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INVESTIGATION OF THE EFFECTIVENESS OF USING QR CODE SUPPORTED BOOKS

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Abstract:
The aim of this study is to examine the effect of course book supported by QR code applications on students' academic achievement and self-learning with technology. Within the scope of the study, printed course book was directed to digital materials. In the other group, the same materials (course book and digital materials) were processed by the teacher. In the 2018-2019 academic years, a 4-week application was carried out within the scope of the research conducted with 98 students in a secondary school. An achievement test and a scale were used as data collection tools. As a result of the research, no difference was found between the academic achievements of the experimental group in which the lessons were taught with qrcode and the control group. However, it was observed that the experimental group students showed a higher development in terms of self-learning with technology. It was concluded that the use of qrcode contributed to the development of students in self-learning with technology.

Keywords: mobile learning, QR code, academic success

1. Introduction

Mobile technologies and mobile devices (tablet, phone, etc.) are developing rapidly. The majority of students now have mobile devices. The use of mobile devices that show rapid development is increasing, students now benefit from mobile devices for social and academic purposes (Seo, Park, Kim & Park, 2016). Research on mobile learning in recent years also shows this use. Especially using m-learning and mobile resources in education

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is called a new e-learning issue (Al-Emran, Abbasi & Mezhuyev, 2021). Similar to e-learning, m-learning offers important new possibilities with the use of mobile devices (Al-Emran, Abbasi & Mezhuyev, 2021). Continuing, lifelong, easy, practical and fast education stands out among the important opportunities offered by m-learning. Learning can take place at any time and place. Despite its successful use on mobile phones and tablets, limitations such as small screen size, less interaction with the teacher and insufficient quota on the internet can occur due to the excessive amount of data (Semerci vd., 2004).

Mobile technologies have rich application options. In this respect, many applications, especially in the group of web 2.0 tools, make mobile technologies more advantageous. (Cappellini, Lewis, & Rivens Mompean, 2017). One of these advantages is the QR (Quick Response) code system that makes routing practical with a special algorithm, and the use of qrcode has increased with the development of camera technology in portable devices (Kalogiannakis & Papadakis, 2017). QR code is a two-dimensional matrix code, and studies for its use in education mostly focused on getting information by guiding students with qrkod. (Akın, 2014; Law & So, 2010).

The QR technology is the advanced form of barcode technology, and was developed in 1994 by Denso Wawe, a Japanese company, for the production tracking of automotive parts (Akın, 2014). Nowadays, it is widely used in many areas due to its high capacity and its ability to store data horizontally and vertically. Barcode is the data interpreted by machines consisting of thin or thick black lines and white spaces vertically (Law & So, 2010). The most commonly used barcode is the linear barcode type. It encodes up to 20 alphanumeric characters into linear barcodes. With the development of linear barcodes in two dimensions, 2D barcode technology has developed. With 2D barcode technology, around 4000 alphanumeric characters can be encoded (Acartürk, 2012). Its use is standardized by the ISO / IEC 18004: 2000/2006 standard determined by ISO. QR codes can be read from all directions, it is more developed than other classical barcode systems due to its high data storage capacity and its widespread use (Elçi, 2014). Although its patent belongs to a commercial organization, its use is public (Elmalı, 2015). One of the biggest features of QR codes is that they can be read with pre-installed standard software on all smartphones with cameras. In cases where manual entries are not trusted and long URLs are forwarded, it is very easy to log into the system with a QR code (Rivers, 2009). The ability to read qrcodes from all sides ensures that the data is easy and fast to read from the qrcode. Providing error-free access to information thanks to the alignment and timing pattern of the data matrix codes whose surface is damaged, the ability to increase and decrease according to the desired dimensions and print them from any printer, with the ability to correct for contamination and errors at a rate of 30%, are among the ease of use of qr codes (Elçi, 2014).

In daily life, qrcode has been used in different areas. Recently, it has been observed that qrcode technology is used in e-mails. QR codes, whose advertisements or website addresses are entered as data, have started to be used in the incoming e-mail. By scanning the qrcode in the e-mail from the mobile phone, the relevant site can be accessed without making any searches. The same system is frequently used in designs such as posters

(Çelik Taşkın, 2012). Similarly, it can be said that the use of the QR code, which has come to life quickly, is used effectively in many areas such as pharmacy, media and banking sectors (Acartürk, 2012). One of these sectors is education.

Smart boards, internet connections, tablets and other mobile devices are used with traditional printed materials in the today educational environments. Digital technologies can be used to direct learners to reliable and correct content with the QR code system. In this respect, the use of QR codes enables integration with traditional technologies such as textbooks and workbooks. Numerous sites / applications for generating QR codes (QR code generator, QR code creator, etc.) offer this free service. In other words, a teacher can direct them to digital resources by producing their own QR codes, pasting this code on a book or similar material, so that they can reach the source they want to direct. QR codes ensure the fast transport of information and at the same time, this information is sent in encrypted form (Aktaş & Çaycı, 2013). There are different studies on the use of digital resources in courses. In this respect, it has been seen in the studies that the trainings on the use of technology in the Mathematics lesson have a positive effect on success, motivation and memorability (Küslü, 2015; Balkan, 2013; Andiç, 2012; Altın, 2012; Öztürk Taşkale, 2011; Fırat, 2011; Turhan, 2010). It is stated that the use of technology in mathematics lessons will be beneficial in schools, as students' progress according to their own learning speed in technology-supported education (Tatar, Kağızmanlı ve Akkaya, 2014). However, traditional printed materials are still used as the main source in schools in addition to digital technologies. In this respect, there are efforts to ensure the usability of printed and digital materials together. In this regard, QR codes are important in terms of offering an alternative. Within the scope of this research, mathematics teaching was enriched by adding digital multimedia elements to the mathematics textbook, which is a printed material, by using the orientation feature of the qrcode, and effective use of mobile devices was attempted.

It is seen that there are different studies on the use of QR codes in education. Akın (2014), in his experimental study, stated that qrcodes were effective in terms of permanence, while qrcode was not different in the group in terms of academic success. Çelik (2012) stated that the use of qrcode in foreign language learning increases the learners' active vocabulary knowledge. When the views of the students were examined, data supporting this result was obtained. Aktaş and Çaycı (2013) investigated the contribution of the QR code to the development of new education methods in mobile education. As a result of the research, they stated that the QR codes made education more enjoyable in mobile learning, increasing the interest of students in the lesson. On the other hand, he stated that the greatest convenience provided by qrcodes to education was also placed in traditional education materials, and these materials turned into a hybrid structure. He also stated that Qrcodes are compatible with traditional educational materials and enable effective use of mobile technology, which eliminates time and space limitations. However, although qrcodes have developed mobile education, he stated that the primary factor for mobile education is the content prepared. Koşan (2014), on the other hand, believes that the student who missed the lesson should be told again with visual materials in his study, and he stated that adding the visual materials to the book

by supporting the question solving and summary of the lecture with qrcode technology by the person preparing the course book will shorten the distance between the student and the user. Abas, Yahya, and Kamaruddin (2015) conducted research on the use of QR codes, and 89.9% of the teachers stated that the QR code can be used in the teaching and learning process. They also suggested that QR codes should be placed in the education system as a mobile learning tool. Ali, Santos, and Areepattamannil (2017) stated that as a result of their research where they gave practical examples about how QR codes can be integrated in teaching, pre-service teachers have a positive attitude towards QR codes and they want to use them in the future. Durak, Özkeski, and Ataizi (2016) revealed that students participating in a course supported by QR codes know QR codes, can use QR codes and find the use of QR codes useful in education.

1.1. Purpose of the Research

The aim of the study is to determine the effect of printed textbooks, which are directed to digital materials with qrcode, on students' academic achievement and their own learning with technology. In this context, the sub-objectives of the research are as follows;

1) What is the effect of using Qrcode supported books on students' academic success?
2) What is the effect of using Qrcode supported books on students' self-learning with technology?

2. Method

2.1. Research Model

This research investigated with the use of supported applications Qrkod books, are from experimental models. Pre-test and post-test group and control group randomly assign one of two experimental models in the experiment, and the other is designated as the control group, the experiment in both groups before and after measurement (Maxwell, 2012).

2.2. Participants

In the experimental process, the application was made with two groups as experiment and control. For this purpose, in the 2018-2019 academic years, an application was made to 8th grade students studying at a secondary school in the Karaman City in Turkey. The unit of "Geometric Objects" determined by the course teacher was applied to a total of 98 students, 50 of whom were male and 48 were female.

2.2. Procedures

In the research, the unit of mathematics lesson "Geometric Objects" was chosen with the suggestion of the teacher. One of the 8th grades was randomly determined as the control and the other as the experimental group. In the experimental group, the "Geometric Objects" unit in the textbook was guided with QR-supported codes, while in the control group, the teacher was verbally directed (the same course book and the same digital resources were used in both groups). Qrcodes of previously prepared sources such as

video, audio and pdf were attached to the printed course books in the experimental group. In both groups, the lesson was taught by the same teacher, using the same methods and techniques. Before and at the end of the study, academic achievement test and technology self-learning scales for children were applied to the experimental and control groups.

2.3. Data Collection Tool and Data Collection

In the study, in order to collect data, academic achievement test and a scale for determining students' self-learning with technology were used. The academic achievement test for the geometric objects unit was developed by the course teacher. In the development of the achievement test, for the content validity of the unit gains, opinions of different field experts were obtained, and a pilot application was carried out. Finally, an achievement test of 20 questions was created. In order to measure students' self-learning with technology, Teo et al. (2010) and adapted to Turkish by Yurdugül and Demir (2013), children's self-learning with technology scale was used. The scale consists of 6 items. The reliability coefficient for the scale is expressed as 0.73. Permission was obtained for the use of the scale.

2.4. Data Analysis

Descriptive statistics were used for the analysis of demographic data. Independent sample t test was used to determine the difference between the experimental and control groups before and after the experimental process, and the dependent sample t test was used to determine the increase of each group before and after the experimental process. In the analysis of all data, the level of significance was taken as .05.

3. Findings

Findings obtained in the research are given below.

3.1. The Effect of Using Qrkod-Supported Books on Students' Academic Achievement

In the study, the effect of using qrcode supported books on students' academic achievement was examined. For this purpose, the achievement test was applied at the beginning and at the end of the training. In order to determine the academic difference of the students after the pre-test, the groups were compared with an independent sample t test, and the results obtained are given in Table 1.

Table 1: Academic Achievement Test Results of Pre-Study Groups

	N	$\bar{X}$	Sd	df	t	p
Experimental Group	51	40,98	13,07	96	1,83	0,07
Control Group	47	36,59	10,48			

*p<.05

As seen in Table 1, there is no difference between the academic achievement test results of the students before using the qrcode supported book [$t_{(96)}$=1.83, p> .05]. When the group averages are examined, it is seen that the experimental group is $\bar{X}$ = 40.98 and the control group is $\bar{X}$ = 36.59. The difference between the achievement tests of the experimental and control groups is not significant at the .05 level. In this respect, it can be stated that there was no difference between the groups before the application.

The difference between the pre-test and post-test success scores of both groups before and after the 4-week training process was examined to investigate the effectiveness of the Qrcode application, and the results are given in Table 2.

Table 2: Comparison of Pre and Post Tests of Groups' Academic Achievement

		N	$\bar{X}$	Sd	df	t	p
Experimental Group	Pre-Test	51	40,98	13,07	50	-9,51	0,00*
	Post-Test	51	61,96	14,14			
Control Group	Pre-Test	47	36,59	10,48	46	-7,03	0,00*
	Post-Test	47	56,06	17,72			

*p<.05

When Table 2 is examined, there is a significant difference between the academic success of the experimental group students before and after the training [$t_{(51)}$=-9,51, p<.05]. While the academic success of the experimental group students before the training was $\bar{X}$ = 40.98, it was found as $\bar{X}$ = 61.96 after the application. Similarly, there is a significant difference between the success of control group students before and after the training [$t_{(47)}$=-7.03, p<.05]. While the academic success of the control group students before the training was $\bar{X}$= 36.59, it was $\bar{X}$= 56.06 after the application. The academic success of both the experimental and control groups increased after the application.

After 4 weeks of training, the same achievement test was applied to the students. After the application, the test results of the experimental and control groups are given in Table 3.

Table 3: Comparison of Groups' Academic Achievement Results after Training

	N	$\bar{X}$	sd	df	t	p
Experimental Group	51	61,96	14,14	96	1,81	0,07
Control Group	47	56,06	17,72			

*p<.05

When Table 3 is examined, there is no difference between the academic achievement test results of the students after using the qrcode supported book [$t_{(96)}$=1.81, p> .05]. When looked at the level of group averages, it is seen that the experimental group ($\bar{X}$=61.96) is the control group ($\bar{X}$=56.06). The difference between the experimental and control groups in terms of achievement test scores is not significant at .05 level. In this respect, it can be stated that there is no significant difference between the groups after the application.

3.2. The Effect of Using Qrkod-Supported Books on Students' Self-Learning Levels with Technology

Within the scope of the study, the effect of using qrcode supported books on students' self-learning with technology was investigated. The results of the analysis made to determine the difference in the level of self-learning with technology after the pre-test of the students are given in Table 4.

Table 4: Comparison of Pre-Experiment Students' Self-Learning Levels with Technology

	N	$\bar{X}$	sd	df	t	p
Experimental Group	51	3,65	0,51	96	-0,16	0,86
Control Group	47	3,67	0,63			

*p<.05

As seen in Table 4, there is no difference between technology and self-learning levels of students before using qrcode supported books [t (96) = -0.16, p> 0.5]. It is seen that the experimental group ($\bar{X}$ = 3.65) and the control group ($\bar{X}$ = 3.67) are at the same level.

The difference between the pre-test and post-test technology and self-learning scores of both groups was examined before and after the 4-week training process carried out to investigate the effectiveness of the qrcode application, and the results are given in Table 5.

Table 5: Comparison of Pre and Post Tests of Groups' Self-Learning Levels with Technology

		N	$\bar{X}$	sd	df	t	p
Experimental Group	Pre-Test	51	3,65	0,51	50	-5,87	0,00*
	Post-Test	51	4,10	0,39			
Control Group	Pre-Test	47	3,67	0,63	46	-1,01	0,31
	Post-Test	47	3,77	0,57			

*p<.05

It can be seen from Table 5 that the experimental group students' levels of self-learning with technology differ after the application [$t_{(51)}$=-5,87, p <.05]. While the level of self-learning of the experimental group students with technology before the training was $\bar{X}$=3.65, this score was calculated as $\bar{X}$=4.10 after the training. The difference is statistically significant. In the control group, it was observed that the level of self-learning with technology did not differ after the application [$t_{(47)}$=-1.01, p> .05]. While the self-learning level of the control group students with technology before the training was $\bar{X}$=3.67, this score after the training was $\bar{X}$=3.77, and this result is not statistically significant. According to the results of the experiment, while there was a significant increase in the level of self-learning with technology in the experimental group students, the level of self-learning with technology did not change in the control group students.

After the training process, the results of the self-learning level with technology belonging to the experimental and control groups are given in Table 6.

Table 6: Comparison of Groups' Self-Learning Levels with Technology after Training

	N	$\bar{X}$	sd	df	t	p
Experimental Group	51	4,10	0,39	96	3,27	0,02*
Control Group	47	3,77	0,57			

*p<.05

When Table 6 is examined, it can be seen that there is a significant difference between the results of the students' level of self-learning with technology after the use of qrcode used books [$t_{(96)}$=3.27, p<0.5]. When looked at the level of group averages, the experimental group has an average of $\bar{X}$=4.10 and the control group $\bar{X}$=3.77. After the 4-week training process, the students in the experimental group using printed materials with qrcode support increased their level of self-learning with technology.

4. Results and Discussion

The research was carried out with 98 secondary school students, and a 4-week training focused on the use of qrcode was provided with the experimental and control groups. In the study, no difference was found in terms of academic achievement after the education process of the experimental group with qrcode-supported directions and the control group students who were directed by the teacher. Considering the age group, students' limited mobile learning experiences and competencies may have affected this result. Ergüney (2017) emphasizes the importance of mobile literacy skills in terms of mobile learning experiences for young children, on the other hand, unconscious use of mobile technologies by young children may cause physical and social harm to them. In this respect, their inexperience may have affected the results. There are similar results in the literature with the result of the research (Akın, 2014; Baştemur Kaya, 2013; Baysan, 2015). Akın (2014) stated that there was no academic difference between the experimental and control groups as a result of a 7-week practice as a result of the qrcode supported learning material application in the high school information communication course. Similarly, Baştemur Kaya (2013) stated that there was no difference in achievement level in a study conducted with secondary school 6th grade students for 3 weeks for social studies lesson. On the other hand, in the opposite direction of the research result, there are studies that qrcode applications support academic achievement (Erdoğdu ve Şahin, 2016; Çelik, 2012; Sönmez, 2018; Kılıç, 2015; Demir, 2014; Kayak, 2014). Erdoğdu and Şahin (2016) conducted a research on university students and the QR codes placed in different parts of the classroom in the human and computer interaction course, and students obtained information by using phones. It was stated that the success level was significant in favor of the experimental group at the end of the 4-week training with Qrcode support. Similarly, Çelik (2012) stated that the group in which qrcode application was used in foreign language education was more successful. When the studies are examined, the fact that the groups that show a difference are mostly individuals in the older age group shows the importance of the necessity of mobile literacy skills expressed by Ergüney (2017).

Another result obtained from the study is that there is a significant difference in the experimental group in the level of self-learning with technology in the mathematics lesson of the students who are taught by using qrcode supported book and normal textbook. The experimental group was found to be positively meaningful in terms of the level of self-learning with technology compared to the control group. This situation can be explained by the usefulness provided by the use of qrcode. In the literature, it is seen that the mobile learning usefulness dimension includes the level of self-learning with technology. In this respect, the advantages of mobile technologies in terms of usability may have caused this difference. According to Korkmaz (2010), as a result of the student's experience of teaching in the classroom with qrcode and mobile technologies, the advantages of mobile learning can be explained as accessing information and improving entrepreneurship aspects, starting to use communication tools effectively, and also motivating the student. There are similar results in the literature with the result of the research (Kantaroğlu, 2017; Gürkan, 2017; Elçiçek, 2015; Kılıç, 2015). Kantaroğlu (2017) analyzed the attitudes towards mobile learning on a total of 441 people from Sakarya University Business and Education Faculties and stated that mobile learning provides a fast learning because students decide on their own learning. It was stated that when mobile learning is applied in the lesson, the interest in that lesson increases, the quality of the lesson increases, and the lessons are more efficient. Similarly, Gürkan (2017) stated that it supports working in a systematic and planned manner on 1460 students in terms of m-learning usefulness dimension and that it can be reached quickly. Murphy et al. (2014) also stated that guiding students in mobile applications is important. In this respect, the fact that the use of qrcode is useful, it provides order, is more systematic than teacher mistakes such as forgetting or not remembering the material may have contributed to this difference.

Another result obtained from the research is that the self-learning levels of the students who are educated with qrcode-supported books have increased more with technology. In the literature, it is seen that the mobile learning usefulness dimension includes the level of self-learning with technology. According to Korkmaz (2010), mobile learning with practicality provides advantages such as accessing information, using communication tools effectively, and also motivating the student. In this respect, the advantages of mobile technologies in terms of usefulness may have caused this difference. There are similar results in the literature with the result of the research (Kantaroğlu, 2017; Gürkan, 2017; Elçiçek, 2015; Kılıç, 2015). Kantaroğlu (2017) examined the attitudes towards mobile learning on a total of 441 people from Sakarya University Faculty of Business and Education and stated that mobile learning provides a fast learning because students decide on their own learning. It was stated that when mobile learning is applied in the lesson, the interest in that lesson increases, the quality of the lesson increases, and the lessons are more efficient. Similarly, Gürkan (2017) stated in his research with 1460 students that it is important to work in a systematic and planned manner in terms of the usefulness dimension of m-learning and to provide fast access opportunity. Murphy et al. (2014) also stated that guiding students in mobile applications is important. In this respect, the fact that the use of qrcode is useful, providing order,

minimizing teacher errors (forgetting, not using the material, etc.) may have contributed to the emergence of this difference.

5. Recommendations

In line with the findings of the study, it can be suggested to practice qrcode supported applications with students with higher age group. Students' higher mobile technology literacy can also increase their academic success. In addition, students' views on the use of qrcode can be investigated in depth with qualitative studies. On the other hand, as a result of the research, it has been observed that qr codes increase their self-learning with technology. It may be suggested to integrate the printed-digital material by supporting the course and workbooks with qr codes.

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Conflict of Interest Statement
The authors declare no conflicts of interests.

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