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Research Article

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Effect of the quantum learning model on attitude anxiety curiosity academic achievement and retention in science course

Gökhan Uyanık [1], Rüya Özdemir Uyanık [2]

[1] Faculty of Education, Kastamonu University, Kastamonu, Turkey; [2] Faculty of Education, Kastamonu University, Kastamonu, Turkey

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CORRESPONDENCE

Gökhan Uyanık,
guyanik@kastamonu.edu.tr

ABSTRACT

In modern societies, addiction has spread to such a degree that it is now regarded as a chronic social disease. Drug addiction has reached increasingly dangerous proportions in many parts of the world. Adolescents have a strong propensity for experimentation, are highly inquisitive, are disposed to peer pressure, rebellious against authority, and have low self-confidence, which makes them prone to Drug addiction. The literature highlights a positive correlation between substance use and disruptive family interactions, impacting a child's development. This study aims to explore substance abuse in the context of parent-child conflict, emphasizing the importance of effective parenting. The investigators utilized secondary data by conducting a comprehensive review of relevant literature. This review involved searches across various databases like Google Scholar, ResearchGate, and Eric, employing a filter to specifically identify studies published in English related to substance abuse/drug addiction, parent-child conflict, and positive parenting. The results of the study found parent-child conflict as one among the strong predictors of adolescents' likelihood to develop addiction problem. High level of parent-child conflict can have a negative impact on a child's development and mental health, as well as increase the risk of drug dependence. The implications of the study are discussed.

Introduction

In the age of science and information, where science affects every aspect of life, adapting to technological developments has become very important for the future of countries. The increasing scientific knowledge and the rapid progress of technological innovations also change the way societies live. For this reason, science literate individuals who have the ability to solve problems and make decisions are needed in all countries. For this purpose, improving the quality of science education has become a necessity. Most of the students have difficulty in comprehending the science course and are not successful enough. Most students who are successful in other courses cannot carry these successes to the science course and may experience difficulties in making sense of science concepts. In order for science teaching to be more efficient, students should be guided to internalize science concepts instead of directing them to memorize.

In this regard, it is very important to use methods and techniques in science teaching where students can actively acquire knowledge by experiencing it, meet their needs in their daily lives, carry the knowledge they have acquired into their own lives and think creatively. As in all courses, different learning models have been developed to increase the quality in science courses. It is unthinkable that one teaching model will be effective in all courses and for all students. For this reason, it is necessary to choose a learning model that will suit the interests, wishes and needs of the students and the structure of the subject to be taught. From past to present, different methods and techniques have been used to provide education in the field of educational sciences. With developing situations and changing conditions, the methods and techniques used for teaching purposes have begun to differ and diversify.

Today, student-centered teaching models are used instead of teacher-centered teaching activities. One of these student-centered teaching models is the Quantum Learning Model. Quantum learning which was a model that emerged in the 1980s. It took its origin from the ideas on education put forward by the famous psychiatrist and educator Georgi Lazanov. The quantum learning model is the process of using all neural networks in the brain and keeping the structures together with personal methods in order to create meaningful information (Vella, 2002).

The quantum learning model, which aims to provide students with academic skills and life skills by integrating them on a common denominator, actively involves students in the learning process and develops their sense of responsibility. This model aims to help students make definitive judgments from their minds. In this respect, it can be said that it is shaped more within the framework of possibilities. The quantum learning model aims at the principle of learning to learn. For this purpose, it increases students' motivation and enables them to internalize abstract concepts more easily. Quantum learning is a model that directs students to do research, inquisitive thinking, problem solving and teamwork. It also helps create the necessary environments for students to enjoy activities. Quantum learning cycle; it consists of six interconnected stages that are based on quantum learning principles, include quantum learning techniques, consist of part-whole relationship and aim for success at the end (DePorter, Rearden & Nourie, 1999).

1. Capture Phase

The capture phase activates the student's prior knowledge and enables the student to identify common structures and make connections between the concepts he has previously learned and the new concepts he will learn.

2. Association Phase

In the association phase, preliminary information is associated with previous experiences in order to keep students' desire to explore alive.

3. Labeling Phase

In the labeling phase, new information is tried to be built on the students' prior knowledge.

4. Demonstration Phase

In the demonstration phase, the student is given the chance to gain and use new knowledge. The knowledge gained at this stage is added to the students' learning and life experiences.

5. Repetition Phase

The repetition phase is the strengthening of neural connections through repetition so that the learned knowledge and skills remain permanently in the students' brains.

6. Celebration Phase

In the celebration phase, students' achievements are congratulated.

Quantum learning is based on five main principles. These principles, some of which are the basis for the creation of the quantum learning system, are as follows (DePorter, Rearden & Nourie, 1999):

- The learning environment consists of adequate light, appropriate colors, positive posters, plants, props and music.
- Everything done on the course is done in accordance with the purpose. Because lessons operate in the rhythm of a symphony orchestra.
- Our brain works better and achieves success when faced with mixed stimuli. Learning becomes more effective and permanent if newly acquired information is combined with previously acquired experiences.
- Learning includes risk factors. If the learning environment is made more enjoyable, the student will learn more easily by seeing learning as safe. Thus, it provides superior skill.
- Things worth learning are also worth celebrating. Appropriate and positive feedback creates an emotional and positive connection with learning.

The Quantum Learning Model enables students to learn more comprehensively by offering them both academic and lifelong learning skills. In this sense, it can be said that learning occurs in a more complex and enjoyable way compared to other methods. During the learning process, breaking down information and reconsidering it to complete a whole, looking at information from different angles, asking why and experiencing a purposeful learning process can be achieved with the quantum learning model. At this point, the student not only has to access information but also has to consider an image from different angles. This is possible by including different senses in the learning process. It is thought that making the learner ready to learn and teaching what and how to learn can make significant contributions to solving educational problems. According to the quantum learning model, students need to acquire some academic skills such as quantum reading, quantum writing, note-taking and memory techniques and use them in the teaching process (Demir, 2006). The academic skills that students acquire when using this model provide them with the competence to learn how to learn and to be responsible for their own learning. It also helps students in organizing and arranging information (Ay, 2010).

There are studies in the literature indicating that students' academic success increases in teaching environments organized according to the quantum teaching model (Acat & Ay, 2014; Benn, 2003; Demir, 2006; Güllü, 2010; Le Tellier & Depoter, 2002; Nourie, 1998; Vos-Groenendal, 1991). There are also studies concluding that the quantum learning model is effective in developing positive attitudes towards lessons and learning (Ay, 2010; Barlas, 2002; Nourie, 1998; Vos-Groenendal, 1991). On the other hand, there are also studies showing that the quantum learning model does not have any effect on academic success (Arı & Alaca, 2015; Trice, 2012). When the relevant literature was examined, it was determined that research using the quantum learning model was mostly at the secondary school and high school level. It has been determined that the number of studies conducted using this model at the primary school level is limited. In this regard, it is thought that this research will contribute to the relevant literature. Based on this, the aim of this research is to examine the effect of the quantum learning model on attitudes and anxiety levels towards the fourth grade science course and academic success and retention. To achieve this goal, answers were sought to the following sub-problems:

1. Is there a significant difference between the science curiosity scale pre-test scores of the experimental and control groups?

2. Is there a significant difference between the science curiosity scale post-test scores of the experimental and control groups?
3. Is there a significant difference between the science course anxiety scale pre-test scores of the experimental and control groups?
4. Is there a significant difference between the science course anxiety scale post-test scores of the experimental and control groups?
5. Is there a significant difference between the science course attitude scale pre-test scores of the experimental and control groups?
6. Is there a significant difference between the science course attitude scale post-test scores of the experimental and control groups?
7. Is there a significant difference between the achievement test pre-test scores of the experimental and control groups?
8. Is there a significant difference between the achievement test post-test scores of the experimental and control groups?
9. Is there a significant difference between the retention test scores of the experimental and control groups?

Method

Research design

A pretest-posttest control group quasi-experimental design model was used in this study. Fraenkel and Wallen (2006) stated that the basic idea of all experimental studies is "try some things and systematically observe what happens." In line with this idea, the effect of science teaching using the quantum learning model on the attitudes and anxiety levels of fourth grade primary school students towards the science course, their academic achievements and the permanence of learning was investigated. While teaching in the control group was carried out according to the current curriculum, science teaching based on the quantum learning model was applied in the experimental group. The symbolic view of the experimental design of the research is given in Table 1.

Table 1 Symbolic view of the experimental design of research

Group	Pre-test	Procedure	Post-test	Retention Test
Experimental	S_1-S_2-S_3-T	X	S_1-S_2-S_3-T	T
Control	S_1-S_2-S_3-T	-	S_1-S_2-S_3-T	T

S1: Curiosity Scale
S2: Anxiety Scale
S3: Attitude Scale
T: Achievement Test

Participants

The participants of the study consisted of a total of 58 fourth grade students studying in two different classes of a public school located in Kastamonu city center in the fall semester of the 2019-2020 academic year. 28 of 58 students were randomly selected as the experimental group and 30 as the control group. Appropriate sampling method was used to select the study group of the research.

Data collection tools

Science curiosity scale, anxiety scale towards science course, attitude scale towards science course and achievement test were used as data gathering tools in the study. In the study, the Science Curiosity Scale, developed by Harty and Beall (1984) and translated into Turkish by Serin

(2010), was used to determine the academic curiosity levels of students in science classes. The scale, developed in a 5-point Likert type, contains a total of 30 items. The Cronbach Alpha (α) reliability coefficient value of the scale was announced as 0.87. For this research, the (α) value of the scale was recalculated and a value of 0.76 was obtained. The minimum score that can be obtained from this 30-item scale is determined as "30" and the maximum score is determined as "150".

The anxiety scale for science course was developed by Yıldırım (2015). This scale, which is a 5-point Likert type and includes 19 items, consists of 3 sub-dimensions. The Cronbach Alpha (α) reliability coefficient for the entire scale was announced as 0.85. For this research, the reliability value of the scale was recalculated, and the alpha (α) value was determined to be 0.72 for this research. The minimum score that can be obtained from this 19-item scale is determined as "19" and the maximum score is determined as "95".

The attitude scale towards science course was developed by Uyanık (2014). The Science Course Attitude Scale, developed to determine students' attitude levels towards science course, consists of 18 items. The Cronbach Alpha (α) reliability coefficient of the scale, which was developed as a 3-point Likert type, was determined as 0.86. For this research, the Cronbach Alpha (α) reliability coefficient of the scale was recalculated, and this value was determined to be 0.79. The minimum score that can be obtained from the scale is determined as "18" and the maximum score is determined as "54".

The achievement test used in the research was also developed by Uyanık (2014). This test consists of 28 multiple choice questions. The KR-20 reliability value of the test was determined as 0.78. The KR-20 reliability value of the test for this research was recalculated and the relevant value was determined as 0.76. The minimum score that can be obtained from the test is determined as "0" and the maximum score is determined as "28".

Procedure

At the beginning of the application process, the classroom environment was arranged in accordance with the quantum learning model. Desks were placed in a cluster seating arrangement to enable group work, and a science board was created so that students could display their individual or group work. The experimental application process involves students in the experimental group performing activities prepared according to the principles of the quantum learning model in the Let's Get to Know Matter unit. In this context, a sample lesson teaching application was carried out in the experimental group according to the following stages:

1. Capture Phase

In order to attract the attention of the students and arouse their curiosity, the capture phase was started by bringing items such as nylon bags, dish sponge, nails, pieces of wood, sawdust, glass cup magnets and a container of water to the classroom. All these items were left on the teacher's desk and then the following questions were asked to the students:

- What is the relationship between the items on the table and the items on the floor?
- When the items on the table are dropped into the bucket one by one, will they all float or sink?
- Do you think this magnet can attract all the items left on the table?
- Which substances do you think attract water? Which ones do not absorb water?

After these questions, it is stated to the students that they will learn the correct answers to the questions asked in this course and that they will get to know these items more closely.

2. Association Phase

Students were reminded of the qualitative properties of the substances they learned in third grade, which can be felt through their sense organs. The purpose of this is to enable students to establish a connection between the new subject they will learn and the old subjects, and to enable them to learn more permanently. The following questions were asked to reveal students' prior knowledge:

- What is matter?
- By which senses can the properties of substances be determined?
- What are the qualitative properties of substances that can be determined by sense organs?

While the students were trying to find the answers, they were given clues and guidance regarding the subject. At this stage, they were also asked to create mind maps regarding the subject.

3. Labeling Phase

Animations and video shows on the topic Characteristics of Matter were shown to students via the smart board in the classroom. Students were asked to occasionally take notes using the animations and videos they watched. Here, the Not AY (Note Taking and Note Making) method, which is an important note-taking method in quantum learning, is introduced to students.

4. Demonstration Phase

At the very beginning of the experimental application process, the classroom environment was arranged according to the cluster seating arrangement. Accordingly, there are 4 students in each cluster. The "Let's Find the Characteristics of Matter" activity was held with groups of four students. Then, a worksheet on the subject was distributed to each group and they were asked to fill it out together.

Activity Name: Let's Find the Characteristics of Substances

Materials: Magnet, plastic bag, container filled with water, paper towel, paper clip, dish sponge, nail, sawdust, eraser, aluminum foil, pencil, plastic cap, key, coin and pin.

Steps:

1. In groups of four students, students poured a small amount of water on the table. Then, they wiped the water on the table with a sponge, napkin, aluminum foil and nylon bag.
2. In another activity, students brought a magnet close to nails, erasers, pencils, paper clips, wood shavings and pins.
3. They left coins, wood shavings, a plastic cap and a key in a bucket full of water.

After these procedures, they marked the appropriate spaces in the table below.

Table 2 Substances and their properties

Substance	Floating on Water	Sinking In Water	Attracting Water	Does not absorb water	Attracted with Magnet	Not Attracted by Magnet
Nail						
Plastic cap						
Pencil						
Pin						
Aluminium foil						
Key						
Paperclip						

Napkin						
Wood chips						
Nylon Bag						
Dish sponge						
Eraser						
Coin						

5. Repetition Phase

In this phase, students wrote a composition covering the topic they learned in the course using the quantum writing method. While writing this composition, students were briefly reminded of what was learned during the course. They were asked to express whether there was a change in their perspective on the items they encounter in daily life.

6. Celebration Phase

The studies carried out in the positive classroom environment created from the beginning of the experimental process were hung on the Science board. Students were thanked for both their individual and group performances and motivating words were said. Then, the whole class was asked to applaud themselves and their friends. In this way, that day's lesson was completed with the celebration phase.

During the experimental application process, students were made to make mind maps, posters and pictures within the scope of the quantum learning model, making the learning process more enjoyable. Note-taking and clustering techniques enabled students to take effective notes. In addition, a path was followed towards the purpose of the research by using quantum reading, quantum writing and quantum memory techniques. Individual and group works of the students were exhibited on activity boards. In addition to all these, classical style music was used during the activities, which positively affected individual and group work and increased students' motivation for the lesson. In this process, lessons were taught with the control group students based on the current curriculum. In the control group, lessons were conducted by the current teacher of the class. Before and after the experimental application process, Science Curiosity Scale, Science Anxiety Scale, Science Lesson Attitude Scale and Achievement Test were applied to both the experimental group and the control group students. Four weeks after the post-test application, the Achievement Test was re-applied to the experimental and control group students to measure the permanence and recall level of the information. In this way, the permanence of the acquired information was tested.

Analysis of data

While analyzing the quantitative data obtained from the research, it was determined that the data showed a normal distribution. For this reason, parametric tests were used to analyze the data. Independent groups t-test analysis was applied to compare the scores obtained from the scales of the experimental and control groups. In the analyses, the "p" significance value was accepted as .01.

Findings

Findings of the first sub-problem

Independent t-test results regarding the science curiosity scale pre-test scores of the experimental and control groups are shown in Table 3.

Table 3 Independent t-test results regarding the science curiosity scale pre-test scores of the experimental and control groups

Groups	N	Mean	SD	df	t	p
Experimental	28	67.32	15.34	56	.275	.784
Control	30	66.26	13.88			

When Table 3 is examined, it is seen that there is no statistically significant difference between the science curiosity scale scores of the experimental and control groups before the experimental procedure ($t_{(56)}$= .275, p>.01). Accordingly, it can be said that the science curiosity level of both groups was at a similar level before the experimental procedure.

Findings of the second sub-problem

Independent t-test results regarding the science curiosity scale post-test scores of the experimental and control groups are shown in Table 4.

Table 4 Independent t-test results regarding the science curiosity scale post-test scores of the experimental and control groups

Groups	N	Mean	SD	df	t	p
Experimental	28	104.85	14.22	56	10.543	.000*
Control	30	66.83	13.24			

*p<.01

According to the findings in Table 4, it was determined that there was a statistically significant difference between the science curiosity scale post-test scores of the experimental and control groups in favor of the experimental group ($t_{(56)}$= 10.543, *p<.01). Accordingly, it can be said that the teaching based on the quantum learning model applied in the experimental group increased the students' curiosity in science.

Findings of the third sub-problem

Independent t-test results regarding the science course anxiety scale pre-test scores of the experimental and control groups are shown in Table 5.

Table 5. Independent t-test results regarding the science course anxiety scale pre-test scores of the experimental and control groups

Groups	N	Mean	SD	df	t	p
Experimental	28	68.39	10.08	56	.161	.873
Control	30	67.96	10.11			

Looking at Table 5, it is seen that there is no statistically significant difference between the science course anxiety scale scores of the experimental and control groups before the experimental procedure ($t_{(56)}$= .161, p>.01). Accordingly, it can be said that the anxiety level of both groups towards the science course was at a similar level before the experimental procedure.

Findings of the fourth sub-problem

Independent t-test results regarding the science course anxiety scale post-test scores of the experimental and control groups are shown in Table 6.

Table 6 Independent t-test results regarding the science course anxiety scale post-test scores of the experimental and control groups

Groups	N	Mean	SD	df	t	p
Experimental	28	43.78	11.02	56	-9.056	.000*
Control	30	67.83	9.16			

*p<.01

According to Table 6, it was determined that there was a statistically significant difference between the science course anxiety scale post-test scores of the experimental and control groups in favor of the experimental group ($t_{(56)}$= -9.056 *p<.01). Accordingly, it can be said that the teaching based on the quantum learning model applied in the experimental group reduced students' anxiety towards the science course.

Findings of the fifth sub-problem

Independent t-test results regarding the science course attitude scale pre-test scores of the experimental and control groups are shown in Table 7.

Table 7 Independent t-test results regarding the science course attitude scale pre-test scores of the experimental and control groups

Groups	N	Mean	SD	df	t	p
Experimental	28	34.67	6.01	56	.356	.723
Control	30	34.13	5.66			

When Table 7 is examined, it is seen that there is no statistically significant difference between the science course attitude scale scores of the experimental and control groups before the experimental procedure ($t_{(56)}$= .356, p>.01). Accordingly, it can be said that the attitudes of both groups towards the science course were at similar levels before the experimental procedure.

Findings of the sixth sub-problem

Independent t-test results regarding the science course attitude scale post-test scores of the experimental and control groups are shown in Table 8.

Table 8 Independent t-test results regarding the science course attitude scale post-test scores of the experimental and control groups

Groups	N	Mean	SD	df	t	p
Experimental	28	35.92	4.42	56	1.355	.181
Control	30	34.26	4.87			

According to the findings in Table 8, it is seen that there is no statistically significant difference between the science course attitude scale scores of the experimental and control groups after the experimental procedure ($t_{(56)}$= 1.355, p>.01). Accordingly, it can be said that the attitudes of both groups towards the science course were at similar levels after the experimental application process. This can be interpreted as teaching based on the quantum learning model does not have any effect on attitudes towards science.

Findings of the seventh sub-problem

Independent t-test results regarding the Let's Get to Know Matter Unit achievement test pre-test scores of the experimental and control groups are given in Table 9.

Table 9 Independent t-test results regarding the achievement test pre-test scores of the experimental and control groups

Groups	N	Mean	SD	df	t	p
Experimental	28	5.71	2.37	56	.217	.829
Control	30	5.56	2.77			

When Table 9 is examined, it is seen that there is no statistically significant difference between the achievement test scores of the experimental and control groups before the experimental procedure ($t_{(56)}$= .217, p>.01). Accordingly, it can be said that the science course achievements of both groups were at similar levels before the experimental procedure.

Findings of the eighth sub-problem

Independent t-test results regarding the Let's Get to Know Matter Unit achievement test post-test scores of the experimental and control groups are given in Table 10.

Table 10 Independent t-test results regarding the achievement test post-test scores of the experimental and control groups

Groups	N	Mean	SD	df	t	p
Experimental	28	21.39	3.38	56	9.026	.000*
Control	30	13.83	2.99			

*p<.01

According to Table 10, it was determined that there was a statistically significant difference between the achievement test post-test scores of the experimental and control groups in favor of the experimental group ($t_{(56)}$= 9.026 *p<.01). Accordingly, it can be said that teaching based on the quantum learning model applied in the experimental group increased students' success in science courses.

Findings of the ninth sub-problem

Independent t-test results regarding the retention test scores of the experimental and control groups are included in Table 11.

Table 11 Independent t-test results regarding the retention test scores of the experimental and control groups

Groups	N	Mean	SD	df	t	p
Experimental	28	20.57	2.83	56	13.953	.000*
Control	30	10.16	2.84			

*p<.01

Looking at Table 11, it is seen that there is a statistically significant difference between the retention test scores of the experimental and control groups in favor of the experimental group ($t_{(56)}$= 13.953 *p<.01). Accordingly, it can be said that the teaching based on the quantum learning model applied in the experimental group was effective in the retention of students' success in science courses. The comparative achievement test scores of the experimental and control group students during the application process are shown in Figure 1.

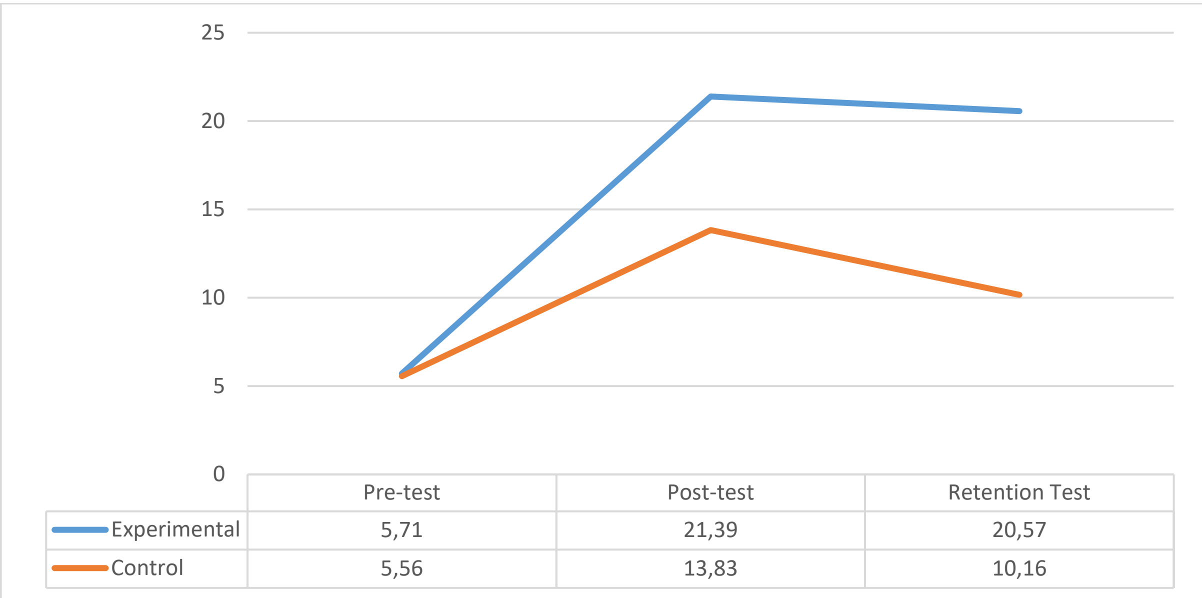

Figure 1 Comparative view of the scores of experimental and control group students

As seen in Figure 1 while the academic success levels of the control group students decreased after a while, it can be said that the success of the experimental group students was more permanent. This can be interpreted as teaching based on the quantum learning model applied in the experimental group is effective in terms of permanent learning.

Results and discussion

In this study, the effect of teaching based on the quantum learning model on attitudes towards primary school science course, curiosity, anxiety, academic success and permanence of learning was investigated. As a result of the research, it was concluded that teaching based on the quantum learning model is effective in increasing students' science curiosity, decreasing their anxiety towards science, increasing their academic success and ensuring permanent learning. When the relevant literature is examined, studies show that teaching based on the quantum learning model increases students' academic success (Acat & Ay, 2014; Benn, 2003; Çakır, 2013; Çelik, 2018; Çırak, 2016; Demir, 2006; Güllü, 2010; Le Tellier & Deporter, 2002; Nourie, 1998; Şimşek, 2016; Şöhretli, 2014; Vos-Groenendal, 1991; Yalçıntaş, 2019). These results are similar to the results obtained in this research. On the other hand, Arı and Alaca (2015) and Trice (2012) concluded in their research that the quantum learning model does not have a significant effect on increasing academic success.

In this study, it was determined that teaching based on the quantum learning model did not have any effect on the attitude towards the science course. This result is similar to the result obtained from the study of Arı and Alaca (2015). On the other hand, Alaca (2014), Ay (2010), Barlas (2002), Çakır (2013), Girit (2011), Güllü (2010), Nourie (1998) and Vos-Groenendal (1991) in their studies found that teaching based on the quantum learning model positively affected students' attitudes towards science courses. In this research, the experimental application process covered a period of 5 weeks. It can also be thought that a period of 5 weeks may be insufficient for any positive or negative change in attitudes. This may be due to the fact that the teaching model used did not have any effect on the attitude towards the science course.

This study concluded that teaching based on the quantum learning model is effective in reducing students' anxiety towards science. On the other hand, Yalçıntaş (2019) found in his research that teaching based on the quantum learning model did not have any effect on the anxiety level towards science. In addition, in this research, the effect of teaching based on the quantum learning model on the permanence of learning was investigated. According to the research results, it has been determined that the quantum learning model has a positive effect on the permanence of academic success. The studies of Arı and Alaca (2015) and Yalçıntaş (2019) in the relevant literature are similar to the results regarding permanence reached in this research.

In this research, it has been determined that science teaching based on the quantum learning model is effective in increasing curiosity about science, decreasing anxiety towards science, increasing success in science courses and ensuring the retention of success. Based on this, it is thought that using this teaching model in the Let's Get to Know Matter unit of the fourth-grade primary school science course will be beneficial to both teachers and students. It is thought that teaching activities to be carried out with this model, in which the constructivist approach is adopted, will be effective in increasing science course success. They should not use the same teaching methods and techniques in teaching every subject in science classes. The content and structure of each unit, each subject and even each lesson are different. Therefore, it is very important to choose the most appropriate teaching methods and techniques for the subject to be taught in the lessons (Uyanık, 2017). Based on this understanding, it can be said that it would be beneficial to use the quantum learning model in some subjects of science courses.

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