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The effect of cartoon-supported problem-based learning method in primary school, fourth-grade social studies course on students' perceptions of their problem-solving skills and their level of achievement*

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Abstract

This study attempted determining the impact of the problem-based learning method supported by cartoons, which are humorous elements, in fourth-grade Social Studies course on students' perceptions of their problem-solving skills and their level of achievement. Accordingly, the study is quasi-experimental and has a pre-test post-test unequalled control group design. The study group consists of 55 fourth-grade primary school students receiving education at a primary school located in Üsküdar, Istanbul. The cartoon-supported problem-based learning method was applied in the experimental group, whereas the standard Social Studies Curriculum was followed in the control group. The experiment lasted for seven weeks. In the collection of data, 'Personal Information Form', 'Problem-Solving Inventory for Children at the Level of Primary Education (PSIC)', and 'Science, Technology, and Society Learning Space in Social Studies Achievement Test' were used. The data obtained from the measurement tools were analysed using frequency (f), percentage (%), and various non-parametric tests. Based on the findings, it was concluded that the use of cartoon-supported problem-based learning method in teaching fourth-grade Social Studies course positively affected the students' perceptions of their levels of problem-solving skills and their level of achievement.

Keywords: Primary School, Social Studies Course, Cartoon, Problem-Solving

Introduction

The Social Studies course, which raises citizens who have adopted democratic values, can make decisions and can solve problems, was added to the curriculum at the beginning of the

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20th century (Kabapınar, 2007). The rapid changes in science and technology, evolving needs of the individual and society, innovations and developments in learning and teaching theories and approaches have also affected the role individuals are expected to play in society. Today, the aim is to raise individuals who can produce knowledge and use it efficiently, solve problems, think critically, act entrepreneurially, communicate effectively, empathise, and contribute to society and culture. To gain students a set of values and skills, the Social Studies Education Programme, which was developed in a manner that considers individual differences, was introduced in Türkiye as of the 2018–2019 academic year. The use of problem-based learning (PBL) was to be one of the important prerequisites for the implementation of the programme.

'Problem-solving' is the process of finding the unknown (Alper, 2011), whereas the 'problem-solving method' is one that steers students to arrive at the solution individually or collectively through invention and research/examination after presenting a problem in the classroom and suggesting the need to solve this problem (Yel et al., 2015). For some individuals, problem-solving is not an innate ability but rather a habit that can be gained later on. All children can be problem-solvers by developing the right skills (Watanabe, 2017). The more PBL is used in Social Studies course, the more students will have the chance to offer solutions to their daily problems and acquire the skills of problem-solving.

Another tool that can be utilised in developing students' problem-solving skills is 'humour'. It has been scientifically proven that humour positively affects the process of learning. According to Loomans and Kolberg (2002), humour not only improves communication, creative/critical thinking, cooperative learning, coping, and awareness skills but also contributes positively to the development of problem-solving skills (Aydoğmuş & Yıldız, 2017). Kılınç (2008) also stated that humour and problem-solving involve the same cognitive processes and that humorous analysis requires divergent thinking, creativity, and a playful awareness (Aydoğmuş & Yıldız, 2017). Therefore, humour can be used in PBL.

Humour is considered as old as humanity itself; its Turkish equivalent, 'mirah', derives etymologically from the Arabic word 'müzah'. The Ottoman-Turkish Encyclopedic Dictionary Lügat defines 'mirah' as a joke, a quip, or a gleek (Develioğlu, 2016), while the definition of the word in the Turkish Dictionary of the Turkish Language Association (TDK) is 'funniness' (gülmece in Turkish) (TDK, 2021). Instead of 'mirah', Nesin (2001) used the word 'gülmece', which is considered to encompass 'Mockery, wit, funny stories and novels, satire, humorous pantomimes and dances, amusement, jokes, humour, lampoonery, irony, jamboree, ombromanie, puppet games, rib, cartoons and their genres, drag, parody, allegory, grotesque, and funny anecdotes and narratives' (Eroğlu, 2008). As mentioned, cartoons and their genres are considered elements of humour.

In instilling a sense of humour in the child, the most important task falls to the parents, educators, and the managers of mass media outlets. Examples of high-quality humour and the educational function of humour should be utilised to develop a positive sense of humour in children (Vural, 2004). The use of humour in education in a balanced and refined manner will positively contribute to the development of the students (Usta, 2005 as cited in Aydoğmuş

& Yıldız, 2017). According to McGhee (2002), supporting and nurturing children's sense of humour from infancy plays a significant role in facilitating their intellectual, social, emotional, cognitive, and personality development. In line with the current approach to education, cartoon, which is an art and a means of visual expression, is one of the best humour elements that can be used in educational settings.

Cartoon, in addition to being a means of communication, is an influential visual art that brings lines to life while describing a given situation (Turan, 1975). Cartoons are influential because they can describe events or situations that cannot be explained with thousands of words and they transcend barriers of language and easily convey a message to many people across the world (Altun, 2014). Cartoons can be used to humour and entertain readers, as well as encourage readers to think about a subject or to draw attention to a situation (Alsaç, 1994). An ideal cartoon is one that pushes readers to think while entertaining them and is drawn neatly (Özer, 1998). In short, as used in this study, cartoons are two-dimensional visual artworks that address human life and related issues in an exaggerated and satirical manner and are drawn to encourage the readers to think about a topic and give them a message.

Cartoons are effective tools to be used in courses such as Social Studies, history, and geography (Özer, 1994), and, from a psychological perspective, they significantly contribute to learning and teaching (Altun, 2014). Caricature has been used in different ways for educational purposes. Among the uses of cartoons for educational purposes are the development of reading skills (Demetrulias, 1982, as cited in Altun, 2014) and vocabulary (Goldstein, 1986, as cited in Altun, 2014); improving problem-solving (Jones, 1987, as cited in Altun, 2014; Köseoğlu, 2014) and thinking skills (De Fren, 1988, as cited in Altun, 2014); building motivation (Heitzmann, 1989, as cited in Altun, 2014); teaching dispute resolution (Naylor & McMurdo, 1990, as cited in Altun, 2014); revealing scientific knowledge that is not expressed verbally or in writing (Guttierrez & Ogborn, 1992, as cited in Altun, 2014), making scientific ideas accessible and useful (Peacock, 1995, as cited in Altun, 2014), developing the skills of decision-making (Köseoğlu, 2014), critical thinking and problem-solving (Uslu, 2007), as well as literacy skills (Keogh & Naylor, 1999, as cited in Demir, 2008), building on students' ability to explore by encouraging creativity (Alaba, 2007, as cited in Sidekli et al., 2014), and teaching democratic values and tolerance (Grünewald, 1979, as cited in Özer, 2007).

With good planning, teachers can use cartoons in Social Studies classes as a way to encourage students to think and improve their thinking skills Uslu (2007), who remarked that 'cartoon allows to see, not merely to look. This art advances the society and to enlighten individuals and help them become competent in becoming aware of problems and solving them'.', emphasised that cartoons can be used in detecting problems.

A literature review showed that there are studies examining the impact of PBL on different variables of the Social Studies course (Baysal, 2003; Deveci, 2002). The studies in the relevant literature were particularly conducted with secondary school students, either by focussing on the science and technology courses, in which concept cartoons were used, or by focussing only on the PBL method. However, this study differs from other studies in the sense

that it was carried out with primary school students with a focus on the Social Studies course, and a cartoon-based PBL method was employed.

1.1. Aim of the Study

This study determined the impact of the cartoon-Supported PBL Method on students' perceptions of their problem-solving skills and their level of achievement. Accordingly, the following hypothesis was tested:

- The Cartoon-Supported PBL Method positively affects students' perceptions of their problem-solving skills.
- The Cartoon-Supported PBL Method positively affects students' level of achievement.

2. Method

Information about the study design, study group, experimental procedure, data collection tools, and data analysis are given below.

2.1. Study Design

The study is quasi-experimental and has a pre-test post-test unequalled control group design. Actually, this model is similar to the pre-test-post-test control group model. The only and most important difference between these two models is that with this model, the groups are not assigned randomly (R). With this model, no special effort is made to equal the groups through the random method, but care is taken to ensure that the participants are similar. Also, it is determined randomly which group will be the experimental group and which will be the control group (Karasar, 2016). In this study, there were two groups, one experimental and one control, which were decided randomly. Measurements were made before and after the experimental procedure in both groups.

2.2. Study Group

The population of the study consists of 55 fourth-year primary school students who were receiving education at a primary school in Üsküdar, Istanbul, during the 2018–2019 academic year. The groups were assigned using the simple random sampling method (Büyüköztürk et al., 2016), and one branch was determined as the experimental group (n=28) and another other as the control group (n=27).

Demographic characteristics of the study group are given below:

Table 1. Demographic Characteristics of the Study Group

Demographic Characteristics		Experimental Group		Control Group	
		f	%	f	%
Gender	Female	15	53,6	14	51,9
	Male	13	46,4	13	48,1
Age	9	4	14,3	10	37,0
	10	23	82,1	16	59,3
	11	1	3,6	1	3,7
Number of people in the household	3	8	28,6	8	29,6
	4	13	46,4	14	51,9
	5	5	17,9	4	14,8
	6	1	3,6	1	3,7
	7	1	3,6	0	0
Number of siblings	1 sibling	10	35,7	8	29,6
	2 siblings	14	50,0	17	63,0
	3 siblings	4	14,3	1	3,7
	4 siblings	0	0	1	3,7
Received pre-school education	Yes	27	96,4	24	88,9
	No	1	3,6	3	11,1
Mother's educational level	Primary school	0	0	7	25,9
	Secondary school	8	28,6	11	40,7
	Higher education	15	53,6	5	18,5
	Graduate	5	17,9	4	14,8
Father's education level	Primary school	0	28,6	6	22,2
	Secondary school	6	21,4	16	59,3
	Higher education	17	60,7	3	11,1
	Graduate	5	17,9	2	7,4
Like the Social Studies Course	Yes, I like it	23	82,1	16	59,3
	No, I don't like it	1	3,6	4	14,8
	I love it	4	14,3	5	18,5
	I like it little	0	0	2	7,4

According to Table 1, a majority of the participants in the experimental group are female, aged 10, live in a 4-person household, have two siblings and received pre-school education. The parents of most participants in the group completed higher education, and the group members stated that they liked the Social Studies course.

2.3. Steps of the Experiment

The experiment consisted of three steps, namely, pre-experiment, experiment and post-experiment.

1. Pre-Experiment: Before the experiment, the perceived problems of the fourth-year primary school students regarding their families and school that they had difficulty solving were investigated. To this end, a qualitative study was conducted on 206 fourth-year primary

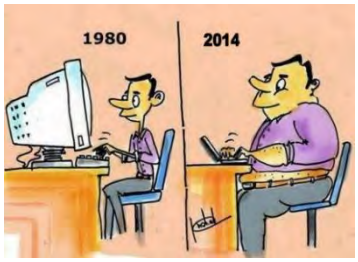
school students. The participants reported that they mostly encounter problems related to violence, communication, family, and friends (Z. et al., 2019). Considering the idea that these problems may be related to the unconscious use of technology, the authors examined the Social Studies Curriculum (2018) and deemed the learning outcomes of 'Compares the past and present uses of technology products in the field of learning' and 'Uses technology products without harming himself, others, and the nature'.' under the 'Science, Technology and Society' learning domain appropriate to place the focus. The seven-week experiment was planned in three stages with different themes, namely 'Technology's harm to nature (three weeks, nine periods)', 'Technology's harm to humans (two weeks, six periods)', and 'Recycling (two weeks, six periods)'. Cartoons on these subjects and achievements were searched in printed and digital sources. After the cartoons to be used were selected, cartoon-supported PBL activities were designed. The activities used in all three stages were designed by the researchers and the steps below were followed.

Since the first researcher is also the performer of the study, she performed the steps in the school where she works. The 'Problem-Solving Inventory for Children at the Level of Primary Education (PSIC)', and 'Science, Technology, and Society Learning Space in Social Studies Achievement Test' were performed as the pre-test in four 4th-year branches, where students were also asked to fill out the personal information form. Of the four branches, two, the pre-test scores which did not differ significantly and the classroom size of which are the most similar, were randomly determined as experimental and control groups.

2. Experiment: Written consent was received from the parents of each student in the experimental and control groups. The students in the experimental group were informed about the aim of the study and the fact that they were chosen as the subjects of this study. Afterward, these students were informed about the PBL and its stages for a total of six periods, as well as cartoons, the basic elements of cartoons, and the analysis and interpretation of the cartoons, for three periods. Since some activities were planned to be performed in groups, the students were divided into groups before the experiment was initiated. Throughout the following seven weeks, for 21 periods, the cartoon-supported PBL method was applied in the Social Studies courses conducted with the students in the experimental group. The cartoons used throughout the experiment were displayed in the classroom in the form of posters. The experimental group carried out the classes with the first researcher, the performer in the study, and the control group conducted their classes with the respective classroom teacher in line with the existing curriculum. At the end of the seven-week experiment, both measurement tools were re-applied to the groups as the post-test. Four weeks later, the same tests were repeated as the retention test.

Below are examples of activities carried out in the second stage:

To raise students' awareness of the problem, a presentation on the second achievement on which the focus was placed, 'Uses technology products without harming himself, others, and the nature', in which many cartoons on the topic were used was given to the students, and general information was provided. Next, the students were distributed the cartoon on the left and asked to write down the problem they saw in the picture and health-, economy- and social life-related issues this problem could cause. Afterward, the students were distributed the cartoons below and were asked to answer the following questions as a group. (What do the children and people in the cartoons have in their hands? Is everyone you see in the cartoons happy? Why? What conveniences do smartphones, computers, television, and tablets bring to our lives? Considering our daily life, can we say that smartphones, computers, television, and tablets are always used for their intended purpose? Why? Apart from the conveniences that smartphones, computers, television, and tablets bring to our lives, do they also harm us? What do you think these harms are? Would you like to be one of the family members of these cartoons? Why?)



Then, to define the problem, the students were asked whether the situations in the cartoons could be identified as problems. They were asked to write this problem in the form of a question sentence if they believed that the situations in the cartoons were problematic.

For the formation of a hypothesis stage, the students were asked what they knew about the situations in the cartoons, and they were expected to indicate which of the situations examined through the cartoons caused harm to our lives due to the use of technology products.

For the data collection and planning stage, students were given example resources they could use for research (such as tbm.org.tr, tuik.gov.tr) and the keywords they could search for (such as technology addiction, harms of technology).

For data collection, the students were asked to conduct the research for 4 days and to investigate the factors that rendered technological products harmful to our lives.

To examine, analyse and evaluate data, students were asked about the aspects of technology use to which heed should be paid and the negativities that may be experienced because of unconscious use of technology. Also, students were asked to write letters to technology addicts.

For generalisation, students were directed 20 questions about the use of technology products and asked to express their opinions on these questions by saying 'I agree/I don't agree/I am undecided'.

3. Post-Experiment: The data obtained from the measurement tools were analysed using the SPSS package software. The statistical analyses were interpreted and the results were reported.

2.4. Data Collection Tools

Information on the data collection tools used in this study is given below.

2.4.1. Personal Information Form

This seven-question form is used to determine the demographic characteristics of the participants, namely age, gender, number of family members, number of siblings, having received pre-school education, parents' educational levels, and whether they like the Social Studies course.

2.4.2. Problem-Solving Inventory for Children at the Level of Primary Education (PSIC)

Problem-Solving Inventory for Children at the Level of Primary Education (PSIC) developed by Serin et al. (2010) was used to measure students' self-perception about their problem-solving skills. A total of 568 students in the 4th, 5th, 6th, 7th and 8th grades of eight primary schools participated in the study carried out to develop the scale. After the factor analysis, the Cronbach Alpha reliability coefficient of the 3-factor (self-confidence in problem-solving ability, 12 items; self-control, seven items; and avoidance, five items) and the 24-item inventory was found to be 0.80. PSIC is the first original inventory developed in Türkiye to determine primary school students' self-perceptions of their problem-solving skills. PSIC is a 24-item, 5-point Likert-type self-assessment scale that measures the individual's self-perception of problem-solving skills. The score range is 24–120. While calculating the scores, the scores of the items in the second (18, 19, 20, 21, 28, 49, 58) and third (41, 43, 59, 62, 64) factors reflecting self-control and avoidance were reverse coded. The higher the total score from the scale, the more individuals perceive themselves to be sufficient in problem-solving (Serin et al., 2010).

2.4.3. Science, Technology, and Society Learning Space in Social Studies Achievement Test

The test developed by the researchers that consists of 17 multiple choice questions and measures students' achievement levels in 'Compares the past and present uses of technology products in the field of learning' and 'Uses technology products without harming himself, others, and the nature'.' learning outcomes under the 'Science, Technology and Society' learning domain was used to determine the participants' achievement levels in the respective areas. Of the questions, six were related to the first learning outcome, and eleven were about the second learning outcome.

In the preparation of the test, firstly, a 30-item test was created on the basis of Bloom's Cognitive Domain Taxonomy. This test was applied as a pilot study to 205 fourth-grade students outside the study group, and validity and reliability analyses were carried out as a part of this study. Because of the reliability analysis, Cronbach's Alpha reliability coefficient of the test was found to be 0.64, the KR21 value 0.57, and the KR20 value 0.64. These values mean that the test is a reliable measurement tool. The validity analysis showed that the item difficulty index (p) value of 13 items was below 0.60 and their item discrimination index (r) value was below 0.20. These items were excluded from the test because they were difficult and not distinctive. An item with an item difficulty index (p) value of 0.90 and an item discrimination index (r) value of 0.16 was revised and corrected because it was weak and had low discrimination power. Thus, the measuring tool was finalised.

2.5. Analysis of Data

Frequency (f) and percentage (%) were used for the analysis of the data obtained with the 'Personal Information Form', which was used to determine the demographic characteristics of the participants in the respective groups. The Wilcoxon Z test, which is a non-parametric test, was used for the intra-group comparison of the participants' scores from other measurement tools, and the Mann–Whitney U test was used for inter-group comparisons.

3. Findings

The findings obtained as a part of the study are given below in the order of the learning outcomes.

3.1. The Cartoon-Supported PBL Method improves students' perceptions of their problem-solving skills. The findings of the Hypotheses Testing

In this section of the study, the results of analyses performed to determine the differences between the pre-test, post-test, and retention test scores of the entire problem-solving inventory and its sub-dimensions are given.

Table 2. The Results of the Non-Parametric Mann–Whitney 'U' Test Performed to Determine the Differences Between the Problem-Solving Inventory Pre-Test Total Scores of the Participants in the Experimental and Control Groups

Score	Group	N	$\sum_{sira}$	$\bar{x}_{sira}$	U	z	p
Total Inventory Score	Experimental Group	28	28,71	804,00	358,00	-,336	,736
	Control Group	27	27,26	736,00			
	Total	55					
Problem-Solving Self-Confidence Sub-Dimension Scores	Experimental Group	28	26,98	755,50	349,500	-,480	,631
	Control Group	27	29,06	784,50			
	Total	55					
Problem-Solving Self-Control Sub-Dimension Scores	Experimental Group	28	28,95	810,50	351,500	-,448	,654
	Control Group	27	27,02	729,50			
	Total	55					
Problem-Solving Avoidance Sub-Dimension Scores	Experimental Group	28	31,05	869,50	292,500	-1,453	,146
	Control Group	27	24,83	670,50			
	Total	55					

Table 2 shows that, because of the test performed before the experiment to determine whether the scores the participants in the experimental and control groups obtained from the entire problem-solving inventory and its sub-dimensions (self-confidence, self-control, and avoidance) varied, no statistically significant difference was found between the arithmetic mean of the results (P<.05). The total and sub-dimension scores of the participants in the experimental and control groups, indicating their perception of their problem-solving skills, were found to be similar before the study.

Table 3. The Results of the Non-Parametric Wilcoxon Signed-Rank Test Performed to Determine Whether There is a Difference Between the Experimental Group Problem-Solving Inventory Pre-test-Post-test Total and Sub-Dimension Scores

Variable	Score	Group	N	$\overline{X}$	$\overline{x}_{sira}$	$\sum_{sira}$	z	P
Total Inventory Score	Pre-Test	Decreasing	1	57,10	1,00	1,00	-4,601	,000
		Increasing	27	94,21	15,00	405,00		
	Post-Test	Equal	0					
		Total	28					
Problem-Solving Self-Confidence Sub-Dimension Scores	Pre-Test	Decreasing	4	29,25	3,50	14,00	-4,309	,000
		Increasing	24	43,75	16,33	392,00		
	Post-Test	Equal	0					
		Total	28					
Problem-Solving Self-Control Sub-Dimension Scores	Pre-Test	Decreasing	3	21,10	8,50	25,50	-4,048	,000
		Increasing	25	28,96	15,22	380,50		
	Post-Test	Equal	0					
		Total	28					
Problem-Solving Avoidance Sub-Dimension Scores	Pre-Test	Decreasing	28	98,52	14,50	406,00	-4,625	,000
		Increasing	0	21,82	0,00	0,00		
	Post-Test	Equal	0					
		Total	28					

According to Table 3, the test performed for the experimental group showed that there is a statistically significant difference between the mean rankings of the participants' pre-test and post-test scores from the entire inventory and its sub-dimensions (P<.05). The difference was found to be in favour of the post-test. While the post-test scores from the entire inventory and the sub-dimensions of self-confidence and self-control were found to have significantly increased from the pre-test, the scores of which were low before the experiment, the post-test score of the negative sub-dimension, avoidance, was found to have decreased.

Table 4. The Results of the Non-Parametric Wilcoxon Signed-Rank Test Performed to Determine Whether There is a Difference Between the Experimental Group Problem-Solving Inventory Pre-Test Retention-Test Total and Sub-Dimension Scores

Variable	Score	Group	N	$\overline{X}$	$\bar{x}_{sira}$	$\sum_{sira}$	z	P
Total Inventory Score	Pre-Test	Decreasing	9	57,10	12,44	112,00	-1,614	,107
		Increasing	17	99,42	14,06	239,00		
	Retention Test	Equal	2					
		Total	28					
Problem-Solving Self-Confidence Sub-Dimension Scores	Pre-Test	Decreasing	10	29,25	10,20	102,00	-2,303	,021
		Increasing	18	48,07	16,89	304,00		
	Retention Test	Equal	0					
		Total	28					
Problem-Solving Self-Control Sub-Dimension Scores	Pre-Test	Decreasing	9	21,10	13,78	124,00	-1,316	,188
		Increasing	17	29,53	13,35	227,00		
	Retention Test	Equal	2					
		Total	28					
Problem-Solving Avoidance Sub-Dimension Scores	Pre-Test	Decreasing	10	98,52	11,93	167,00	-,488	,626
		Increasing	14	21,50	13,30	133,00		
	Retention Test	Equal	4					
		Total	28					

According to Table 4, the analyses performed for the experimental group showed that there is a statistically significant difference between the mean rankings of the participants' pre-test and retention test scores from the self-confidence sub-dimension (P<.05). The difference was found to be in favour of the retention test. The scores obtained from the self-confidence sub-dimension of the problem-solving inventory, which were low before the experiment, were found to increase significantly from the pre-test to the retention test. However, the relevant table shows that the pre-test and retention test scores obtained from the entire inventory and from its self-control and avoidance sub-dimensions did not significantly differ statistically in terms of mean rankings (P>.05).

Table 5. The Results of the Non-Parametric Wilcoxon Signed-Rank test Performed to Determine Whether There is a Difference Between the Experimental Group Problem-Solving Inventory Post-Test Retention-Test Total Scores

Variable	Score	Group	N	$\overline{X}$	$\overline{x}_{sira}$	$\sum_{sira}$	z	P
Total Inventory Score	Post-Test	Decreasing	0	94,21	0,00	0,00	-4,624	,000
		Increasing	28	99,42	14,50	406,00		
	Retention Test	Equal	0					
		Total	28					
Problem-Solving Self-Confidence Sub-Dimension Scores	Post-Test	Decreasing	0	43,75	0,00	0,00	-4,626	,000
		Increasing	28	48,07	14,50	406,00		
	Retention Test	Equal	0					
		Total	28					
Problem-Solving Self-Control Sub-Dimension Scores	Post-Test	Decreasing	1	28,96	4,50	4,50	-4,442	,000
		Increasing	26	29,53	14,37	373,50		
	Retention Test	Equal	1					
		Total	28					
Problem-Solving Avoidance Sub-Dimension Scores	Post-Test	Decreasing	28	21,82	14,50	406,00	-4,627	,000
		Increasing	0	21,50	0,00	0,00		
	Retention Test	Equal	0					
		Total	28					

According to Table 5, the test performed for the experimental group showed that there is a statistically significant difference between the mean rankings of the participants' post-test and retention test scores from the entire inventory and its sub-dimensions (P<.05). The score participants in the experimental group obtained from the entire problem-solving inventory and its self-confidence and self-control sub-dimensions showed an increasing trend from the post-test to the retention test. However, the scores the participants in the experimental group obtained from the avoidance sub-dimension showed a decreasing trend from the post-test to the retention test.

Table 6. The Results of the Non-Parametric Wilcoxon Signed-Rank Test Performed to Determine Whether There is a Difference Between the Control Group Problem-Solving Inventory Pre-Test-Post-Test Total and Sub-Dimension Scores

Variable	Score	Group	N	$\overline{X}$	$\bar{x}_{sira}$	$\sum_{sira}$	Z	P
Total Inventory Score	Pre-Test	Decreasing	11	93,85	9,73	107,00	-,075	,940
		Increasing	9	94,51	11,44	103,00		
	Post-Test	Equal	7					
		Total	27					
Problem-Solving Self-Confidence Sub-Dimension Scores	Pre-Test	Decreasing	10	44,51	7,60	76,00	-,414	,679
		Increasing	8	45,14	11,88	95,00		
	Post-Test	Equal	9					
		Total	27					
Problem-Solving Self-Control Sub-Dimension Scores	Pre-Test	Decreasing	9	29,07	9,00	81,00	-1,199	,231
		Increasing	6	28,00	6,50	39,00		
	Post-Test	Equal	12					
		Total	27					
Problem-Solving Avoidance Sub-Dimension Scores	Pre-Test	Decreasing	4	20,25	7,75	31,00	-1,660	,097
		Increasing	11	21,37	8,09	89,00		
	Post-Test	Equal	12					
		Total	27					

According to Table 6, the test performed for the control group showed that there is no statistically significant difference between the mean rankings of the participants' pre-test and post-test scores from the entire inventory and its self-confidence, self-control, and avoidance sub-dimensions (P<.05). No change occurred in the control group participants' pre-test and post-test scores from the entire inventory and its sub-dimensions.

Table 7. The Results of the Non-Parametric Mann–Whitney 'U' Test Performed to Determine the Differences Between the Problem-Solving Inventory Post-Test Scores of the Participants in the Experimental and Control Groups

Score	Group	N	$\sum_{sira}$	$\bar{x}_{sira}$	U	z	p
Total Inventory Score	Experimental Group	28	42,00	1134,00	0,000	-6,370	,000
	Control Group	27	14,50	406,00			
	Total	55					
Problem-Solving Self-Confidence Sub-Dimension Scores	Experimental Group	28	37,83	1021,50	112,500	-4,478	,000
	Control Group	27	18,52	518,50			
	Total	55					
Problem-Solving Self-Control Sub-Dimension Scores	Experimental Group	28	37,11	1002,00	132,000	-4,154	,000
	Control Group	27	19,21	538,00			
	Total	55					
Problem-Solving Avoidance Sub-Dimension Scores	Experimental Group	28	14,00	378,00	0,000	-6,378	,000
	Control Group	27	41,50	1162,00			
	Total	55					

According to Table 7, statistically significant differences were found because of the test performed to determine whether the scores obtained by the participants in the experimental and control groups from the entire problem-solving inventory and its sub-dimensions changed after the experiment (P<.05). These differences were found to be in favour of the post-test scores of the participants in the experimental group. The scores the participants in the experimental group obtained from the entire problem-solving inventory and its self-confidence and self-control sub-dimensions, which were similar to those of the participants in the control group before the experiment, increased significantly vis-à-vis the control group, whereas the avoidance sub-dimension score of the participants in the same group statistically decreased.

3.2. The Cartoon-Supported PBL Method positively affects students' total level of achievement. The findings of the Hypotheses Testing

In this section of the study, the analyses were performed to determine the changes between the pre-test, post-test, and retention test scores of the achievement test applied to the students before and after the experiment and after the post-test.

Table 8. The Results of the Non-Parametric Mann–Whitney 'U' Test Performed to Determine the Differences Between the Achievement Test Pre-Test Scores of the Participants in the Experimental and Control Groups

Score	Group	N	$\sum_{sira}$	$\bar{x}_{sira}$	U	z	p
Success Test	Experimental Group	28	28,09	786,50	375,500	-,449	,654
	Control Group	27	27,91	753,50			
	Total	55					

Table 8 shows that, because of the test performed before the experiment to determine whether the scores of the participants in the experimental and control groups obtained from the achievement test varied, no statistically significant difference was found (P>.05). The achievement pre-test scores of the participants in the experimental and control groups were found to be similar.

Table 9. The Results of the Non-Parametric Wilcoxon Signed-Rank Test Performed to Determine Whether There Is a Difference Between the Experimental Group Achievement Test Pre-Test and Post-Test Scores

Score	Group	N	$\overline{X}$	$\bar{x}_{sira}$	$\sum_{sira}$	z	P
Pre-Test	Decreasing	3	15,42	6,00	18,00	-3,848	,000
	Increasing	21	16,78	13,43	282,00		
Post-Test	Equal	4					
	Total	28					

According to Table 9, the test performed for the experimental group showed that there is a statistically significant difference between the mean rankings of the participants' pre-test

and post-test scores from the achievement test (P<.05). The difference was found to be in favour of the post-test. The scores the said participants obtained from the achievement test, which were low before the experiment, were found to significantly increase from the pre-test to the post-test.

Table 10. The Results of the Non-Parametric Wilcoxon Signed-Rank Test Performed to Determine Whether There Is a Difference Between The Experimental Group Achievement Test Pre-Test and Retention Test Scores

Score	Group	N	$\overline{X}$	$\bar{x}_{sira}$	$\sum_{sira}$	z	P
Pre-Test	Decreasing	3	15,42	4,50	13,50	-2,876	,004
	Increasing	13	16,28	9,42	122,50		
Retention Test	Equal	12					
	Total	28					

According to Table 10, the test performed for the experimental group showed that there is a statistically significant difference between the mean rankings of the participants' pre-test and retention test scores from the achievement test (P<.05). The difference was found to be in favour of the retention test. The achievement test scores of the participants in the experimental group, which were found to be low after the pre-test, were found to be significantly higher after the retention test.

Table 11. The Results of the Non-Parametric Wilcoxon Signed-Rank Test Performed to Determine Whether There Is a Difference Between The Experimental Group Achievement Test Post-Test and Retention Test Scores

Score	Group	N	$\overline{X}$	$\bar{x}_{sira}$	$\sum_{sira}$	z	P
Post-Test	Decreasing	16	16,78	12,38	198,00	-1,894	,058
	Increasing	7	16,28	11,14	78,00		
Retention Test	Equal	5					
	Total	28					

According to Table 11, the test performed for the experimental group showed that there is no statistically significant difference between the mean rankings of the participants' post-test and retention test scores from the achievement test (P<.05). The increase in the achievement test scores of the participants in the experimental group from the pre-test to the post-test was found to be permanent.

Table 12. The results of the Non-Parametric Wilcoxon Signed-Rank Test Performed to Determine Whether There is a Difference Between the Control Group Achievement Test Pre-Test and Post-Test Scores

Score	Group	N	$\overline{X}$	$\bar{x}_{sira}$	$\sum_{sira}$	z	P
Pre-Test	Decreasing	11	12,74	9,77	107,50	-,940	,347
	Increasing	12	13,22	14,04	168,50		
Post-Test	Equal	4					
	Total	27					

According to Table 12, the test performed for the control group showed that there is no statistically significant difference between the mean rankings of the participants' pre-test and post-test scores from the achievement test (P<.05). No statistically significant change occurred in the control group participants' pre-test and post-test scores from the achievement test.

Table 13. The Results of the Non-Parametric Mann–Whitney 'U' Test Performed to Determine the Differences Between the Achievement Test Post-Test Scores of the Participants in the Experimental and Control Groups

Score	Group	N	$\sum_{sira}$	$\bar{x}_{sira}$	U	z	p
Success Test	Experimental Group	28	39,36	1102,00	60,00	-5,412	,000
	Control Group	27	16,22	438,50			
	Total	55					

Table 13 shows that, because of the test performed after the experiment to determine whether the scores of the participants in the experimental and control groups obtained from the achievement test varied, a statistically significant difference was found (P<.05). This difference was found to be in favour of the post-test scores of the participants in the experimental group. The achievement test scores of the participants in the experimental and control groups, which were found to be similar before the experiment, were found to differ statistically significantly after the experiment.

4. Discussion and Conclusion

- The following conclusions were reached in this study:
- The total and sub-dimension scores of the participants in the experimental and control groups, indicating their perception of their problem-solving skills, were similar before the study.
- After the experiments, the 'self-confidence in problem-solving skills' and 'self-control' sub-dimension scores and total problem-solving inventory scores of the participants in the experimental group significantly increased, while their scores from the 'avoidance' sub-dimension, which is a negative aspect of problem-solving, significantly decreased.
- The retention test scores of the participants in the experimental group from the entire problem-solving inventory and its self-control and avoidance sub-dimensions were observed to regress to the post-test levels. This suggests that the practices should be

carried on to ensure that the knowledge learnt by the students is more permanent. Otherwise, what is learnt is forgotten and, therefore, is not permanently retained.

- The scores participants in the experimental group obtained from the entire problem-solving inventory and its self-confidence and self-control sub-dimensions showed an increasing trend from the post-test to the retention test. However, the scores the participants in the experimental group obtained from the avoidance sub-dimension showed a decreasing trend from the post-test to the retention test.
- No change occurred in the control group participants' pre-test and post-test scores from the entire inventory and its sub-dimensions.
- The scores the participants in the experimental group obtained from the entire problem-solving inventory and its self-confidence and self-control sub-dimensions, which were similar to those of the participants in the control group before the experiment, increased significantly vis-à-vis the control group, whereas the avoidance sub-dimension score of the participants in the same group statistically decreased.
- The achievement pre-test scores of the participants in the experimental and control groups were found to be similar.
- The activities carried out in the experimental group led to a significant increase in the achievement levels of the students.
- The achievement test scores of the participants in the experimental group, which were found to be low after the pre-test, were found to be significantly higher after the retention test.
- The increase in the achievement test scores of the participants in the experimental group from the pre-test to the post-test was found to be permanent.
- No statistically significant change occurred in the control group participants' pre-test and post-test scores from the achievement test.
- The achievement test scores of the participants in the experimental and control groups, which were found to be similar before the experiment, were found to differ statistically significantly after the experiment.

It was concluded that the activities carried out with the participants in the experimental groups positively affected their perceptions of their problem-solving skills. Similarly, in their study carried out with secondary school students, Totan (2011) and Güner-Yüksel (2019) found that the use of the PBL method in the Social Studies course positively affected the problem-solving skills of the participants. Similarly, both in Inel (2012), where cartoons related to concepts of science and technology were used, and in Balım et al. (2015), where a concept cartoon-supported PBL method was adopted, it was concluded that cartoons affect students' perceptions of their problem-solving skills positively.

Another finding of this study is that the activities carried out with the participants in the experimental group fostered a significant increase in students' achievement levels. Similarly, in Güner-Yüksel (2019); Altun and Emir (2008); Çiftçi et al. (2007); Unal et al. (2003); Uluçamlıbel (2009), Deveci (2002); Adeyemi (2008), and Abdu-Raheem (2012), which were carried out on the impacts of the PBL in the Social Studies course given in different grade levels, it was found

that the use of this method positively affected the students' achievement levels. Again, in Akbaş and Toros (2016); Kocoglu (2016); Sidekli et al. (2014); Akengin and İbrahimoğlu (2010); Fasting (2010); Yaman (2018); Aksoy et al. (2010); Island (2020); Mike (2019), and Tokcan and Alkan (2013), which investigated the impacts of the use of concept cartoons in the Social Studies course given in different grade levels, it was concluded that cartoons positively contributed to the academic achievement levels of students, as found in this study. These examples from the literature show that both cartoons and the PBL method positively affect students' problem-solving skills and academic achievement levels. The findings of this study also support these results.

5. Recommendations

Considering the findings of this study, we make the following recommendation:

- Learning outcomes related to cartoons and problem-solving skills may be included in the curriculum, and these topics may be featured in the coursebooks.
- Particularly, supporting materials, where cartoons are used and scrutinised, can be prepared.
- The data obtained from the studies investigating the impacts of humour and humorous elements (anecdotes, cartoons, etc.) and case studies on the topic may be shared with teachers in settings such as panels and symposiums organised by the respective institutions.
- In educational settings by continuously and regularly utilising activities that help improve students' problem-solving skills, it may be ensured that the students gain these skills permanently and use them throughout their lives.

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