sciences and Science and Technology.

Keywords: Infographic, Infographics, Elementary Education, Mathematics, Turkish, Social Sciences, Science and Technology
Categories: L.1.2, L.3.0, L.3.5, L.3.6, L.6.1

1 Introduction

Technological developments and their integration in education have opened new paths which enable materials that are different in type and structure to be used in educational environments. [Bausell 2008] stated that the scientific and technological developments also have an impact on the educational system, and due to this fact the learners should be exposed to new information and communication technologies in order to enhance learning and get the students ready for their future working or studying environments. [Renshaw and Taylor 2000] argued that the educational environments where technology is integrated allow students to find a room for a personalized education solve the time and environment issues and support different types of learning. The integration of information and communication technologies in learning and teaching processes is beneficial in various ways for both the educators and the learners [Vladescu 2016]. Information and communication technologies are an important instructional tool that enables the achievement of instructional objectives and provides knowledge retention [Cartwright and Hammond 2003]. Likewise, information and communication technologies which embody a basic and innovative

approach make it possible for the learners to access information easily, be active in learning and provide knowledge retention [Buster 2006] [Ozcan et al. 2015] [Kalelioglu 2016].

Hand-made traditional instructional tools were used in education in the past. However, the technological tools, especially computers, are used in production and designing of teaching materials in recent times. The designing, application and the characteristics of different types and features of teaching materials are popular topics in the literature of education.

Teaching materials are being used as an enhancing feature during teaching and learning processes. The teaching materials which are chosen appropriately, serve the lessons and the target, enhance the lessons, enrich the learning process and increase learning. Moreover, the teaching materials also have a positive impact on the learners' motivation and attract their interest to the lessons [Ceker and Ozdamli 2016] [Demiralp 2007]. [Uzunboylu and Tugun 2016] stated that using materials during the teaching and learning processes creates opportunities for both the teachers and the learners in terms of making abstract concepts concrete, the complex items simpler to understand, making learning more real, making it possible to reach to concepts which are not easy to see and conceive, giving opportunity to exercise and repeat, presenting, providing knowledge retention, supporting different types of learning, shortening the time spent teaching and enhancing productivity. [Yalin 2010] argued that using materials in education provides a multiple learning environment, answers the students' personal needs, enhances motivation and attention of the students and provides safe environments for observation.

Teaching materials embody a crucial role with the possibilities they offer during the learning and instructional processes along with the developments in technology and in-service and pre-service teachers, as significant stakeholders of education should be able to benefit from them [Prevalla 2016] [Alakurt 2017]. Therefore, the in-service and pre-service teachers should be able to design teaching materials and use them appropriately. The current teacher training programs offer 'Instructional Technology and Material Development' courses to the pre-service teachers in order to train them in material development and improve their skills about using materials properly.

As stated by [Beydogan 2011], 'Instructional Technology and Material Development' courses are able to acquire pre-service teachers with the skills of developing, using and evaluating educational tools, materials, technologies and instructional technologies. [Cakir 2006] argued that technology should not be excluded from the learning environments and that the instructors should be trained enough to use the teaching materials and tools efficiently.

Visual materials are used widely during the learning and instruction processes. [Smaldino et al. 2007] stated that the use of visual materials in teaching makes objects and concepts related to the lessons concrete, makes abstract thoughts concrete, increases motivation which leads to involvement of the students to the courses, increases the diversity of the teaching environments, helps the learners recall previously learned information, improves the learners' critical thinking skills and saves both time and effort. [Ucar 2004] argued that messages which are prepared as visual communication materials have better persistency compared to aural communication materials.

[Yeh and Cheng 2010] emphasise the importance of visualising information and state that from the beginning of civilization visuals are being used in communication and learning processes. Moreover, it is argued that both printed materials and media technologies such as visuals enhance learning so they must be integrated within educational processes. According to [Castelyn and Mottart 2012], the usage of visuals in education leads to active learning and that the instructors should use different types of visuals that incorporate with the course content which increases the learners' performance and motivation.

Visuality has been gaining importance in learning and teaching processes similar to its increased importance in our daily lives. Visuals when used separately or when used combined with writing is known to enhance learning. There is a general belief that visuals are easier to understand when compared to writing. Along with that, visual materials have universal acceptability when compared to written materials. Visuals provide many opportunities to help learners grasp the content, attract the learners' attention, motive them, allow complex and abstract ideas to be learned effectively, provide interactive learning environments and make recalling information easier. Furthermore, Winarski pinpointed the power of visuals as a mean of communication and instructing tool [Isler 2003]. There are many scientific studies about the use of different types of visual materials in teaching environments in the literature.

[Demirci 2008] investigated the effect of the use of computer-aided static and dynamic visual materials on student success in Chemistry teaching. The research showed that using visual materials in Chemistry lessons had a positive impact on student success. Similarly, [Eroglu 2006] investigated the effect of using visual and aural materials when eighth grade secondary school students were learning concepts related to Biotechnology and their attitudes towards it. The results of the research stated that visual and aural material-aided instruction had a positive impact on student success.

[Gultekin 2009] investigated the effect of the use of visual materials during the instruction of psychomotor learning when teaching some of the basic skills in basketball to the fifth and sixth grade primary school students' physical education lessons. When the results of the study were evaluated, it was stated that the use of visual materials had a positive impact on the learning of psychomotor skills of the students. Similarly, a research by [Canning-Wilson 2011] investigated the impact of using visual materials when teaching languages. The results showed that using visual materials when teaching languages had influenced students' motivation, success and attitude positively.

[Catak and Tekinarslan 2008] investigated the effect of using reading materials prepared with PowerPoint on the reading ability of the students with mild mental retardation. The results of the study implied that the reading materials prepared with PowerPoint which used visuals mostly had a positive contribution on reading skills of the students with mild mental retardation. Moreover, the results implied that using the developed materials helped the students with mild mental retardation to concretize and interpret words, sentences and text effectively. Another similar research by [Ayyildiz 2010] investigated how using cartoons as visual materials when teaching Geography influenced students' success. The study which used pre-test post-test

control group design had contributed positively to the students' success when using cartoons as visuals.

As it can be observed in the literature review, the use of visuals during learning and instructional processes offers many advantages. Thus, real photos, illustrations and drawings are used frequently because of their attractiveness, attention drawing feature and motivating characteristic. In recent times, the use of infographics as visual presentation of information and messages has been a trend in educational technologies and social media. Infographics, also accepted as information graphics, are based on transmission of information in graphical forms [Baglama et al. 2017].

Infographics can be described as the design of arranging information with graphical features and transferring it to the recipient. [Educatorstechnology 2016] stated that infographics have a significant role when considering the competence of the educators in the 21st century. Furthermore, infographics have a structure that arranges profound and complex information with an aesthetic design and present the content of the subjects to the recipients using illustrations, photographs, maps, symbols, diagrams, pictograms and colour codes [Ozturk 2012]. Another research by [Smiciklas 2012] similarly stated that detailed and complex contents can be visualized into easily understood and quickly perceived contents by people with the use of infographics.

[Islamoglu et al. 2015] stated that infographics which were defined as a new field of competence for teachers became popular in both printed and digital environments and were used to visualize data. [Zedeli 2014] defined infographics as 'making a visual story out of information'. [Smiciklas 2012] defined infographics as information design or information architecture of visual representation of data and information, aiming to present complex and detailed information in a fast and easy way visualising the data and keeping in mind the general aim and target.

[Simiciklas 2012] associated the reason behind visuals being grasped more quickly compared to written information with the way the brain perceives information. Along with that, the brain evaluates information consisting of visuals as a whole, while written data is evaluated linearly. These are the reasons why [Simiciklas 2012] stated the idea that infographics make communication and transferring of information easier and provide viewers with an easy and effective way of understanding of complex information. [Ozdamli et al. 2016] stated that infographics which are effective in presenting complex and long-text information in simple and easily understood manner are highly beneficial materials for transferring information, and are used not only in educational environments but also in various situations such as academic settings and social media. [Davis and Quinn 2014] stated that infographics embodying all these characteristics also support the development of the learners.

Infographics differ from other types of visualization tools in terms of being effective when understanding and learning of profound and complex information related to the subject by simple typography and page layout. Infographics which consist of a combination of design elements (maps, diagrams and tables) related to the content and are created with the help of graphical items (colour and typography) are important tools in teaching and learning processes because of their extensive design factor, graphical elements and design principles [Lai et al. 2016] [Nuhoglu and Akkoyunlu 2015]. These characteristics of infographics allow students to understand

information and form basis in an organized way and may also help students build critical-thinking abilities [Hart 2013].

Using infographics in both printed and digital areas provides great ease for teachers and students in terms of integrating into different environments. In particular, mobile technology, which is being used recently, provides great advantages in terms of sharing and presenting infographics. While [Lai et al. 2016] indicate that the use of mobile technologies in educational environments has increased over the last 10 years. [Gloria and Oluwadara 2016] point out that mobile technologies offer advantages such as ease of use and portability in terms of educational presentations. [Chu 2014] states that mobile and wireless communication technologies have progressed in recent years, and that mobile technologies have increased the number of researches on mobile learning in recent years and that mobile technology has provided learners with instant access to online resources.

1.1 Theoretical Background

Infographics is a data visualisation method derived from the words info (information) and graphic, which is also known as information graphics. An examination of the studies in the literature reveals different definitions of infographics as a current concept. Used in transferring information and in communication processes, infographics [Lankow et al. 2012] is a visualisation method which became very popular combining data visualisation elements with a visual organisation within the design. In addition, infographics effectively construct information in the format of a story using visual design principles and present them to the reader [Harrison et al. 2015]. Similarly, [Ru and Ming 2014] emphasized about infographics the definition of a visualisation method which benefits from graphics and visual presentation to convey data or information.

Today infographics can be used for different educative purposes. Through infographics, it can be possible to present information with a wide coverage easily and rapidly. Thus, remembering the previously learned information, reflecting the relationships between concepts and elements, conveying processes or events in an effective way, presenting course contents and summarising data can be easier through infographics [Meeusah and Tangkijviwat 2013]. In a similar vein, infographics is an attractive method to make contents more easily understandable and accessible. It is seen today that most designed infographics are focusing on daily topics and technological trends; however, they also began to gain popularity for educative purposes [Sudakov et al. 2014].

In the literature, it is emphasized that successful and well-designed infographics should have some characteristics.

In addition to these pieces of information, when studies in the literature are examined, it can be seen that some recommendations are made to finalise infographic design process successfully and effectively. [Rajamanickam 2005] emphasises the necessity to consider three basic principles in the successful design of infographics. The first principle is to clearly choose among spatial, chronological or quantitative communication patterns in communication process. Second principle is to ensure that information is constructed so as to create a meaningful and consistent whole. The last principle is to decide the medium where infographic is to be presented. Similarly, [Davidson 2014] states that a well-designed infographic should represent a story, that

it should be attractive, that the used images should be related to the content, and that there should be consistency among elements. [Davis and Quinn 2014] emphasise the need for determining the purpose, deciding the elements to be included in the design, deciding on the type of infographic, and organizing and presenting the information at a level that the target audience can understand in the infographic design process. [Golombisky and Hagen 2013] argue that in the infographic design process designer should perform adequate research on the content so as to possess adequate knowledge about the topic content. In addition to this suggestion, researchers state that elements used in infographics should constitute a whole, that a guide could be used for organising information, and that information and elements should be grouped in order to prevent a possible complication. [Kos and Sims 2014] emphasized in their study the elements of 'consistency', 'legibleness', 'emphasis' and 'simplicity' in the design of infographics in their study.

2 The Aim of this study

Considering all the aspects of infographics, it is thought that they are beneficial in educational environments in terms of aspects such as academic success, knowledge retention and motivation. Additionally, infographics have the possibility of being integrated with printed materials, digital media and other types of materials, and this offer a great advantage for the learning environments. However, considering all the beneficial aspects embodied by infographics and their popularity within the literature, it is still hard to find scientific studies on design and use of infographics in education. Likewise, [Nuhoglu and Akkoyunlu 2015] also stated that infographics, even the educational ones, have a widely spread use in digital platforms especially in digital media, but there are only few studies about the design and use of infographics in the literature of education. Considering all these general knowledge and needs about the infographics, this research aimed to investigate the use of infographics in education of fifth grade primary school students' academic success, knowledge retention, and evaluation of the students' views about the use of infographics in Maths, Turkish, Social Sciences and Science and Technology subjects. The specific objectives of the study are listed in the following.

1) Is there a significant difference between the post-test results of the experimental group who were instructed using infographics and the control group who were instructed using traditional materials in terms of academic success in Maths, Turkish, Social Science and Science and Technology courses?

2) Is there a significant difference between the retention test results of the experimental group who were instructed using infographics and traditionally instructed control group students' Maths, Turkish, Social Science and Science and Technology courses?

3) What are the views of the experimental group students' about the use of infographics in education?

3 Methodology

Both qualitative and quantitative data gathering methods were combined in this study.

3.1 Research Model

The study which aimed to investigate the use of infographics in education used post-The study aimed to investigate the use of infographics in education-used post-test control group experimental design. In this context, this research aimed to investigate the effect of the use of infographics on student success at the end of the application. Pre-test was not given to the research participants as the content of the lessons was new to them.

The interview method was used with the experimental group in order to determine their views about the use of infographics during the lessons. [Yildirim and Simsek 2005] stated that the interview method is a powerful method in terms of revealing the data, views, experiences and feelings of the individuals.

Group	Material	Post Test
Experimental group	Infographics	Achievement Test Retention Test Semi-structured Interview Form
Control group	Traditional Materials	Achievement Test Retention Test

Table 1: Design of the Research

3.2 Participants

Eighty two fifth grade primary school students from a private school in Cyprus participated in this study (Study: 41 and Control: 41). The research design was applied to both the control and experimental group simultaneously. All of the participating experimental and control group fifth grade primary school students were 11 years old. The 41 students in the experimental group consisted of 25 female and 16 male students, while the students in the control group consisted of 21 female and 20 male students.

3.3 Data Collection Tools

In the quantitative dimension of the study, separate achievement tests were developed for four classes and then the same tests were used as retention tests. Semi-structured interview forms were used for the qualitative dimension of the research.

3.3.1 The achievement tests on Maths, Turkish, Social Sciences and Science and Technology Subjects

Four different achievement tests each consisting of 20 items were used for Maths, Turkish, Social Sciences and Science and Technology subjects. The achievement tests were prepared as multiple choice items and included all the content given during the application process. These achievement tests were prepared by the class teachers of the classes which were included in the research and application. The expert opinion of 15 specialists, 10 of which were academics and 5 teachers were taken for the

reliability and validity of the tests developed and were practised with 62 students. KR-20 reliability coefficient statistical evaluation was used for the reliability of the tests.

The achievement tests applied at the end of the research were reapplied after a month in order to determine the retention of the learned information.

3.3.2 Semi-structured Interview Form Developed for the use of Infographics in Education

A semi-structured interview form consisted of four items developed in order to evaluate the students' views on the use of infographics in education. The literature of the content validity was reviewed, while preparing the interview questions. In order to determine the clarity of the items and the way they serve the purpose of five education technologists' and five primary school teachers' opinions were received. The interview questions were prepared in order that they were appropriate for the fifth grade primary school students' age group.

3.4 Application

The application process of the research was structured as 12 weeks. In the application process, 52 hours for Turkish classes, 52 hours for mathematics classes, 28 hours for social sciences classes and 24 hours for science and technology classes were spared for the current weekly course programme of fifth grade students. The application process was carried out staying loyal to the fifth grade primary school students' current syllabus, and the courses were carried out concurrently with the experimental group whom were instructed using infographics and the control group whom were instructed using traditional teaching materials. Table 2 shows the course content of the Maths, Turkish, Social Sciences and Science and Technology subjects.

Maths	Turkish	Social Sciences	Science and Technology
• Fractions • Percentages • Geometric shapes	• Root and types of roots • Inflectional suffixes • Derivational affixes • Word structure	• Democracy • Legislation • Assembly of the Republic • President of the Republic • Council of Ministers • Government Formation Process	• Earth crust • Extractive resources • Mine • Avalanche • Erosion
11 infographics	9 infographics	12 infographics	10 infographics

Table 2: The Course Content Used during the Application Process

The researcher designed the infographics using CorelDRAW X7 software before the application process by taking into consideration the course content and intended learning outcomes shown in Table 2 and by taking the opinions of the course teachers. The infographics that were used in the instruction process were prepared by taking the

opinions of the class teachers of the classes that the application was made and ten experts in the field considering several criteria such as appropriateness to the target audience, graphic design criteria, content, student learning outcomes and students' prior knowledge. Infographic evaluation rubic was used in evaluating infographics. The infographics were rearranged considering the opinions taken, got ready for the application. Figures 1–4 show the examples of infographics designed for each subject.

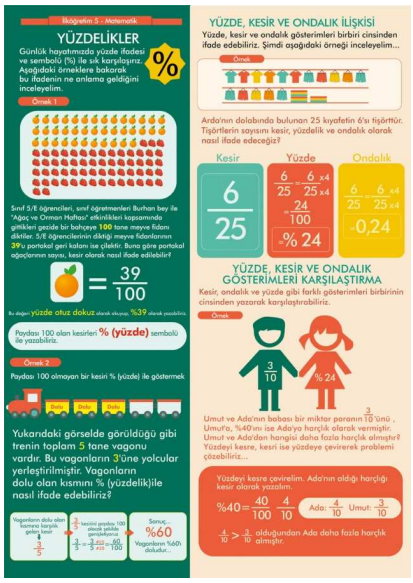


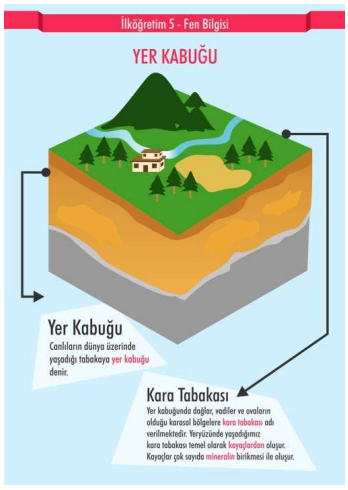
Figure 1: Maths - inforaphic about percentages & Figure 2: Turkish - infographic about inflectional suffixes

The school where the study took place uses mobile-supported education with tablets so all the students had tablets. The infographics designed according to the course content the experimental group were shown by QR code links on stickers which were stuck on the students' notebooks and textbooks. The instructors asked the students to scan the related QR codes. Furthermore, the instructors showed the infographics using projections when necessary. The students had the opportunity to view the infographics, whenever they wanted to revise and strengthen the content they learned.

The control group was instructed only using the textbooks and course materials on their tablets throughout the term. The infographics could only be viewed by the experimental group students as the system banned the control group students from viewing them.

At the end of the 12 weeks, the achievement tests for four different courses were given to both the experimental and control groups. Interviews with 41 students from the experimental group were made to determine the thoughts of the students about infographics. The interviews were recorded with a voice recorder and converted to an academic record with the permission of the students to ensure that no data were lost. 'Coding according to concept derived from data' technique was used for qualitative

data. A researcher and field expert academician coded the data separately and then compared them. The data collected from the students' answers in this research were coded separately and put together according to certain concepts. The frequencies of these codes were then presented as tables to make it easier for the reader. The identities of the students interviewed were kept secret and each one was given a number (First Student: S1, S2…). Besides this, the achievement tests were given again one month later in order to test knowledge retention.



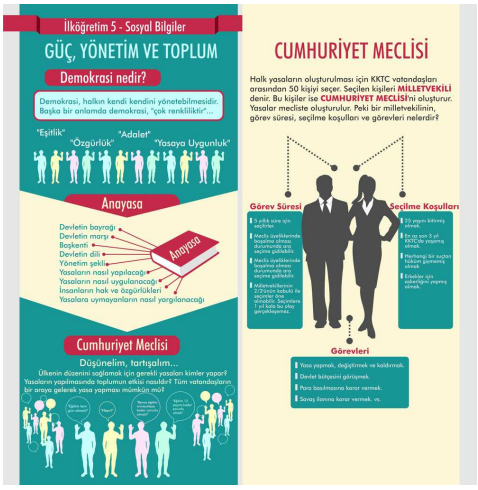


Figure 3: Science and Technology - infographic about Earth crust & Figure 4: Social Sciences - infographic about democracy

3.5 Data Analysis

The quantitative data collected during the experimental application process of the research were analysed using SPSS 20. First, the analysis of research data included Shapiro-Wilk test in order to see whether post-test and retention test data showed normal distribution. As can be seen in Table 3, significant values of the data (p) show normal distribution. In addition, Levene test was conducted for variance homogeneity, and it was found out that the data were homogeneous. Analysis concluded that the data were suitable for parametric tests. Frequency, percentage, arithmetic mean and standard deviation were used in order to determine post-test academic success grades of the fifth grade students in the experimental and control groups, and t-test were applied in order to compare the results of the post-test success grades of the experimental and control groups.

The qualitative data gathered from the semi-structured interviews were analysed using Nvivo 10 and the content analysis method, and the data were presented as frequency in the tables.

			p	**Explanation**
Math		Post-test	0.10	There is normal distribution
		Retention	0.12	
Turkish		Post-test	0.16	There is normal distribution
		Retention	0.2	
Social sciences		Post-test	0.11	There is normal distribution
		Retention	0.09	
Science and technology		Post-test	0.16	There is normal distribution
		Retention	0.2	

Table 3: Shapiro-Wilk Test Results

4 Findings

The main objective of the study is presented under subtitles below with the data collected considering the specific objectives of the study.

4.1 The post-test results of the experimental and control group students' academic success in Maths, Turkish, Social Sciences and Science and Technology

The experimental group students' academic success in Maths, Turkish, Social Sciences and Science and Technology subjects is presented in Table 3.

	Group	*N*	$\overline{X}$	*S*	sd	*t*	P
Maths	Experimental	41	73.7	17.6	77.3	0.683	0.496
	Control	41	71.2	14.6			
Turkish	Experimental	41	84.4	13.5	79.8	2.129	0.056
	Control	41	78.2	12.9			
Social Sciences	Experimental	41	91.7	10.4	71.3	6.172	0.000
	Control	41	74.1	15.0			
Science and Technology	Experimental	41	82.6	14.1	79.9	3.748	0.000
	Control	41	71.0	13.8			

Table 4: The comparison of the post-test success scores of the experimental and control group students

According to Table 4 the experimental group students whom were instructed using infographics had the average score of 73.7 in Maths post, 84.4 in Turkish, 91.7 in Social Science and 82.6 in Science and Technology. The academic success scores were given out of 100 and the lowest score was 30 in Maths, 50 in Turkish, 65 in Social Sciences and 45 in Science and Technology. According to the same data, it was observed that the highest score achieved was 100 for all the subjects.

The academic success scores of the control group students whom were instructed using the traditional teaching techniques shown in Table 4 were 71.2 for Maths, 78.2 for Turkish, 74.1 for Social Sciences and 71 for Science and Technology. The academic success scores were given out of 100 and the lowest score was 30 in Maths, 40 in Turkish, 30 in Social Sciences and 35 in Science and Technology. According to

the same data, it was observed that the highest score achieved was 100 for all the subjects.

The data showed that the post-test academic success grades of the experimental group students whom were instructed using the infographics were higher in Maths, Turkish, Social Sciences, and Science and Technology subjects when compared to the control group students' results. However, this finding is not sufficient to prove that there is a significant difference between the post-test results of these two groups. Therefore, an independent t-test analysis was applied in order to determine whether there was a significant difference between the post-test results of these groups.

According to the independent t-test results shown in Table 4, no statistically significant difference was found between the experimental group whom were instructed using the infographics and the control group in Maths and Turkish post-test success scores ($p > 0.05$). However, when the post-test success results of Social Sciences and Science and Technology courses were analysed, a statistically significant difference was observed in favour of the experimental group ($p < 0.05$). Taking this finding into consideration, it can be stated that using infographics during Social Science and Science and Technology subjects is effective in meeting the course objectives and increasing the academic success rates of the students.

4.2 The comparison of the retention test results of the experimental and the control group students

Table 5 shows the data related to the comparison of the retention test of the experimental and control groups.

	Group	*N*	$\overline{X}$	*S*	sd	*t*	*p*
Maths	Experimental	41	72.2	17.7	77.433	0.985	0.328
	Control	41	68.7	14.7			
Turkish	Experimental	41	83.4	13.1	75.234	3.731	0.000
	Control	41	71.0	16.9			
Social sciences	Experimental	41	88.0	10.8	70.167	6.290	0.000
	Control	41	69.0	16.1			
Science and technology	Experimental	41	80.9	14.3	79.658	4.587	0.000
	Control	41	65.9	15.3			

Table 5: The comparison of the experimental and control group students' retention test results

The t-test results show that there is no statistically significant difference in the retention test results of Maths between the experimental group whom were instructed using the infographics and the control group whom were instructed using the traditional teaching materials ($t = .985$, $p > 0.05$). However, when the retention test results of these two groups were compared, it was observed that the experimental group had a higher retention test average score than the control group. According to the same data, when the experimental group and the control group were compared in terms of their retention test scores in Turkish, Social Sciences and Science and Technology, a statistically significant difference was observed in favour of the experimental group (Turkish: $t = 3.731$, $p < 0.05$; Social Sciences: $t = 6.290$, $p < 0.05$;

Science and Technology: $t = 4.587$, $p < 0.05$). The data indicated that using infographics in Turkish, Social Sciences and Science and Technology subjects had a positive effect in terms of making knowledge retention.

4.3 The experimental group students' views about the use of infographics and their efficiency

A semi-structured interview form was used in order to gather the views of the experimental group students about the use of infographics in education. The data which were gathered from the interviews are presented in details below.
The question 'What did you think when we told you at the beginning of the semester we would use infographics in four of your subjects and what were your thoughts about it at the end of the semester?' was addressed to the experimental group students. After the qualitative data analysis, the codes and frequencies gathered from the students' answers are presented in Table 6. Table 6 shows the data about the students' views about the use of infographics in education before and after the application process.

Theme	Codes	*f*
Views before application	They will not be useful.	28
	I'm confused.	14
	I'm worried.	12
	I think they will be fun.	8
	I don't care about them.	4
Views after application	Much better than before.	32
	They are fun.	20
	They should be used in all subjects.	19
	It is not necessary to use them.	4

Table 6: Students' views about the use of infographics in the study

Table 6 shows the first reactions of the students who learned they would receive education with infographics. When the students first learned that they would receive education with infographics, the majority thought they would not be useful (f = 28), some were confused (f = 14) and some were worried (f = 12). Besides, eight students thought that it would be fun and four students said they did not care about receiving education with infographics. Some student views are given below:

'When our class teacher told us that we would use infographics in 4 of our courses I thought that it would be unnecessary and useless and I didn't care much about it'. (student 4)

'When our teacher told us about infographics, I did not understand what it was and I was a bit worried because I thought I would not understand Maths since I already had trouble understanding it'. (student 12)

'When it was first explained, I was surprised and thought it would not be useful'. (student 20)

As it can be seen from Table 6, only eight students had positive thoughts when the study was announced. Some examples of the students with positive thoughts are given below.

'When our teacher told us that we could reach the graphics using our tablets and that they we would be able to reach visuals related to the content I thought that the lessons would be more fun and that it would help us learn'. (student 6)

'I thought that Social Sciences which was a boring subject would especially be more fun with these materials'. (student 8)

Taking the findings into consideration, it can be said that the students' thoughts about the study were negative at the beginning.

Table 6 shows the views of the students after the infographics were used in their courses. The students pinpointed after the use of infographics in their courses that the courses were much better than before now (f = 32), it is fun (f = 20) and this should be used in all the courses (f = 19). Only four of the students stated at the end of the study that the use of infographics is not necessary. Some student views are given below.

'After the infographics were used a couple of times I realized that I was worried for no reason and that it was a better and more fun way than before. I gathered information about the course content by scanning the stickers before and after the lessons were given'. (student 14)

'At first I was a bit confused thinking how infographics would work but then when we started to use them, I realized that they were interesting and fun and that I was eager to find out what the next one would be'. (student 32)

'I was worried at first because I did not have any idea what it would be like and I was especially worried about Maths as I found it hard to understand. However, I found out that I was worried for no good reason since now I think that the infographics could be used in any subject easily'. (student 12)

Despite this, some of the students still had negative thoughts about the use of infographics after the application of the study and four of the students stated that the use of infographics in the courses to help the students understand the content easily is actually not something necessary.

'I think this application it not necessary and that it is a waste of time. Instead of focusing on the infographics we would solve many exercises about the lessons'. (student 23)

'The first time we told that they would be used I thought the same about it that they were not necessary and now I still think the same at the end of the application. I accept that they helped us understand more easily still they were not necessary'. (student 34)

When the data are evaluated, it can be said that the majority of the students changed their minds towards a positive attitude about the use of infographics after they were used. Only a little number of students thought that it was not necessary to use infographics in education.

Along with the evaluation of the views of the experimental group students about the use of infographics another question was asked to them: 'How efficient do you think was the use of infographics in education in your learning of the course contents?' The answers given by the students to this question were categorised in two themes which were 'effective' and 'ineffective'. Table 7 shows the codes and frequencies of the evaluation.

Themes	Codes	*f*
Effective	Made things easy	34
	Attention drawing	27
	Made the lessons more fun	16
	Did not need to take notes	11
Ineffective	Not bad	2

Table 7: The students' views on the effectiveness of infographics

Table 7 shows that under the theme of 'effective' most of the students stated that the use of infographics in education 'helped us understand the lessons better', 'attention drawing', 'made the course content more fun' and 'the students did not have to take notes'. Almost all of the students stated that the use of infographics made the course content understood more easily (f = 34). The students' views stating this are given below.

'The use of infographics made the course content understood better. I especially found Social Studies course very boring before the application of the infographics. However, the colourful visuals and the simple expression made the course more appealing to me'. (student 27)

'I think that the course content which was simplified with infographics is much easier to understand. This helped me prepare for the exams easily'. (student 19)

The majority of the students stated that the lessons became more attention drawing and fun with the use of infographics.

'It was fun to scan the stickers of the colourful infographics in Science and Technology course and the course content became more appealing. However, I think it would even be better to add sound and animation to the infographics'. (student 6)

'I viewed the infographics about the lessons using our tablets. I scanned the stickers and viewed the infographics related to the lessons and made comments about them with my family and I think that they were really fun and easy to understand'. (student 29)

'It is very easy and fast to access infographics by using tablets. I liked the lessons with the tablets and the infographics'. (student 21)

'Social Sciences course became more interesting especially. The infographics facilitated the learning of the lessons. I think they should be used in all of the courses'. (student 37)

Some of the students stated that because the infographics were used they did not have to take notes (f = 11).

'We can access the infographics using our tablet. Therefore, I did not have to take notes or summarize the important parts as the infographics already summarise the important parts'. (student 8)

'I used to spend a lot of time taking notes previously. Now that the infographics give us a short summary of the lessons I only take my own short notes besides them. It's much easier this way'. (student 11)

'Before this practise, tablet was just a game tool for me. Now I use infographics for my lessons. In particular, the application of QR code and stickers is incredibly easy'. (student 28)

According to the data collected from the students under the theme of 'ineffective', only two of the students evaluated infographics as 'not bad'.

'When I compared the use of infographics with the previous methods I can say that they are not bad. However, it did not make a big difference for me'. (student 34)

'There is not much to say. It's not bad but not necessary actually'. (student 3)

As it can be understood from the data given above, the majority of the students did not consider infographics as something ineffective and thought that the use of infographics in education is effective. According to the views of students, it can be seen that the use of QR code sticker applications such as tablets and mobile devices in the process of gore learning is advantageous in terms of sharing and display of phonographs and that they are in a more positive attitude towards such devices and applications.

5 Discussion, Conclusion and Suggestions

The aim of the study was to investigate the effect of mobile supported infographics on academic success and knowledge retention in fifth grade primary students' Maths, Turkish, Social Sciences and Science and Technology courses. Along with that, the evaluation of the students' views about the use of infographics in education is the other main objective of the study. The research, targeting these main objectives of the study, revealed that the use of infographics had positive effects on the academic success of the students in Social Sciences and Science and Technology subjects. When the control group and experimental group were compared in terms of their academic success, it was revealed that the experimental group received higher scores in all of the targeted subjects; especially, the differences were even greater in Social Sciences and Science and Technology subjects. Furthermore, when the students' views are evaluated, it was observed that infographics especially were effective for Social Sciences and Science and Technology subjects. The reason behind this could be understood from the students' views. The students considered these two subjects as being boring before and said that after the use of infographics these subjects became fun which increased their motivation.

The research showed no statistically significant difference between the achievement test scores of Maths and Turkish subjects. However, this study only investigated fifth grade primary school students and only limited course content was used. This study might be replicated using different age groups and course content in future studies.

The other main objective of the study was to investigate how using infographics affected knowledge retention levels of fifth grade primary school students in Maths, Turkish, Social Studies and Science and Technology subjects. In this context, achievement tests were given to both of the groups (experimental and control group) after 1 month of the application and the data collected were analysed statistically. According to the data collected, there were statistically significant differences in favour of the experimental group in Maths, Turkish, Social Sciences and Science and Technology subjects. On the other hand, when the achievement test results of the two groups in Maths were analysed, there were no statistically significant differences. This result revealed that the use of infographics is especially effective in theoretical subjects. Similarly, [Al Hosni 2016] investigated the effects of infographics in

English Language education as a tool to improve the skills of understanding and remembering of the students and found that the experimental group students performed better and remembered more after 1 week of the application.

When the students' views are evaluated, it was observed that they have positive attitudes towards the use of infographics in education. The experimental group students stated that they considered infographics as an effective teaching material in terms of making the course content more concrete, contributing to their learning processes, bringing diversity to the educational environments, being effective in bringing persistency to the learned information, giving the opportunity of repetition and reinforcement. Similarly, [Ozdamli et al. 2016] reached a conclusion in a study with university students that the students preferred the use of infographics that possess effective visuals to the traditional teaching materials and also agreed on the idea that infographics are easier to understand and more satisfying when compared to the traditional teaching materials.

In addition, according to the findings of the researcher, it is determined that the use of mobile devices and applications such as QR code and stickers facilitates students in terms of the learning process, is also useful in providing instant access to desired course content and provides practical application for recreational activities.

This study has its limitations as the research only considered fifth grade primary school students and the study was applied to only four of their school subjects. Therefore, similar studies in the future should target different educational stages and the data can be compared. What is more, similar studies should include subjects such as language teaching and the results should be evaluated. Another limitation of the study is that it only included the students in the study; however, the teachers as the main stakeholders of education can also be targeted in similar studies and the teachers' views about the use of infographics in education, their needs and designing of infographics.

This study investigated the use of infographics-aided education via tablet aids. In future studies, in order to increase effectiveness and improve this model, field experts can express their views and workshops can be held. Finally, the positive results can be obtained using peer learning and project-based learning in activities.

This study will be an important reference due to it being primary education–based scientific study that focuses on student success and knowledge retention.

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