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Opinions of students and parents on the QR code-supported cooperative learning method

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Abstract

QR codes are now encountered in many areas of life. QR codes have started to be used in education as well, serving as a bridge between today's world and the digital world. In the current study, it is aimed to reveal the opinions of students and parents about the use of QR codes, which are rapidly becoming widespread in our daily life, in cooperative learning groups in the science teaching process. The study was carried out with the participation of 6th grade (12-13 years old) students attending a state middle school and their parents with the focus on the accomplishment of the objectives set for the subjects of "Nervous System, Endocrine Glands and Sense Organs". The case study design, one of the qualitative research methods, was employed in the study. The data were obtained through written documents and analyzed with the content analysis method. In the study, the jigsaw (II) technique was used in cooperative learning groups. The students themselves generated the QR codes necessary for the learning process on the models prepared by the science teacher. QR codes were used in teaching and evaluating the subjects. In this study, findings were obtained from students and their parents regarding the use of QR codes used in cooperative learning groups in the science teaching process, and it is thought that the suggestions made based on these findings will contribute to teachers and researchers who want to work in this field.

Keywords: QR code, cooperative learning method, jigsaw II technique, middle school students, science course

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1. Introduction

1.1. QR Codes and Their Use in Education

QR codes were developed in 1994 by the Japanese Denso-Wave Company as a barcode that could be easily read through a scanner for tracking products in the automotive sector (Law and So, 2010). They have been widely used particularly in Japan and all over the world in general today. The reason for the widespread use of the QR code technology in Japan is that the QR code scanning program is already installed on the mobile phones sold in Japan (Rivers, 2009). QR codes are a two-dimensional barcode that can be deciphered by reading with the camera of various mobile devices (Ramsden, 2008). They can store information both horizontally and vertically. They have greater capacity than linear barcodes. QR codes can hold much more information than ordinary barcodes, are easy to use, and today there are many applications on the internet as a QR code reader or generator (Pons, Valles, Abarca and Rubio, 2011). Generating QR codes is very easy and practical. There are many websites free to use for this purpose. Text, URL link, SMS, business card information or any information can be easily encrypted in QR codes. This information hidden in a QR code can be read using the mobile phone camera and QR code scanning applications (Rivers, 2009). QR codes are a relatively new technology that has entered our lives in recent years. It is mainly used in the advertising and marketing sector, and its use in education is gradually increasing (Mileva and Stoyanova, 2017). According to Rikala and Kankaanranta (2014), QR codes have great potential as a learning and teaching tool. Accordingly, the QR code technology has been expanded in the educational process with an increased focus on enriching traditional teaching and learning processes by including open educational resources (Yip, Melling and Shaw, 2016). Moreover, it helps to attach educational aids such as written texts, images, videos, or educational games to a QR code and provide them to students as continuous enrichment materials (Talan, 2020).

In many studies by researchers, it is emphasized that the use of QR codes in education should be encouraged. For example, Karahan and Canbazoğlu Bilici (2017) stated that QR codes can increase students' interest and motivation in science classes. Moreover, Sharma (2013), Mehendal et al. (2017), Saprudin, Goolamally and Latif (2014) stated that QR codes are used as a powerful learning tool to improve student knowledge, especially in the teaching and learning process. As a result of their study, Mileva and Stoyanova (2017) showed that QR codes are an effective tool that stimulates the interest and cognitive activities of middle school students and increases their motivation to learn. Stoyanova, Vakrilov, Stoyanova-Petrova, Kafadarova and Mileva (2020) emphasized that the integration of QR codes into laboratory work shortens the explanation time, reduces the misuse of laboratory equipment and increases the efficiency of students' laboratory work. Again, according to Jun, Lee and Kwon (2012), combining QR code, which is a fun and convenient learning environment, with smartphone support can help students be

enthusiastic and motivated while doing laboratory work. According to Alharbi and Al Sawy (2022), the QR code technology should be disseminated through all segments of society, including students and faculty members, and should be utilized in such a way as to benefit from the advantages of e-learning in accordance with quality standards. According to Dabke et al. (2021), while QR code can be employed in completing homework, students often encounter difficulties that require additional explanation or other resources that cannot be included in homework. For example, educational videos can be converted into QR codes that allow access to those resources once the learners scan them. According to Traser, Hoffman, Seifert and Wilson (2015), QR code can also be used in classroom activities aimed at self-learning; a QR code with the correct answer can be integrated next to each question to allow the student to verify the correctness of his/her answer. QR codes can direct students to the online environment via mobile devices through printed educational materials (Chen, Teng, Lee and Kinshuk, 2011). In this context, QR codes form a bridge between teachers or students and information. Students can directly access the content on the mobile web pages they want to access without being exposed to information pollution.

In some studies, it was recommended to integrate cooperative learning into teaching systems with technology (Resta and Laferriere, 2007; Domalewska, 2014). Gogova and Kocaska (2014) found that the use of QR codes facilitated collaborative learning. Therefore, in the current study, QR codes were used in cooperative learning groups. In addition, QR codes allow the implementation of systems based on paradigms such as just-in-time and collaborative learning (De Pietro and Frontera, 2012).

1.2. Cooperative Learning Method and Jigsaw II Technique

Collaborative learning can be defined as a learning approach in which students actively participate in the education-teaching process, help each other learn, improve their self-confidence and communication, problem solving and critical thinking by forming heterogeneous small groups, both in the classroom and out of the classroom for a specific purpose (Ballantine and Larres, 2007; Bowen, 2000; Doymus, 2008; Doymus et al., 2009; Eilks, 2005; Hazne and Berger, 2007; Levine, 2001; Lin, 2006). Cooperative learning has many sub-techniques (Doymus, 2007). Jigsaw techniques are the most used sub-techniques of the cooperative learning method (Colburn, 2004; Doymus, 2008). Jigsaw techniques include Jigsaw, Jigsaw II, Jigsaw III, Jigsaw IV, Reverse Jigsaw and Subject Jigsaw techniques (Doymus, 2008; Hedeen, 2003). The reason why jigsaw techniques are called by different names is that their application stages are different. The Jigsaw II technique was developed by Slavin in 1980 (Sharan, 1990). This technique requires groups consisted of 2 to 6 students (Aykaç, 2005). While forming these groups, care is taken to ensure that the within-groups are heterogeneous and the between-groups are homogeneous (Klein, 2006). Considering the number of people in the group, the

subjects are determined and each student chooses his/her own subject by drawing lots and improves himself/herself in this regard. Students choosing the same subject come together and work and discuss about it. This group is called the expert group. Afterwards, students return to their teams and teach what they have learned in expert groups to their friends. At the end of the study, students take a quiz from the material and the quiz results are used in both team scores and individual scores as in student teams success sections (Slavin et al., 1985).

With the Jigsaw learning technique, it is thought that learning takes place at a high level, as students teach each other by doing and experiencing the subjects. As stated by Lord (2001), students who learn cooperatively talk more about the subject, ask questions, find the opportunity to help each other, become both the narrator and the listener and when they listen, they test the knowledge in their minds. The use of Jigsaw technique in the teaching process has been found to have positive effects such as increasing academic success, improving thinking skills, raising interest and attention in the subject of study, improving the frequency and quality of communication with the teacher, improving the knowledge about the subject, improving the frequency and quality of communication with classmates and groupmates, fostering democratic and friendly interaction with the teacher, allowing preparation for the lesson and developing students' ability to express themselves (Gürbüz, Çakmak, and Derman, 2012).

1.3. Significance of the Study

21st century skills are defined as skills that should be acquired through education by individuals (Trilling and Fadel, 2009). In this context, 21st century skills that are basically built on school subjects such as mathematics, science, history, geography and expanded with the addition of career skills, learning and innovation skills (critical thinking and problem solving, communication, cooperation and creativity) and knowledge and media and technology skills (Partnership for 21st Century Learning, 2007; Trilling and Fadel, 2009). It is also seen that 21st century skills are classified as cognitive skills (e.g., critical thinking, problem solving, creativity), interpersonal skills (communication skills, social skills, teamwork, cultural sensitivity, coping with challenges) and internal skills (self-management, self-regulation, time management, personal development, lifelong learning, compatibility) (Binkley, Erstad, Herman, Raizen and Ripley, 2010; Kylonen, 2012; Soland et al., 2013). Teachers, on the other hand, are held responsible for imparting these skills to students in their classes (Weixel and Wempen, 2010). The use of QR codes in education is quite new, and there are still limited number of studies in which students' opinions are taken. No study was found in which parents' opinions were collected on the use of QR code in education and group work. In this regard, the current study is believed to make a contribution to the literature.

1.4. Purpose of the Study

The main purpose of the current study is to reveal the opinions of students and their parents on the use of QR codes, which are rapidly becoming widespread in our daily life, in cooperative learning groups in the science teaching process. To this end, answers to the following questions were sought:

- What are the opinions of students and parents on the use of QR codes in science classes?

- What are the opinions of students and parents on cooperative learning groups in science classes?

2. Method

2.1. Research Design

The case study design, one of the qualitative research methods, was used in the study. In a case study, it is aimed to come up with a detailed description and examination of a research topic in its real environment. The case to be chosen as a research topic can be a person, a student, an administrator, a program or groups such as a class, a school and a community (Creswell, 2012).

2.2. Study Group

The study group of the study is comprised of 6th grade (12-13 years old) students (10 boys, 10 girls) attending a state school in a city located in the west of Turkey in the 2021-2022 school year and parents (11 mothers, 3 fathers, 1 elder brother and 1 elder sister). Of the parents in the study group, 1 father is a tradesman, 1 father is a textile worker and 1 father is a mechanic; 2 mothers are teachers, 4 mothers are textile workers and 5 mothers are housewives; the elder brother is a nurse in a hospital and the elder sister is working in a patisserie. The school where the study was conducted was especially chosen because one of the researchers was working as a science teacher in this school; thus, it was expected to be easy to reach the participants. The number of students in the classes is around 20-25 on average. The students in the study group were coded as S1, S2, S3,…., while the parents were coded as P1, P2, P3,…..

2.3. Data collection tools

The opinions of the students and their parents in the study were elicited through written documents. First of all, the researchers prepared the questions to be asked to the

students and their parents. The questions prepared were examined by two faculty members who were experts in the field of science education. Pilot interviews were held with 2 students and their parents who were not included in the study as they would not be able to attend all the classes to confirm whether the questions were comprehensible or not and then the questions were given their final form. When incomprehensible data were detected during the analysis of the written documents, the data were elaborated through the interviews conducted with the relevant students and parents.

2.4. Conduct of the study

Before the study, it was determined whether the students had knowledge about the QR code. 5 students (S5, S6, S13, S17, S20) stated that they had seen the QR code in many places but never used it, 15 students (S1, S2, S3, S4, S7, S8, S9, S10, S11, S12, S14, S15, S16, S18, S19) stated that did not know how to generate a QR code, but they had used it, 9 students (S3, S4, S7, S8, S9, S10, S11, S16, S18) stated that they had encountered it in test books, 6 students (S1, S2, S4, S10, S11, S15) stated that they had seen in EBA (Education Informatics Network), 3 students (S2, S7, S14) stated that they knew it from the HES code (an application used during the pandemic), 1 student (S18) stated that he/she had encountered it while reading the menu in a cafe, 1 student (S4) stated that he/she had seen it at a bus stop and 1 student (S12) stated that his/her father was using it in his workplace. Since some students did not know the QR code and how to generate QR codes, the information technology teacher and science teacher gave information about how to generate QR codes and applications (kine master, vivavideo and canva) where students can generate their own videos within QR codes.

The study lasted for 3 weeks (12 class hours in total). At the beginning of the study, cooperative learning groups were formed (using jigsaw II technique). A total of 20 students were divided into four groups of five. Attention was paid to heterogeneity within groups and homogeneity between groups. These groups were named as A, B, C, and D groups. Then the students in the groups were named among themselves (Group A students such as A1, A2, A3, A4, A5). The same grouping was performed within the other groups (B, C and D). The same number was given to the student who took the same subject in each group. In the formation of expert groups, A1, B1, C1, D1 students who took the same subject in groups formed an expert group, while A2, B2, C2, D2 students, A3, B3, C3, D3 students, A4, B4, C4, D4 students and A5, B5, C5, D5 students formed the other expert groups. The subjects of nervous system (first week), endocrine glands (second week) and sensory organs (third week) were distributed to expert groups and peer learning took place. The students took an active role in the generation and use of QR codes. The study was carried out based on the topics to be covered within the context of the objectives set in the science curriculum. At the end of the study, the data were

analyzed under two headings; the students and their parents' opinions on the use of QR codes in science lessons and their opinions on group works. The activities that the students did during the lesson in the classroom, what they did in the activities that day, the students' comments about the activities (the answers to the questions such as whether they liked/disliked, which work they liked the most/why?) were put in the portfolio files by the students and the parents regularly examined their children's portfolio files and thus remained informed about what they were doing. In addition, through the WhatsApp group established with the parents, the photos taken during the classroom activities and the things done in the classroom were shared with the parents of the students and thus they were provided with more information about the study. At the end of the study, the parents were invited to the school and the students presented their portfolio files to the parents. After the presentation, written opinions of the parents and students about the study were received. Four parents who could not attend the portfolio presentation and whose opinions could not be obtained were excluded from the study. Pictures of some applications made in the study are presented below.

Nervous System (First week)

Endocrine Glands (Second week)

Sense Organs (Third week)

2.5. Data Analysis

The data obtained from the students and their parents were analyzed by using the content analysis method. First of all, the collected data were analyzed by both researchers separately on the basis of codes and themes. The codings were checked by using the Miles and Huberman (1994) formula. It was seen that the reliability was over 90%, and the reliability of the written data was ensured with the researchers reaching the same results by persuading each other. The data agreed by the researchers were tabulated and interpreted with the support of sample quotations.

3. Results

In this section, the findings obtained from the data collected from the students and their parents are presented. In the study, the findings are presented under two headings:

The students' opinions on the use of QR codes and cooperative learning groups in science lessons; their parents' opinions on the use of QR codes and cooperative learning groups in science lessons.

3.1. Students' opinions on the use of QR codes and cooperative learning groups in science lessons

The students' opinions on the use of QR codes and cooperative learning groups in science lessons are presented in the table below (Table 3.1).

Table 3.1. Students' opinions on the use of QR codes in science lessons

Themes	**Codes**	**Students mentioning**
QR code generation process	**State of getting help**	
	From science teachers	S1,S2,S3,S4,S5,S6,S7,S8,S9,S10,S11,S12,S15,S16,S17,S18,S19,S20
	From the internet	S3,S6,S13
	From the family	S4,S8,S5
	From the friends in the group	S2,S5,S14
	Difficulties experienced	
	Experiencing some difficulties	S1,S3,S6,S7,S9,S11,S12,S15,S17
	Experiencing no difficulties	S2,S10,S13,S16,S18,S20
	Experiencing difficulties	S4,S5,S8,S14,S19
Feelings aroused by the generation of QR code in students	**Positive feelings**	
	Feeling good	S3,S8,S11,S14,S15,S16,S17,S18,S19,S20
	Feeling happy	S1,S2,S3,S5,S7,S10,S11,S14,S16
	Desire to study	S7,S8,S9,S10,S16,S17
	Successful	S1,S4,S8
	Proud	S1,S10
	Feeling like a teacher	S6,S5
	Feeling like working on a special duty	S13
	Negative feelings	
	Exhausted	S5,S18
	Uneasy	S1
Student opinions on the use of QR codes in science lessons	**Comparing with the previous science lessons**	
	Making better learning possible	S1,S3,S4,S5,S9,S11,S14,S16,S18,S19,S20
	Being more active	S5,S6,S7,S8,S9,S12
	Better understanding as the student does himself/herself	S7,S8,S10,S11,S17
	Making learning easier and faster	S1,S5,S13,S15,S19
	More enjoyable	S2,S3,S8,S10
	Better retention	S1,S2,S4,S8
	More interesting and beautiful	S11,S18
	Use in science education	
	In learning a subject	S5,S7,S12,S13,S14,S17,S18
	In every part of the lesson	S4,S10,S11,S16,S20
	In the evaluation of the subject	S5,S6,S8,S9,S15
	In the revision of the subject	S1,S2,S3,S19
	Subjects drawing the interest of students in lessons where QR codes are used	
	Sense organs	S1,S2,S3,S6,S7,S8,S9,S10,S11,S18
	Endocrine glands	S9,S12,S13,S14,S18
	Nervous system	S5,S7,S15,S19
	All	S4,S16,S17,S20

	Science lessons where QR codes can be used	
	In some subjects	
	-Solar system	S1,S3,S4,S6,S7,S8,S9,S10,S12,S13,S15,S20
	- Support and movement system	S3,S6
	-Digestive system	S7,S18
	-Light and heat	S5
	-The circulatory system	S2
	In all subjects	S11,S14,S16,S17,S19
Positive and negative aspects of the use of QR codes	**Positive aspects**	
	Making learning easier	S1,S2,S3,S4,S6,S7,S8,S10,S11,S13,S14,S15,S16, S17,S19,S20
	Preventing paper waste	S1,S2,S5,S8,S9,S20
	Making lesson more enjoyable	S6,S8,S10,S11,S12,S17
	Making learning faster	S1,S12,S13
	Making a difference	S5
	Being accessible	S7
	Negative aspects	
	Difficulty of generating the QR code content	S5,S7,S9,S10,S18
	Technological tools required	S8,S17
Areas of use for QR codes in areas outside science classes	**Other school subjects where QR codes can be used**	
	Mathematics	S1,S2,S5,S6,S8,S10,S11,S12,S13,S14,S15,S20
	Social studies	S2,S5,S6,S9,S11,S12,S14,S18,S19
	All school subjects	S3,S7,S10,S12,S16,S17
	English	S1,S5,S6,S11,S19
	Turkish	S1,S4,S13,S14
	Art	S8
	Informatics	S13
	Religious	S14
	Use of QR codes outside the classroom in the school environment	
	Everywhere	S2,S4,S5,S7,S8,S13,S14,S16,S17,S18
	Canteen	S6,S9,S12,S15
	On school boards	S1,S10,S19
	In books	S1,S11,S20
	School promotions	S1,S3,S10
	Activities and competitions participated by the school	S3,S10
	In laboratories	S6
Student opinions on QR codes after the use of QR c odes in lessons	**QR code awareness**	
	Recognizing the numerousness of the areas where QR codes can be used	S1,S2,S3,S5,S6,S8,S9,S10,S11,S12,S13,S15,S16,S17,S18,S20
	Ease of use	S2,S4,S6,S14
	Desire for and curiosity about scanning QR codes	S3,S7,S17,S18,
	Prevention of visual pollution by QR codes	S2,S5,S8,S10

Most of the students stated that they received support from the science teacher during the QR code generation process and there were also students who stated that they received support from the internet, family and peers in their groups. While some students (6 students) stated that they did not experience difficulties during the process, some (9 students) stated that they had some difficulties, and some (5 students) stated that they had difficulties. Some of the student opinions regarding this are as follows:

"I had no difficulty in the QR code generation process. I made a lot of effort while working. I was so afraid that I wouldn't be able to. At first, I got help from peers in our group and my teachers while preparing. When I learned later, I generated it myself" (S2).

"I found it a little difficult at first, but then it became very easy. I learned how to generate a QR code first from our teacher and then by searching internet sites. It took me a long time to create the videos but it was easy to prepare the QR code" (S3).

"I first learned how to generate a QR code from our teacher. At first, I got help from my friends and family while preparing QR code videos. After a while, I started to prepare myself because I started to find it easy. I had difficulties in generating QR codes, it was difficult to deal with them" (S5).

In terms of the feelings that the QR code generation process aroused in students, the majority of the students drew attention to positive feelings and the majority of them stated that generating a QR code made them feel good and happy. Only three students expressed negative feelings. Some of the student opinions regarding this theme are as follows:

"It made me feel so good because it made me very happy that my teacher gave me responsibility" (S3).

"I got so tired, I worked so hard. It feels so good to do this work" (S18).

"It felt very good to take charge and take responsibility" (S20).

""It made me feel very good. For the first time, a work I have done has been highly appreciated" (S19).

"At first I was very nervous, then I took such a responsibility and felt proud of myself for succeeding" (S1).

From the student's point of view regarding the use of QR code in science lessons, the majority of students stated that the use of QR code in science lessons enabled them to learn better when compared to previous science lessons. The majority of them found the use of QR codes more effective in science lessons, especially in the learning stage of the subject. QR codes were used in the teaching of the subjects of Sense Organs, Endocrine Glands and Nervous Systems, and most of the students were more interested in the subject of Sense Organs. The students were asked which subject(s) apart from the

subjects instructed through QR codes in the current study should be taught by using QR codes and the majority of the students stated the subject of "Solar System" as the best subject to be taught with QR codes. Some of the student opinions regarding this theme are as follows:

"In terms of my learning, the QR code was better and we learned better because in other lessons, it was just in the form of questions and answers. We became a group, formed expert groups, and became both students and teachers in the lessons we taught with QR codes. We both explained and listened, so it was more memorable and we learned easily. I think the QR code was effective in the revision of the lesson because when we revised the subjects we learned better and better retention was achieved. Of the subjects taught with QR codes, it was the sense organs that caught my attention the most because our teacher brought tongue, nose, eyes, skin and ears. We examined all of them one by one and organized a competition with the wheel of fortune game that we created with QR codes. Apart from the subjects already taught with QR codes, QR codes can be used in the teaching of the subject of Solar system so that we can visualize the subject and learn more easily" (S1).

"The QR code made it easier for me to learn by visualizing the subject. So I learned the subject better. I am a visual learner. In our previous lessons, I was just a listener and could not give myself to the lesson, but now I feel as if I am connected to that lesson. We created groups in the lesson taught with QR codes, I became both a teacher and a student. It can be used in the teaching of the subject of light and heat, apart from the lessons already taught with QR codes because I think these subjects have an important place in our lives. I think that QR code will be more effective in learning and evaluating the subject. I think it will be more useful when learning and evaluating ourselves" (S5).

In terms of positive and negative aspects of using QR codes, the majority of the students mentioned the positive aspects of using QR codes in science lessons. Among the positive aspects, the greatest emphasis was put on facilitating learning. Positive aspects such as preventing paper waste, making the lesson fun, making learning faster, making a difference and being easily accessible were also mentioned by the students. As negative aspects, the difficulty of preparing the QR code content and the need for technological tools were mentioned. Some of the student opinions regarding this theme are as follows:

"Its positive aspect is that it helped me learn the lesson better and made the lesson more fun. Its negative aspect is that not everyone has technological devices like phones. Thus, QR code can be difficult to read for them" (S17).

"Through QR codes, the subject can be taught in a shorter time and more easily, and the lesson is more fun. We can also fit a lot of information into a small QR code instead of huge billboards; we can also prevent waste of paper. The negative aspect is that not everyone has a QR code reader" (S8).

In terms of the potential usage areas of QR code outside science classes, the majority of the students stated that it can be used in mathematics classes. There are also students stating that it can be used in all classes, in English and Turkish classes, in art, informatics and religion classes. When the opinions of the students regarding the use of QR code in extracurricular school environments are evaluated, it is seen that the majority of the students are of the opinion that QR codes can be used everywhere, while there are students saying that they can be used on school boards, in books, school promotions, activities and competitions attended by the school, laboratories and canteens. Some of the student opinions regarding this theme are as follows:

"It can be used in social studies classes because we can increase the retention by visualizing the topics there, so the lesson will be more fun" (S18).

"It can be used in any lesson because with QR codes, the lesson is more fun and more beautiful. We participate more in the lesson" (S16).

"QR code can be used in the school canteen because my father has a market and it makes his job easier there. That's why it would be good to have it in canteens" (S12).

When the students' opinions on the use of QR codes after the lessons taught with QR codes were examined, it was found that the majority of the students stated that the places where QR codes were used started to attract their attention after this study. They stated that QR codes are used for different purposes in different environments, noticed the ease of use of QR codes and recognized that visual pollution can be prevented by using QR codes. They also stated that they started to be curious about having QR codes read in different environments. Some of the student opinions regarding this theme are as follows:

"The use of QR codes begins to attract my attention everywhere I go. Visual pollution can be prevented with a small QR code, especially instead of long written and colourful picture advertisements and promotions on billboards" (S5).

"Now, QR codes are used everywhere in our lives and I like to have them read and I wonder what will come out when they are read" (S3).

"QR codes attract my attention everywhere, as I have been working on and interested in QR codes in the lessons. For example, I always see them on buses, shopping malls, hospitals, and they always attract my attention" (S16).

The students' opinions on the group works are presented in a table below (Table 3.2).

Table 3.2. Student opinions on group works

Themes	**Codes**	**Students mentioning**
Contributions of group works to students	**Contribution to the learning of the subject**	
	Making it possible to learn the subject better	S2,S3,S6,S7,S8,S9,S10,S12,S17,S18,S19
	Contribution of the group members to learning	S1,S5,S6,S8,S11,S12,S15,S16,S18,S19
	Working harder on behalf of the group	S4,S6,S12,S14,S17,S20

	Making the understanding of the subject easier and faster	S8,S13
Student feelings on group works	**Positive feelings aroused by the responsibility of being a member of a group**	
	Feeling like a teacher	S6,S9,S10,S12,S14,S16
	Increasing desire to study	S7,S8,S9,S16,S17
	The pleasure of fulfilling your responsibility	S3,S7,S13,S18
	The pleasure of taking responsibility	S2,S15,S18,S19,S20
	Feeling good	S3,S11,S15,S19,S20
	Feeling special	S13,S5
	Negative feelings aroused by the responsibility of being a member of a group	
	The anxiety of taking responsibility	S1,S4,S5,S7,S10,S13,S16
	Feeling exhausted	S8,S10
	Positive feelings generated by within-group interaction	
	Unity, togetherness and solidarity	S1,S2,S5,S7,S8,S9, S11,S16,S17
	Motivation	S6,S12,S15,S20
	Negative feelings generated by within-group interaction	
	Loss of motivation caused by within-group conflict	S3,S13,S14,S18,S19
	The sadness of attributing a failure to a person	S4,S14, S19
Student thoughts on group works	**Opinions on group works**	
	I enjoyed group works	S1,S2,S3,S4,S5,S6,S7,S8,S9,S10,S11,S12,S13,S14 ,S15,S16,S17,S18,S19
	I partially enjoyed group works	S20
	Opinions on group competitions	
	I had some difficulty in competitions between groups	S2,S4,S5,S6,S9,S10,S11,S12,S17
	I had difficulty in competitions between groups	S1,S7,S8,S13,S14,S18
	I did not have any difficulty in competitions between groups	S3,S15,S16,S19,S20
	Factors having contributions to the victory in competitions	
	Working hard	S1,S2,S4,S5,S8,S9,S10,S11,S13,S14,S15,S16,S18, S19,S20
	Sense of togetherness	S2,S8,S9,S10,S17
	Sense of victory	S6
	Being diligent	S11
	Factors having contributions to the failure in competitions	
	Not working hard	S1,S4,S5,S10,S11,S14,S15,S16,S18,S20
	Excitement	S5,S8,S10,S14,S17
	Lack of dedication on the part of group mates	S3,S7,S13,S19
	Stress	S6,S9,S14,S17
	Finding the subject difficult	S11,S5
	Not learning from mistakes	S12
	Lack of self-confidence	S10
Within-groups and between-groups interaction and change	**Not making changes within group**	
	Sense of togetherness	S1,S2,S9,S12,S14,S16,S17
	Desire to make change within group	
	Desire to make a different distribution of tasks	S5,S8,S11
	Desire to make changes between groups	
	Exclusion of students not working from the group	S3,S6,S7,S10,S13,S15,S18,S19
	Desire to go to the group of working students	S4,S20

In terms of the contributions of group works to the students, the majority of the students stated that group works enabled them to learn the subject better. There were also some students who stated that group mates contributed to their learning, that they worked harder on behalf of the group and that group works facilitated and accelerated the understanding of the subject. Some of the student opinions regarding this theme are as follows:

"Together with my friends, we explained the subjects to each other. We did our best to help those who did not understand the subject to understand. We helped each other to learn better by asking questions" (S6).

"I understood the subject better in group works. I used to work less; I worked harder in a group. I contributed to the learning of my friends. We supported each other in groups. We were asking questions about the things we didn't know, why or where we went wrong and thus correcting our mistakes" (S12).

In terms of student feelings about group work, students mentioned positive and negative feelings about the responsibility of being a group member and positive and negative feelings created by within-group interaction. Among the positive feelings created by the responsibility of being a group member, the most frequently mentioned feeling by the students is feeling like a teacher. In terms of the negative feelings of being a group member, the uneasiness of taking responsibility was mentioned the most. The most mentioned positive feelings generated by within-group interaction were found to include the establishment of unity, togetherness and solidarity and the most mentioned negative feelings were found to include the loss of motivation caused by within-group conflicts. Some of the student opinions regarding this theme are as follows:

"The workload and taking responsibility was too much for me. I was exhausted. I studied and prepared for the lesson from many sources. I spent hours working because I had responsibilities both as a teacher and as a learner in my group. It was very difficult to be the one teaching because you were not allowed to make a mistake. I was not allowed to teach anything wrong to my friends. I had to give correct answers to the questions as a teacher because the mistake made by a student would affect the whole group" (S10).

"Although my responsibility was challenging, it made me feel very good to be able to handle it. It was very fun and good to be both a student and a teacher in the group. The fact that some of our friends in the group did not study and did not show enough commitment even though we helped them study negatively affected our group and this saddened us a lot. We did not achieve the desired success because one person's success is the group's success and one person's failure is the group's failure" (S3).

When the students' thoughts on group work were examined, it was seen that most of the students stated that they liked group work and that they had some difficulties in group competitions. While the majority of the students stated that their working hard

was the most effective factor in their winning, they attributed their inability to win group competitions to their working not hard enough. Some of the student opinions regarding this theme are as follows:

"I liked the group work very much because there was a sense of togetherness. For example, in group competitions, we were upset when a person in the group gave the wrong answer to the questions, and we were happy when someone answered the question correctly. I liked the group competitions very much and it was very enjoyable. It was very difficult and I had to study a lot because the competitions were very competitive. Everyone had so much fun. There were times when our hands trembled with excitement. In my opinion, what was effective in winning the group competitions was our hard work. The reason why we lost was because we were excited" (S8).

"I found group work very good and beautiful. We worked hard for the success of the group, we had some difficulties in group work, but we learned a lot and tried hard. We fought until the end to win the competitions. It was very nice work. There were times when our group won and lost the competition. It was not possible for us to win every competition anyway. Our group fought to the end in the competitions, that's what mattered. Many things contributed to our group's winning and losing. But I think that our excitement and stress were most effective in losing, and trust and support were the most effective in our winning (S17)"

In terms of the interaction and change within and between groups, the students were asked "What would you change if you wanted to make changes within and between groups? Why?" and the majority of the students stated that they wanted to exclude the students not working from the group. However, while some students stated that they would not make any change in the group and that unity and solidarity were at the forefront, some students stated that they would make a different distribution of tasks in the same group. Some of the student opinions expressed in this regard are given below.

"I wouldn't want anyone from my group to go to another group. Important thing is not winning or losing rather being a group is the most important thing. But I would make changes in the distribution of tasks within the group because some of the subjects were difficult for my friends to study and explain" (S5).

"I wouldn't want anyone from my group to go to another group because we got on very well as a group and we fought to the end. There were times we won and lost but we did not lose the feeling of being a group" (S16).

3.2. Parents' opinions on the use of QR codes and cooperative learning groups in science lessons

Parents' opinions on the use of QR codes and cooperative learning groups in science lessons are tabulated below (Table 3.3).

Table 3.3. Parents' opinions on the use of QR codes and group works

Themes	**Codes**	**Parents mentioning**
Experience regarding the use of QR codes	**Information about QR code**	
	I already knew	
	-I was using in the workplace	P12,P13
	Having partial knowledge	
	-Withdrawing money from ATM'	P5,P7,P10,P12,P14,P16
	-From test books	P8,P9,P10,P13
	-From the environment (Bill boards, advertisements, restaurants, shopping malls, HES…)	P5,P2,P10,P11
	-Only making QR code read	P11
	I did not know	P1,P2,P3,P4,P6,P15
	- I learned after this study	P2,P4,P14
Contribution of family members to the student in the QR code generation process	**Contributions from family members to the student**	
	Mother	P2,P5,P7,P8,P9,P10
	Elder sister	P1,P3,P9,P14,P16
	Elder brother	P4,P6,P8,P13
	Father	P1,P10,P12,P16
	Younger sibling	P11
Experiences of students in the QR code generation process according to parents	**Positive experiences**	
	Enjoying the process	P1,P2,P3,P4,P5,P6,P7,P8,P9,P10,P11,P12,P13,P14,P15,P16
	Self-confidence for being successful	P1,P3,P4,P5,P6,P11,P12,P15,P16
	Willingness to be involved in the work	P3,P4,P5,P6,P10,P14,P15,P16
	Excitement felt about the work	P4,P6,P7,P11,P12
	Negative experiences	
	Worried	P1,P8,P9,P11,P13
	Stressed	P5, P6,P13
Difficulties in the QR code generation process	**Having difficulty**	
	Fear of failure	P1,P4,P11,P12,P14,P15,P16
	Time	P3,P5,P6,P8,P9,P16,P13
	Internet problem	P3,P5,P7,P8
	Technological tools-induced problems	P3,P5
	Problems experienced in using QR codes	P9
	Lack of experience	P13
	Not having difficulty	P2,P10
Parents' interest in QR code after the completion of QR code-supported activities	**Interesting for me**	
	Awareness of using it in daily life	P1,P2,P4,P7,P10,P11,P12,P13,P14
	Making life easier	P8,P9,P10,P12,P13,P14,P16
	Positive effect of the love for his/her child	P3,P5
	Not interesting for me	
	Not necessary	P6,P15
	Positive aspects	

Parents' opinions on the integration of QR codes and technology into science classes	Effect on learning	
	-Making learning easier and faster	P3,P4,P7,P10,P11,P12,P13,P14,P15,P16
	-Fun and instructive	P2,P3,P4,P5,P8,P10,P11,P16
	-Making students active	P6,P7,P8,P9,P10,P11,P12
	-Increasing willingness to work	P5,P8
	-Willingness to research	P5
	-A new and difficult study	P6
	Effect on the student behaviours	
	-Sense of responsibility	P1,P7,P10
	-Sense of commitment	P1,P7
	-Increasing self-confidence	P10
	Effect of technology on life	
	-Teaching through technology is a good investment for future	P2,P6,P7,P10,P11,P13,P14
	-Technology-assisted education is fun and instructive	P2,P3,P8,P10,P16,P9
	-Interest in technology	P4,P5,P12,P14
	-Technology's being a part of daily life	P1,P5
	-Correct use of technology	P15
	Negative aspects	
	Fear of technology	
	-Health problems	P11
	-Addiction	P11
Parents' opinions on group works	**Opinions on group works**	
	Finding useful	P1,P2,P3,P5,P7,P9,P10,P14,P16
	Finding successful	P4,P5,P8,P12,P15,P16
	Creating group awareness	P3,P6,P10,P11
	A new and different approach	P6,P10
	Developing a sense of responsibility	P13
	Developing communication skills	P13
	Developing social intelligence	P15
	Contribution to learning	
	Learning with fun	P3,P10,P15
	Being practical and instructive	P4,P8
	Increasing retention	P6
	Improving study skills	P11

In terms of the experience of the parents regarding QR codes, the parents were asked "Have you had information about QR codes? If yes, where did you learn it from?" and their answers revealed that some parents did not have any information, some parents had some information and some used them in their work places. Some of the parents' opinions on this theme are as follows:

"I saw QR codes in some places around me. However, I gained certain information after being involved in activities based on QR codes in science classes." (P2)

"We didn't know much about QR code. When we went somewhere during the pandemic, we used QR codes to enter some places. We knew that when money was withdrawn from ATMs, the transaction took place by scanning QR codes. We did not know that it was used so widely in every field. We also knew that test answers could be accessed by QR code." (P10)

In relation to the contribution of parents to their children in the QR code generation process, the parents were asked "Did you help your children with the QR code applications at home? If yes, which family member helped? and as a result, it was found that the family members helping the child the most were mothers and fathers. Some of the parents' opinions on this theme are as follows:

"I helped him/her as his/her elder sister. I helped him/her make the videos." (P3)

"As his/her elder brother, I explained the points that my sister/brother did not understand and helped him/her find out which sources he/she should use when he/she had a lack of information." (P13)

In relation to the opinions of parents on the experiences of their children in the QR code generation process, the parents were asked "How did your child feel while generating QR codes? What were the changes you observed in your child?" and the great majority of the parents stated that these applications had positive effects on their children and that their children enjoyed working with QR codes. Some of the parents' opinions on this theme are as follows:

"He/she was a little excited. I think he/she enjoyed this work. We even did some parts over and over again until we were able to do it correctly. He/she did not have much difficulty during the study, he/she was sure that he/she would succeed. He/she organized the work himself/herself and was willing to do the work." (P4)

"He/she was worried about whether he/she could do this work. But he/she was confident and enjoyed the work." (P1)

"He/she was excited at first and a little stressed. He/she enjoyed the work. He/she worked very hard to prepare the videos. He/she was very confident that he/she would do the work and was willing to do the work." (P6)

In relation to the difficulties experienced in the QR code generation process, the parents were asked "Did your child and you yourself experience ant difficulty while getting ready for the QR code applications? If yes, what problems did you experience?" and the great majority of the parents stated that they had some difficulties at the beginning of the study. Especially the number of parents who mentioned the fear of not being able to do and fear of failure and time constraint is high. Two parents stated that their children did not have any difficulty. Some of the parents' opinions on this theme are as follows:

"My child did not experience any difficulties, reluctance or fear of not being able to prepare. On the contrary, he/she prepared it willingly because it was a different work." (P10)

"Yes, in the beginning there was a fear of not being able to do it. But he/she finally did." (P11)

In terms of the interest of parents in QR code after the completion of the QR activities, the parents were asked "Do you find QR code interesting after this study? Why?" and the great majority of the parents stated that they find it interesting while two of the parents stated that they do not find it interesting. Some of the parents' opinions on this theme are as follows:

"Yes, it interests me. When I see it everywhere, my daughter's work comes to my mind." (P11)

"It interests me. Reason; I noticed that QR code is used in many places and it is very useful for us. It makes our job easier." (P14)

"As a mother, I found it interesting as it created a new experience and desire to work for my child." (P5)

In relation to the opinions of parents on the integration of QR codes and technology into science classes, the parents were asked "How did you find QR code-supported science education? What kind of contributions can be made by such technology-assisted lessons to your child?" and the great majority of the parents pointed to positive aspects of technology integration. The parents especially mentioned that it facilitates and accelerates learning, and they also mentioned their contributions to the behaviour of their children and the effect of technology on life. Only one parent expressed his/her concern that it could adversely affect the child's health and cause him/her to develop harmful habits. Some of the parents' opinions on this theme are as follows:

"We found it pretty good. It is good for children to know how to fulfil their responsibilities and to see what would happen if they did not fulfil their responsibilities. Today, technology is everywhere and intertwined with daily life. As a result of this study, children will be more alert to technology." (P1)

"I found it educational and instructive. They are quick, easy and understandable in terms of learning. Since children are more interested in technology, it is very good to use it in the classroom. It is understood that there is a lot of effort when they have their work read through QR codes." (P4)

"Although this type of technology-supported education is good for my child's learning, I do not find it good for his/her health. In addition, spending time with technological devices can result in some harmful habits." (P11)

In relation to the opinions of parents on group works, the parents were asked "How did you find the activities conducted by the science teacher with your children?" and the great majority of the parents pointed to the positive aspects of group works. Most of the parents stated that they found group works useful. They also mentioned that it contributed to learning by having fun. Some of the parents' opinions on this theme are as follows:

"It is a very good work for children to learn the lesson in different ways and to keep the information they learn in mind. At least they're all trying to do something for the group." (P6)

"Group works made me very happy. It was a different teaching. I think it is beneficial for the development of team spirit, for feeling the happiness of achieving something individually and as a group, and for learning while having fun." (P10)

"I think it develops responsibility and communication skills." (P13)

4. Discussion and Suggestions

The results and discussions of the findings of the study are presented under two headings and suggestions are made in light of the findings.

4.1. Discussions on the opinions of students and parents on the use of QR code in science lessons

When the findings of the study regarding QR code were evaluated in terms of student opinions, the majority of the students stated that they received support from the science teacher during the QR code generation process. The students stated that they took responsibility while generating QR codes. After the students were taught how to generate QR codes, all the QR codes used on the models during the education process were generated by the students. It was observed that the students were very enthusiastic and motivated during the QR code generation process. In an experimental study conducted on the use of QR codes in education (Rikala and Kankaanranta, 2014), the views of 76 learners and of their teachers from four different-level schools were

determined. The results of the study revealed that the learners were eager and motivated to use the QR codes. As for their teachers, they approached cautiously to the use of QR codes in education and mentioned the likelihood of various difficulties to be experienced in relation to the preparation of lesson units and time. In addition, in the study, it was found that QR codes could motivate learners and draw their attention to class since these codes support learning and provide opportunities both for independent learning and for cooperative learning. The majority of the students stated that they learned better in science lessons using QR codes when compared to previous science lessons. The vast majority of them found the use of QR codes more effective in learning the subject, especially in Science lessons. QR codes were used in the teaching of the subjects of Sense Organs, Endocrine Glands and Nervous Systems, and most of the students found the subject of Sense Organs more interesting. Other than the topics covered, there were some who stated that it would be easier to learn if QR codes were used, especially the subject of the Solar System. When the studies are examined, it is seen that there are studies focused on the use of QR code technology in the evaluation phase of the education-teaching process (Bayat et al., 2014; Fujimura and Doi, 2006; Susono and Shimomura, 2006) and that there are some studies focused on the applied use of QR codes in the teaching environment. Chen and Choi (2010) aimed to create an effective learning environment in the classroom environment by integrating QR code-enriched technological software into the middle school history course. In this technological design process for history learning, the class was divided into groups and each group was given a phone with internet support. In addition, with the QR code scanning feature on these phones, students were given question cards to improve their historical inquiry and critical thinking skills.

Considering the positive and negative aspects of the use of QR codes, the majority of the students mentioned the positive aspects of using QR codes in science lessons. Among the positive aspects, the main emphasis was placed on the facilitation of learning. It was also mentioned that it has positive features such as preventing paper waste, making the lesson fun, accelerating learning, making a difference and being easily accessible. In the studies conducted by Rivers (2009) and Gogova and Koçeska (2014), students stated that the use of QR codes makes the lesson fun. Yılmaz and Canbazoğlu Bilici (2017) also revealed in their study that students found it interesting and entertaining that the questions are hidden in the codes in the games designed with QR codes. The findings revealed by Uçak (2019) showed that the use of QR codes arouses interest and curiosity, entertains, integrates science with technology, fosters permanent learning and supports learning. Uçak (2019), Aktaş and Çaycı (2013) stated that one of the advantages of QR codes is that it provides convenience for students to access more resources and prevents paper waste. As a negative aspect, only the need for technological tools was mentioned. Uçak (2019) also stated that the need for a tablet and phone, internet connection problems and the generation of QR codes in scheduled programs are the disadvantages of

the QR code technology. Akın (2014) also stated that the disadvantages of QR codes can be grouped under three headings; problems caused by devices, problems related to deformation of QR codes and problems arising from the user.

The majority of the students stated that it can be used in mathematics lessons apart from science lessons. There were also some students who stated that it can be used in all lessons, social studies, Turkish and English lessons, arts, informatics and religion lessons. The results obtained from the opinions of students and teachers by Karakuş and Şeyihoğlu (2022) indicated that social studies teaching supported by QR code applications contributes to the development of cognitive and affective skills. In the study conducted by Dönmez Usta and Turan Güntepe (2019), it was suggested the integration of relevant technologies into learning environments in the teaching of subjects/concepts in different classes such as mathematics, English and Turkish, considering that technologies such as QR code can enrich teaching. When the studies examining the effect of QR code use on foreign language learning in the literature are reviewed, it is seen that users have a positive attitude towards the QR code technology (Çelik, 2012; Liu, Tan and Chu, 2010; Rivers, 2009). When the opinions of the students regarding its use in extracurricular school environments are evaluated, it is seen that the majority of the students said that it should be used everywhere, while there are students who said that it can be used on school boards, books, school promotions, activities and competitions attended by the school, laboratories and canteens. In the study conducted by Uçak (2019), it was concluded that QR code can be used in classroom boards, school corridors, course evaluation and homework, laboratory and game-based teaching in the teaching process. Karahan and Canbazoğlu Bilici (2017) stated that videos and texts promoting scientists can be placed on classroom boards in QR codes, and QR codes can be added to questions and answers during the measurement-evaluation phase of the teaching process. In addition, after the lessons taught with QR codes, the majority of the students stated that places where QR codes are used draw their attention more, that they noticed QR codes can be used in different environments for different purposes, that they recognized how easy it is to use them and that visual pollution can be prevented with the use of QR codes. Moreover, they stated that their desire to have QR codes read they see in different environments increased.

When the parents' opinions on the use of QR codes were evaluated, it was seen that most of the parents had partial knowledge about QR code. They stated that they only used QR codes during the pandemic, especially for the purpose of having HES code read, withdrawing money from ATMs, solving the questions in the textbooks and checking the answers, and that they did not have any information about QR code generation and different usage areas. It was found that only two parents used QR codes actively in their workplaces and the reason for these parents to use them is to have them read. Parents who said that they had no knowledge about QR code before stated that they learned about QR code after studies in science lessons and they became very interested. During

the QR code generation process, it was seen that family members helped in the process of preparing the videos in a QR code and encouraged them to work harder. The majority of the parents stated that their children enjoyed working in the QR code generation process as a positive experience. In addition to these positive experiences, some parents stated that they were worried and stressed that their children would not be able to do the work. Some parents stated that children had some difficulties in the generation of a QR code and that the first of these difficulties was the fear of not being able to do it and not being able to overcome this task because the students had not generated a QR code before. There were also students who had problems with time because they had to generate QR codes within a certain time period. Parents also stated that their children had problems with the internet and technological devices. They stated that their children had problems with time, internet and technological devices because they were young, because they did not have devices such as phones, computers, etc., and because they used their parents' technological devices.

When the parents' interest in QR codes was examined, it was seen that most of the parents became aware of the use of QR codes in daily life after this study, and they thought that the use of QR codes would make life easier. Some parents, on the other hand, said that their children's positive opinions about QR code and their love of working with them reflected on their thoughts about QR code and that is why they became interested. A few parents stated that the QR code did not interest them. The parents were found to generally have positive opinions about the integration of QR codes and technology into science lessons. While only one parent expressed her/his concern that it could negatively affect his/her child's health and cause him/her to develop harmful habits, some parents stated that integrating such activities into science lessons would have a positive effect on students' learning and behaviour. They stated that their children were active in this study, and thus their willingness to research and work increased. They stated that this study attracted the attention of the students because it was different from the previous science lessons and they also found the study educational and instructive. It was also stated that the students developed their sense of responsibility and increased their self-confidence because they were responsible for their work and learning. They stated that today's children grow up with technology, and integrating such activities into science lessons makes the lessons more fun and instructive, and increases the children's interest in and curiosity about technology. According to the parents, it is seen as a good investment for the future to distract children from the harmful aspects of today's technology, which is developing so rapidly, and to enable these technology-savvy children to use technology for a beneficial purpose and to integrate it into the lessons. In the relevant literature, no study has been found in which the opinions of parents on the use of QR codes in education were examined. It was revealed that although the majority of students and parents had not used QR codes before this study, they were positive about using QR codes in science lessons.

4.2. Discussions on the opinions of students and parents on cooperative learning groups

It was concluded that the group activities contributed to the better learning of the students and that the group mates made a great contribution to the learning of the students. It was observed that students worked harder and made an effort to learn because they felt responsible not only for their own learning but also for the learning of their friends. Artut and Tarım (2007) stated that in cooperative learning, students are responsible for both their own learning and the learning of the other group members. According to Aydın and Bıyıklı (2017), students working with other students in the jigsaw group share information, engage in critical discussions, and interact with others, which help them develop and learn more effectively. It is seen that being a member of a group brings some responsibilities, and these responsibilities not only arouse positive feelings in students but also cause negative feelings. It was observed that some students wanted to work more with the responsibility of being a group member, that they felt themselves not only as learners but also as teachers, and that they felt great pleasure when they took responsibility as a group member in group work and fulfilled this responsibility. As stated by Lord (2001), students who learn cooperatively talk more about the subject, ask questions, find the opportunity to help each other, become both the narrator and the listener and when they listen, they test the knowledge in their minds. On the other hand, it was seen that when some students took responsibility in the group, they experienced uneasiness due to the fear of not fulfilling the responsibility they took, so they worked more and they felt tired. It was seen that while the students generally liked group work very much, some students said that they liked it partially. The students stated that they interacted with each other during the group work, this interaction increased their sense of unity and solidarity, encouraged them to work and increased their motivation. Johnson and Johnson (2005) stated that cooperative learning increases social cohesion among group members and provides mutual benefit and intrinsic motivation to members. Alfares (2020) also found that using the Jigsaw II technique positively affects the learning process, improves relations with other learners and increases motivation for learning. Moreover, it was concluded that there are disagreements within group members and that the attribution of mistakes to a group member or members reduces the motivation of the students. The students stated that they enjoyed the competitions held for evaluation purposes. It was observed that some students had some difficulties in group competitions. They said that they worked hard to win the group competitions and that their success was the success of the group and therefore they put more effort. It was seen that their hard work was effective in the success of their group, and the sense of unity brought by being a member of the group was effective. While it was seen that the most important reason for the group members to fail in group competitions is the lack of hard work, it was seen that the stress caused by the feeling of not being able to win and the lack of self-confidence of the students during

the competitions were also the reasons for failure. According to Scheepers (2000), the negative aspects of cooperative learning are that the student with low self-confidence has difficulty in feeling committed to the group, that there occur destructive discussions in the group, that time is wasted, that group success leads to individual helplessness and that high-achievers put pressure on the group leading other group members to be hesitant about displaying their skills. When the students were asked whether they wanted to make changes within and between groups, it was observed that they mostly did not want to make changes within the group with the awareness of unity and solidarity. The reason why some students wanted to make changes within the group is that some subjects were very difficult for some students. Again, there were some students who wanted to make changes between groups. Students who had problems with their friends in the group were wanted to be sent to other groups by their friends. It was also seen that the students who were unsuccessful in the competitions also wanted to go to the groups that were successful. Açıkgöz (2014) lists the negative aspects of group work as follows; difficulties in explaining complex subjects, some students' dislike for group work, the use of talented and successful students as teachers and the exclusion of slow learners from the group.

When the opinions of the parents on group work were evaluated, it was seen that the parents in general had a positive view of the group work and found it useful. Some parents stated that this study improved students' group awareness, sense of responsibility, communication skills and social intelligence. According to Costouros (2020), through group interactions in the cooperative learning classroom, students can improve their communication skills and learn to be more tolerant and understanding of others and their differences. According to Sevim (2015), the cooperative learning method improves the social skills that students will use during their communication in the group, their ability to find instant solutions to the problems that arise in the process, to solve interpersonal communication problems and conflict situations and to see their mistakes and to look for solutions, leading to developments in their problem solving skills. For this reason, the Jigsaw II technique is important for students to use skills such as critical thinking, analytical thinking, problem solving and decision making. According to Alfares (2020), the Jigsaw II technique will help improve learning, increase collaboration, foster confidence and make students more active. It can also help students build or develop good relationships in crowded classrooms. Sometimes students can spend a whole year working with the same people in a crowded classroom without knowing them well. This is because they do not have a chance to work with them. Therefore, the jigsaw technique will help all students in the same class to communicate with each other, teach each other and share knowledge.

4.3. Suggestions

In the study, technology integration was achieved in cooperative learning groups by using the Jigsaw II technique, which is one of the cooperative learning methods, and the QR code technology together. The QR code technology can be used with different techniques.

The use of QR codes in the cooperative learning groups in the current study was carried out within the scope of the 6th grade "Digestive System, Endocrine Glands and Sense Organs" units. Similar studies can be carried out on other science subjects such as the solar system, support and movement system, and nervous system, which were especially mentioned by the students.

QR codes can be used in different ways by embedding QR codes in school boards, activities that the school participates in (in activities related to out-of-school learning environments such as science centre, plethenarium, zoo, botanical garden), laboratories, educational games.

QR code can be used in homework, especially where individual learning needs to be supported.

Individual learning of inclusion students can be supported with QR codes. Visual materials can be embedded in QR codes, especially for children who are visual learners, and students' views on such applications can be examined.

Sample studies can be conducted on how QR codes, which can be used in different ways in line with the creativity of the practitioners, can be used in the teaching processes of other classes apart from science classes, and students, parents and teachers' opinions can be taken regarding these studies.

Researchers can conduct quantitative research to investigate the effects of science teaching on different variables such as academic achievement and attitude towards the course.

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