The Effect of Popular Science Journals Supported Life-Based Teaching Practices on the Solar System and Eclipses on Academic Achievement

Ayşe Eren[*]
Sevgül Çalış[**]

[*] Department of Science Education
Institute of Educational Sciences
Bursa Uludağ University

[**] Department of Mathematics and Science Teachers Education
Bursa Uludağ University Faculty of Education
Bursa Uludağ University
scalis@uludag.edu.tr

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Abstract

This study investigates the effect of life-based teaching using popular science journals on the success of solving life-based questions prepared by associating them with daily life. The study included 6th-grade students studying in a public secondary school in the spring semester of the 2020 - 2021 academic year. Using the quasi-experimental method, the study's sample consisted of 50 students. The study obtained quantitative data by the academic achievement test consisting of life-based questions and analyzed them using the SPSS program. The study concluded that some of the activities in the textbooks were insufficient to associate science subjects with daily life, and teachers' using resources containing life-like examples such as popular science journals would contribute to academic success.

Keywords: Science education, solar system and eclipses, popular science journal, life-based questions.

INTRODUCTION

In our world, where globalization is rapidly occurring, the ways of accessing the information and knowledge required to follow science and technology are changing. Therefore, the need for science and the importance of science education are increasing daily. It is the target of a generation of information societies to investigate, examine, question, draw conclusions from these inquiries and solve today's problems (Tatar, 2006; Ünal, 2011). To achieve this goal, students should take responsibility for daily life problems and use knowledge, scientific process skills and other life skills related to science in solving these problems (MoNE, 2018).

Science is a difficult lesson to learn due to the abstract topics (Ecevit & Özdemir Şimşek, 2017; Koç, 2014; Çiçek & Saraç, 2017). It is more important today that science teaching will provide more concrete experiences to the student. In addition, it aims to make the knowledge meaningful and experiential for the individual rather than evaluating the student's level of knowledge while preparing the Science curriculum. Since learning is not limited to school environments or classes but covers the whole life, the information learned must be available daily (Hasançebi, 2014). In addition, when students are working on a subject, they often question why they have to learn that subject, whether they will use the information again, and where they can use it in daily life. The biggest reason for these inquiries is that science subjects require abstract and mathematical operations, and students cannot establish a connection between science subjects and their real lives (Whitelegg & Parry, 1999; Bilge & Yaman, 2011; Keskin & Çam, 2019).

The fact that students cannot establish a relationship between science subjects and their daily lives also appears in the measurement and evaluation dimension. The high school placement exams held until 2018 in Turkey are generally knowledge-based, memorized and far from reading comprehension and questioning skills. On the other hand, international exams such as TIMSS and PISA have enabled countries to have the opportunity to evaluate their educational activities and to take various measures in this regard. Unfortunately, Turkey has not achieved the desired success in these exams, and it is in the last row compared to other countries (MoNE, 2016; OECD, 2016). The failure of our students to achieve the desired success in international exams such as TIMSS and PISA has led to criticism of high school entrance exams. After these criticisms, the High School Entrance Exam, which includes life-based questions, has started to be applied from 2018 (Batur, Ulutaş and Beyret, 2019).

In the life or context-based questions, problems related to science subjects or concepts are included in short stories consisting of events called context in daily life (Ahmed and Pollitt, 2007; De Jong, 2008; Heller and Hollabaugh, 1992; Elmas and Eryılmaz, 2015; Sak, 2018). The problem in a context materializes in the students' eyes and comes to life in the students' minds. Problem-solving approaches that facilitate the solution of the problems they face in their

daily lives develop in students who answer life-based questions (Dhlamini, 2011; Rennie and Parker, 1996; Yu, Fan and Lin, 2015).

Students face many problems in their daily lives and should have specific knowledge, as they will defend their thoughts with evidence while seeking solutions to these problems. For this purpose, students should read and understand the resources correctly to reach the correct information (Hacıoğlu and Şahin, 2010). With science education using different sources, students can grow up questioning and researching individuals while developing their critical thinking skills. Using different teaching materials in educational processes contributes to activities such as attracting attention, motivating, reminding, giving clues, reinforcing, being effective in the course, and increasing efficiency for teachers and students. As Güngör and Çavuş (2015) stated, the tools used in education are a vital part of the teaching-learning process. In Turkey, teachers use different tools and printed materials to make the lesson more effective and efficient, as well as textbooks. Using books and brochures by students in the teaching process increases the versatility of teaching and students' research and development capabilities (Thessaloniki Ay, 2010). Popular science journals are also critical auxiliary resources that can support teachers and students in teaching. In the studies conducted in Turkey, there are many studies on the suitability of popular science books for teaching (Bulut and Kuşdemir, 2013; Özsevgeç, Eroğlu, Öztürk Köroğlu, 2017), but the effect of popular science books on success is not sufficiently included in the studies.

Affective behaviours such as desire, interest and excitement are significant in learning and the cognitive field. These behaviours have led humans to research activities around them throughout history (Senemoğlu, 2012). The sense of curiosity has led people to deal with many events and conduct research on this subject. One of the most popular topics has been the subject of stars, planets and other celestial bodies. To make sense of the events in the sky, students should recognize the planet, solar system and other celestial bodies. They also need to understand their relationship, rank and model the planets according to their proximity to the sun and understand how the solar eclipse and lunar eclipses occur (MoNE, 2018). To make the solar system and eclipses more interesting, associating daily life with student knowledge will make the student more active. Life-based learning is the teaching of science concepts and skills by using situations appropriate for students and encountered in daily life (Khun & Müller, 2014). Students should connect real-life and science concepts (Acar & Yaman, 2011).

Among the studies on life-based questions in the literature, there are usually studies investigating the effectiveness of life-based questions (Ülger et al., 2022; Akpınar, 2012; Bellocchi, King and Ritchie, 2016; Benckert and Petterson, 2008; Broman, Bernholt and Parchmann, 2015; Chu, Treagust and Chandrasegaran, 2009; Enghag, 2004; Georghiades, 2006; Kurbanoğlu and Nefes, 2015; Soobard and Rannikmae, 2015; Tekbıyık and Akdeniz, 2010). Life-based questions are essential for students to understand where and how to use the

information they learn. The subjects and achievements in the curricula, including problems in daily life, will contribute to the development of students' high-level thinking skills, increase their success and improve the quality of education to a high level (Güneş, 2013). There are also studies in the literature explaining how to write life-based questions (Elmas and Eryılmaz, 2015), the difference between life-based questions from traditional questions (Poikela, 2004), the ability of teachers (Kurnaz, 2013) and teacher candidates (Ültay and Usta, 2016; Ültay, 2017) to prepare life-based questions. However, not many studies examine academic success with life-based questions using popular science journals that contribute to science literacy in teaching.

Purpose of the study

The study aims to observe the effect of life-based teaching using popular science journals on the subject of the Solar System and Eclipses on the success of LBQT prepared by associating with daily life. For this reason, the study sought answers to the following questions.

1. Is there a significant difference between the results of the LBQT pre-test applied to the students in the experimental and control groups?
2. Is there a significant difference between the post-test results of the experimental group of students who received popular Science Journals Supported Science Teaching and the control group of students who received the current program?
3. Is there a significant difference between the pre-test and post-test scores of the students in the control group taught using the current program?
4. Is there a significant difference between the LBQT pre-test and post-test scores of the students in the experimental group taught using popular Science Journals Supported Science Teaching?

METHOD

Research Pattern

The study used a quasi-experimental design with a pre-test and post-test control group, one of the quantitative research methods. The study uses the experimental method to measure variables and reveal cause-effect relationships between these variables. The studies using experimental methods randomly place the individuals in groups. (Büyüköztürk, 2001). In some cases, random distribution of individuals to experimental and control groups may be impossible. In these cases, the quasi-experimental method is an alternative. In this respect, the quasi-experimental method is frequently used (Çepni, 2021). The quasi-experimental studies use pre-created groups (Fraenkel, Wallen & Hyun, 2012). Since the school has ready-made classes, the quasi-experimental method suits the study.

Study Group

The study group of the research consists of a total of 50 students, 25 experimental groups (15 boys, 10 girls) and 25 control groups (16 boys, 9 girls) studying in the 6th grade in a public school in Turkey in the spring semester of the 2020-2021 academic year. The study collected and analyzed the data related to the pre-test results to determine the equivalence of the experimental and control groups and concluded that the groups were equivalent by looking at the normality distribution.

Implementation Process of the Study

(Scientific and Technological Research Council of Turkey (TUBITAK), used in the study, received opinions from science education experts on the parallelism of popular science journal supplements with the curriculum and designed learning activities under the achievements. Learning activities used weekly and daily lesson plans, TUBITAK science journal supplements and textbooks distributed to students to keep students' interests alive. In addition to the visuals in the textbook during the course plan preparation phase, exciting information or pictures on the subject of "Solar System and Eclipses" in the journal supplements were used during the processing of the subject in the experimental group by using TUBITAK science children's journals. The study lasted 5 weeks, except for the time spent (4 weeks) on LBQT preparation created by the researchers. Table 1 presents the work schedule for the applications in the experimental and control groups.

Table 1. *Study Schedule*

Week	Lesson Duration	Groups	Activities
1	2 hours	Experiment and Control G	Performing pre-test applications of life-based question test.
2	2 hours	Experiment G.	Brief introduction of science journals and explanation of how to use them. To draw the attention of the student to the subject, Reading supplements of the journals "We know the solar system" and "Planet or Dwarf Planet". Conducting a discussion on the properties required for a celestial body to become a planet by guiding students
	2 hours	Experiment G.	Examining the planets and their properties in the solar system by examining the journal supplements "Seasons on Planets" and "Saturn from Earth". Reviewing the "Interesting information about space" booklet and having students discuss and match this information with the planets. Examination of the NASA website and performing the "Early Shield, Planet Observations" activity with the students. Giving the students the task of observing the sky for the next lesson by looking at the sky observation map.

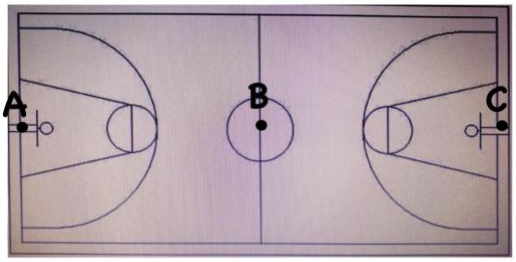
			After the lesson, sending "Space-Related Riddles "cards to the students online and asking them to play games with their parents at home with these cards.
2	2 hours	Control G.	Teaching the lesson with the current program in the presence of slides prepared using the textbook. Supporting the lesson with visuals by examining the planet visuals in the textbook with the students.
	2 hours	Control G.	Solving the subject evaluation questions by continuing to teach the lesson. Giving the solar system, let's do activity as homework.
3	2 hours	Experiment G.	Short review of the course and evaluation of the assignments. Evaluation of sky images with the active participation of students. Active presentation of asteroid, meteor and asteroid concepts with the support of journal supplements. Giving the 'Let's Make a Solar System Model' activity as homework.
	2 hours	Experiment G.	After reading the travel text to Mars, giving information and visuals about the spacecraft Insight sent to the planet and performing the activity containing the model of this spacecraft. Giving Planetary Puzzles and Solar System Cards activities as homework.
3	2 hours	Control G.	Short review of the course and evaluation of the assignments. Asking the students the questions in the book and presentation of asteroid, meteor and asteroid concepts through slides.
	2 hours	Control G.	Using the Q&A method, asking questions to the students, trying to determine their deficiencies about the subject explained and doing exercises.
4	2 hours	Experiment G.	Reinforcing the Solar System Cards event. Reading the text "Why doesn't the Lunar Eclipse happen every month?" and the introduction to the topic of eclipses. Demonstrating the models of a solar and lunar eclipse with easy-to-find materials to the students
	2 hours	Experiment G.	Drawing attention to the differences between solar and lunar eclipses with the help of the text "Partial Solar Eclipse". Solution of end of unit questions together with the students.
4	2 hours	Control G.	Reading texts from the textbook. Explaining the differences between solar and lunar eclipses. Conducting an activity
		Control G.	Solution of end-of-unit evaluation questions to reinforce the subject.
5	2 hours	Experiment and Control G	Conducting pre-test applications of life-based question test.

Data Collection Tools

The study used the life-based question test (LBQT) created by the researchers to measure the students' success in the solar system and eclipses as a data collection tool. While creating the LBQT, the achievements in the MoNE curriculum related to the subject were examined. The 6th grade textbook of the Ministry of National Education has matched the content of the popular science journal supplements and the course contents used by examining

the achievements with the case studies in daily life. Three faculty members who are experts in the field of science, 1 doctoral student working in the life-based question development team and one science teacher checked the 25-question LBQT prepared in the four weeks. As a result of the examinations, questions in the LBQT were reduced to 16. An expert also checked the language, readability and confidingness of the questions and options and made necessary changes. Table 2 presents two sample questions from the LBQT. The questions prepared were in line with the content validity and spelling rules. To measure the validity and reliability of LBQT, 80 students from 1st-grade and 8th-grade students 19 students took the test. In the LBQT, consisting of 16 multiple-choice questions, the value of each question was 1 point, and the highest score was 16. While correct answering the question was 1-point, incorrect answer or leaving blank was 0 point. The test results were evaluated using the SPSS 23 program, and the Cronbach's Alpha reliability coefficient of the test was 0.78. According to Tavşancıl (2006), a coefficient between 0.60 and 0.90 proves that the test is very reliable.

Table 2. *LBQT Question Sample*

<table>
<tr><th>Question number</th><th>Sample Question</th></tr>
<tr><td>7</td><td>Teacher Semih gives information about the locations of the Earth, the sun and the moon during the eclipse in science class. He wants to create a model to evaluate the comprehensibility of the eclipse by the students. For this purpose, he took his students to the indoor gym and determined the following points on the basketball court.
 

Semih teacher will use points A, B and C while creating the model. The teacher distributes the light source, basketball and tennis ball to some students in the classroom.
Light Source: Asel, Bilge, Yiğit
Basketball: Kublay, Mehmet, Azra
Tennis Ball: Ahmet, Erkan, Merve
Considering the points A, B, and C and the materials distributed to the students, which of the following is the student ranking that correctly models the solar eclipse?

<table>
<tr><th></th><th>Point A</th><th>Point B</th><th>Point C</th></tr>
<tr><td>A)</td><td>Kubilay</td><td>Bilge</td><td>Ahmet</td></tr>
<tr><td>B)</td><td>Asel</td><td>Mehmet</td><td>Merve</td></tr>
<tr><td>C)</td><td>Yiğit</td><td>Erkan</td><td>Azra</td></tr>
<tr><td>D)</td><td>Erkan</td><td>Kubilay</td><td>Bilge</td></tr>
</table>
</td></tr>
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8	Osman, who responded to the Ministry of Health's call for 'Stay at Home 'due to the coronavirus pandemic in August 2020, was bored. His mother, who knows that an event will happen in the sky that day, suggests to Osman that boredom can pass if he goes to the balcony and watches the sky. Osman encounters an image like the picture below when he looks at the sky.  He immediately tells his mother about the image he sees. His mother explains the event to him and says that this image called meteor rain emerges from some celestial bodies in space, entering the Earth's atmosphere and emitting light in this way. She adds that the meteors were called asteroids before they entered the Earth's atmosphere, and they were called asteroids when they hit the Earth. **Accordingly, what features should Osman's mother have to call the celestial body a meteor?** A) Being able to travel free in space B) Reaching the Earth by passing through the Earth's atmosphere C) Entering the Earth's atmosphere and creating a light-emitting image D) Emitting a fixed light in the sky

Data Analysis

In observing the effects of the experimental study, Statistical Package for Social Science (SPSS 23) program was used to analyse the data obtained by applying LBQT to the experimental and control group students. First, examining skewness and kurtosis values determined whether the sample data were parametric or non-parametric. George & Mallery (2016) stated that the variables showed normal distribution when skewness and kurtosis values were between -2 and +2. Table 3 gives the findings of the data obtained from the study. According to Table 3, in the examination of the kurtosis and skewness values, the values were within the specified range. These results indicated that the distribution was expected, and it was appropriate to perform the t-test.

Table 3. *Normality test information of LBQT*

LBQT	Groups	Groups	Skewness	Kurtosis
Pre-test	Control	25	0.21	-0.0-9
	Experiment	25	-0.03	-0.17
Post-test	Control	25	0.44	0,43
	Experiment	25	-0.21	-0.5

FINDINGS

The study firstly investigated whether there was a significant difference between the LBQT pre-test scores of the students in the experimental and control groups. Independent samples t-test was applied through the SPSS 23 program for the YSTS pre-test data of both groups. Table 4 presents the findings obtained as a result of the analysis.

Table 4. *Experimental and Control Group LBQT Pre-test Data*

Group	N	$\overline{X}$	Ss	P	t
Experimental group pre-test	25	5.68	1.70	0,43	-0,79
Control group pre-test	25	5.24	3.18		

According to Table 4, the mean scores of both groups and the pre-entrepreneurship skills of the students were close. The independent t-test result was p= 0.43 when p > 0.05; there was no significant difference between the groups, and the selected groups were suitable for the research.

The study sought an answer to the question, "Is there a significant difference between the LBQT post-test scores of the experimental group students who received Popular Science Journals Supported Science Teaching and the control group students taught with the current program? ". T-test was applied to the LBQT post-test data obtained from the experimental and control groups for independent samples through the SPSS program. Table 5 presents descriptive statistics of the data.

Table 5. *Experimental and Control Group Data of LBQT Post-test*

Group	N	$\overline{X}$	Ss	P	t
Experimental group post-test	25	10.64	4.65	0.008	-4.21
Control group post-test	25	6.08	2.72		

In examining the post-test mean scores of the groups, the scores and knowledge levels after the implementation were not close to each other. The independent t-test result was p= 0.008. There was a significant difference between the groups when p < 0.05, so the groups lost their similarity after the application. This situation supported the view that popular science journals supported science teaching increased academic success.

Finally, the study aimed to determine whether there was a significant difference between the LBQT pre-test and post-test scores of the students in the control group taught with the current program. It was also an aim of the study to determine the LBQT pre-test and post-test scores of the students in the experimental group receiving Popular Science Journals Supported Science Teaching. For this purpose, the study used the LBQT pre-test and post-test data obtained from the control and experimental groups for independent samples through the SPSS program. Table 6 and Table 7 present descriptive statistics of the data.

Table 6. *Control Group Data of LBQT Pre-test and Post-test*

Group	**N**	$\overline{X}$	**Ss**	**P**	**t**
Control group pre-test	25	5.2	2.18	0.1	-1.73
Control group post-test	25	6.08	2.72		

As a result of the examination, the difference between the pre-test and post-test data of the control group was low. Independent t-test result was $p = 0.1$. When $p > 0.05$, the current teaching method was insufficient to increase academic achievement since there was no significant difference between the groups and the pre-test and post-test results of the control group.

Table 7. *Experimental Group Data of LBQT Pre-test and Post-test*

Group	**N**	$\overline{X}$	**Ss**	**P**	**t**
Experimental group pre-test	25	5.68	1.70	0.003	-4.47
Experimental group post-test	25	10.64	4.68		

In examining the average number of correct answers in the pre-test and post-test of the experimental group, there was an increase of 4.96 between the data. Since $p < 0.05$ showed a significant difference between the groups, the independent t-test result being $p = 0.003$ indicated that the pre-test and post-test results of the experimental group were different. According to these results, popular science journal-assisted science teaching increased academic success in solving life-based questions. Figure 1 presents the comparison of the data in Tables 6 and 7.

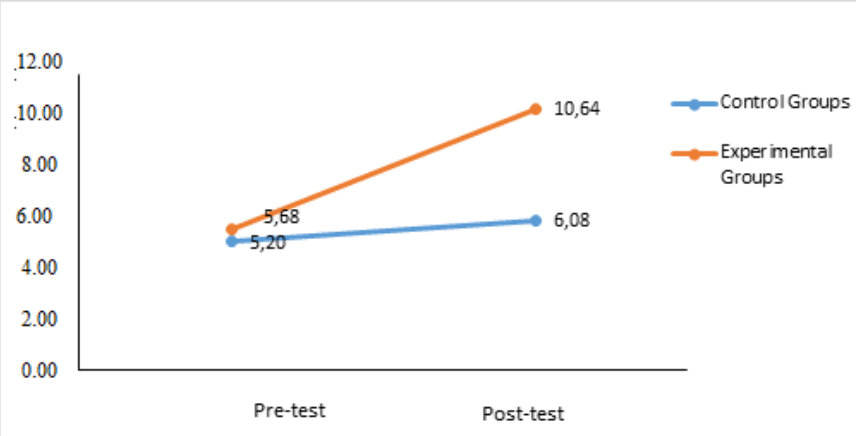

Figure 1. *LBQT Pre-test-Post-test Averages of Experimental and Control Groups*

DISCUSSION

In exam-based teaching systems, the primary goal is to educate the subjects in the curriculum and to ensure that the students get high scores in the exams. However, such an environment directs students to rote-learning and puts them in an inactive audience role. Students have difficulty establishing the connections between the units and associating the subjects with daily life. For this reason, the study associated the subjects with daily life to better comprehend the solar system and eclipses unit. Life-based teaching by using TUBITAK popular science journals tried to increase students' academic success with the help of life-based questions. Considering Turkish students' success in international exams such as PISA and TIMSS, there are severe problems in raising internationally competitive students. For this reason, it is vital to increase the comprehension and application skills of the student by using teaching methods that will increase the quality of education. In this respect, the study aimed to increase students' level of understanding and thus contribute to academic success.

The study determined that the students in the experimental group gave more correct answers in the LBQT after the lecture than in the control group. This result shows that popular science journals positively contribute to students' academic success in learning the Solar System and Beyond unit and in the solution of the LBQT. The study by Varelas et al. (2014) on primary school students created learning experiences using scientific text and daily life activities in subject teaching. At the end of the study, using informative texts in the course increased success by providing active learning. The study by İnci (2019) with eighth-grade students determined positive developments in students' participation in the course and academic achievement in science, giving the students motivation and creating a context-based learning environment. Similarly, Karakuş et al. (2012) and Güngör and Çavuş (2015) concluded that the use of additional materials in teaching increased student success. Parkinson and Adendorf (2004) also stated that popular science journals were significant in science teaching. The study by İlhan

(2010) examined the effect of the life-based teaching approach in teaching the subject of chemical balance. According to the results, life-based teaching positively affected academic achievement and motivation compared to traditional teaching. Similar studies by Korsacılar and Çalışkan (2015), Acar and Yaman (2011), and Murphy and Whitelegg (2006) also stated that life-based teaching increased academic success.

The study revealed that teaching with the current curriculum teaching method and using only textbooks was not effective enough in solving life-based questions. Gilbert (2006) stated that some textbook activities did not include daily life examples and did not coincide with a life-based approach. However, he stated that the examples and activities in popular science journals enabled the student to participate more actively in the lesson by appealing to more than one sensory organ. He also expressed that the academic success of the students in the experimental group increased. In the study by Kirman-Bilgin (2015) using a life-based approach, the result that the REACT strategy was more effective in increasing academic success than the classical teaching method also supported our research.

Recommendations

Most of the students participating in the study did not have much information about popular science journals and did not read such journals. For this reason, investigating the effect of science courses on students' achievement and motivation in science can be beneficial by ensuring that they are taught by reading popular science journals and doing activities. Popular science journals can contribute to gaining the habit of reading, making science lessons loved and increasing interest, stimulating feelings of curiosity, thinking and research. Today's technology enables access directly to additional resources by adding three-dimensional images and links to the content of textbooks. Since science journals contain many subjects, similar studies with different levels can be helpful. Besides the science course, examining the effect of science journals on life-based questions on academic achievement can also benefit courses in different branches.

Conflict of Interest

The Authors declare that there is no conflict of interest.

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