The effects of argumentatıon based scıence learnıng approach on creatıve thınkıng skılls of students

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Abstract

The aim of this study is to explore the effects of argumentation based science learning (ABSL) approach on 9th Grade of Secondary Education students' creative thinking skills. The sample of the study included 22 9th grade of Secondary Education students in Bayburt in 2012-2013 academic year. In this study quantitative research method and pretest-posttest experimental design was adopted. As a data collection tool Torrance Test of Creativity Thinking Verbal-Figural Form A was used and the collected data were evaluated by using SPSS program (Statistical Package for the Social Sciences). While evaluating data, t-test was used for the sub-dimensions with normal distribution, whereas Wilcoxon test was used for the sub-dimensions not with normal distribution. The results of analysis showed that argumentation based science learning approach has a positive effect on creative thinking skills of students'. At the beginning and end of semester, Torrance test analysis showed that there is a significant difference in favor of the posttest. Furthermore, according to the sub-dimensions of Torrance Test of Creativity Thinking Verbal/Figural Form A, significant differences were found for Verbal Form A all sub-dimensions. While significant differences were not found between pretest and posttest results for the sub-dimensions of elaboration, synthesis of incomplete figures and emotional expressiveness, significant differences were found for the rest of sub-dimensions in favor of the posttest. In addition, it was observed that critical discussion skills of students were developed in the process.

Introduction

Today, the information society defines human as a researching, questioning, creative and critical thinking individuals who have the ability to solve problems. This can

only occur with well-trained individuals in a contemporary educational process and for this, it is needed to reveal intelligence, free and creative thinking of individuals (Alkan, 1998). Mathematic courses may be considered as a lesson that helps revealing these abilities. Societies which do not give enough importance to mathematics will have to take information from other societies in some way because of being unable to produce information they need for their own. Societies which do not produce new ideas and reveal their creativity can not progress. In other words, mathematics is one of the most important instrument that helps revealing creative thinking skills of individuals. People use mathematics almost all areas of daily life. But it is seen that when students' education degrees increased, they can be afraid of undertaking it and can be prejudiced against mathematics and they fail to do it. Therefore, it is important to get students like mathematics, to tell students importance of this course, to give examples relating to daily life. Because the use of different teaching methods can help to increase the success of mathematics and creative thinking skills of students'.

In new teaching programs, it was seen that it is inevitable to obtain successful results from courses which designed in relation to students' daily lives, personal interests and practical applications. Inquiry based learning approach is an approach that highlights learning by thinking, generates interest and curiosity in connection with students' real life (Duban, 2008). Research and inquiry based learning is a process of converting research, examination, information analysis and data into useful information (Perry and Richardson, 2001). By using the research and inquiry based learning approach students involve in processes such as thinking and examining an existential problem or matter, planning activities in order to reach a solution, interpreting data obtained by these activities, discussing the ideas and finally making reflection on obtained solutions.

Research and inquiry are the basis of Argumentation Based Science Learning(ABSL) approach and they support processes which give importance to thinking (Hohenshell, 2004). With ABSL approach students suggest ideas based on questioning and research, advance argument by analyzing question, claim and evidence processes and they perform a reconciliation and discussion processes (Akkuş, Günel ve Hand, 2007). In classrooms which this approach is applied, ABSL approach provides students doing scientific studies with their friends and doing writing activity by discussing (Hohenshell, 2004). If students believe the benefit of discussion, they debate the topic with each other. Students who can debate in quality, judge the relationship between the claim and the reason and between the claim and evidence. Thus, students ' critical thinking skills develop (Erduran vd., 2006). Scientific discussions also enable the development of communication skills (Erduran vd., 2006; Uluçınar Sağır, 2008). Studies which were done with this approach revealed that research, writing, critical thinking and conceptual understanding abilities of students' serve as a basis structurally (Keys vd., 1999; Rudd vd., 2001; Hand vd., 2002; Hand vd., 2004). Studies show that students are more successful in conceptual question at courses that use this approach than the other students at courses that use the traditional method (Von Aufschnaiter, Erduran, Osborne and Simon, 2008; Hand, Yang and Bruxvoort, 2007; Hand vd., 2004; Hand vd, 2002; Rudd vd., 2001).

The development of creative thinking skills appears to be an important objective at all levels of education from primary education to university. In the primary school curriculum which is prepared by Board of Education and Discipline, the development of creative thinking skills is aimed (MEB, 2004). In parallel to this approach, the general aim of this study is to examine the effects of argumentation

based science learning (ABSL) approach on creative thinking skills of 9th grade students'.

Method
In this study quantitative research method was used. In addition, pretest and posttest experimental design was adopted. Karasar (2007) stated that independent variable was carried out to a group selected randomly for pretest and posttest design and measurements were done before and after pretest and posttest experimental design.

Participants
The sample of the study included a total of 22 students studying at Science High School in Bayburt during 2012-2013 academic year. Purposive sampling was used for choosing students. In this study the students studying at Science High School were chosen because it was thought that these students make more qualified and efficient discussions. Science High Schools aim to help training high qualified scientists in the areas of mathematics and science, to lead students to carry out research, to prepare conditions to students who are interested in scientific and technological developments and new discoveries, to educate individuals who are able to use new technologies and carry out projects (MEB, 2009).

Implementatıon procedure
In the classroom which ABSL approach is applied, it is expected that students will be able to suggest their own claims depending on the data, to build up valid and acceptable connection between their claims and data, to support their claims with applicable information when people oppose against these claims in this process. To direct the students in cognitive way is very important in this process. Firstly, students were expected to learn concepts of the topic

without applying memorization, to reach co-decision by discussing their ideas with their friends in the group, to present their claims to other groups by creating new claim with co-decision and to support or invalidate the claim with solid evidence after listening the claims of each group. After arguing for a while, students were asked to discuss the topic again by giving an activity and ultimately they were provided to reach the solution by thinking and discussing. During this process, the researcher often contributed to the formation of the negotiation process between the students with questions like "Do you agree with the opinion of your friends?, Why?, How". After all groups have finished their discussions, the researcher put together the topic by using question-answer method and has provided to associate the main idea of the course with the activities.

Data collection tool

Torrance Test of Creativity Thinking was used for data collection in this study. This test was published in 1966 by Torrance and used approximately in 615 studies and more than 100 graduate thesis in order to measure individuals' creativity (Öztürk, 2007). There are two forms (A and B) of the TTCT-Verbal and two forms (A and B) of the TTCT-Figural. The TTCT has been translated into more than 35 languages. It has become highly recommended in the educational field and is the most widely used creativity test. TTCT consists of two different tests: Verbal and Figural Form. Each form has other activities. Verbal form consists of 7 activities and Figural Form consists of 3 activities. Both forms of the test are applied to all levels from kindergarten to university.

TTCT Figural Form is titled "Thinking Creatively With Pictures". TTCT Figural Form has two parallel forms, A and B. It consists of 3 activities: picture construction, picture completion and lines. The TTCT Figural measures

fluency, originality, elaboration, abstractness of titles and resistance to premature closure. In this form norm and criterion-referenced subscales are obtained. TTCT Figural Form A consists of five norm-referenced subscales: fluency, originality, elaboration, abstractness of titles and resistance to premature closure. It also consists of 13 criterion-referenced subscales: emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of lines, unusual visualization, internal visualization, extending or breaking boundaries, humor, richness of imagery, colorfulness of imagery, and fantasy.

TTCT Verbal Form is titled "Thinking Creatively With Words". The TTCT Verbal measures fluency, originality and flexibility. It consists of seven activities: asking, guessing causes, guessing consequences, product improvement, unusual uses (cardboard boxes), unusual questions, and just suppose.

The data analysis

There is a score table for each student for scoring the data obtained from TCTT and scores which belong to activities are collected separately and there are 3 types of scores such as fluency, flexibility and originality for Verbal Form A. Figural Form A uses picture-based exercises to assess five mental characteristics such as fluency, originality, abstractness of titles, elaboration and resistance to premature closure. Figural Form A also consists of 13 criterion-referenced subscales that are called Creativity Strengths: emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of lines or circles, unusual visualization, internal visualization, extending or breaking boundaries, humor, richness of imagery, colorfulness of imagery, and fantasy. SPSS 18.0 program (Statistical Package for the Social

Sciences) was used for analyzing the obtained data for TCTT. The skewness and kurtosis values were examined for normality test. While valuating the data, the paired sample t test was done for these sub-dimension values which remain -1 and +1 and Wilcoxon test was done for other sub-dimensions.

Findings

The skewness and kurtosis values, which are calculated for determining whether the required assumptions are met before performing the paired sample t test that is decided for using to identify whether a statistically meaningful difference existed between the Verbal and Figural Form A pretest and the posttest of the Torrance Creative Thinking Test *(the "TCTT)*, remain between -1 and +1, therefore indicating a normal distribution of data. Table 1 presents the results of the paired sample t test, which belongs to the Verbal and Figural Form pretest - the posttest averages of the students.

Table 1. The Results of the Paired Sample T Test, which belongs to the Pretest - Posttest Averages of the Students concerning their Creative Thinking Abilities

Measurement	N	$\overline{X}$	SS	T	p
Verbal pretest	22	49.13	15.10		
Verbal posttest	22	80.40	21.16	-10.90	.000
Figural pretest	22	60.86	14.49		
Figural posttest	22	94.86	22.89	-8.57	.000

When Table 1 is examined, it is seen that this difference in Verbal Form A is meaningful according to the result obtained

from the paired sample t test (p<.05). According to this findings, one can say that the approached used has a positive and meaningful impact on creative thinking. Similarly, this difference was found meaningful in Figural Form A (p<.05). According to this findings, one can say that the approached used has a positive and meaningful impact on creative thinking. One method to be used for introducing the creative thinking skill is ABSL (Argumentation Based Science Learning). Utilizing the said ABSL approach for each possible and appropriate subject seems important for improving creative thinking. When the ABSL approach, which helps the lesson become more interesting and joyful, also provides motivation, it helps creating an environment that improves creative thinking.

For the sub-dimensions of TCTT, all of which show normal distribution and which consist of the flexibility sub-dimension of the Verbal Form, and the sub-dimensions of the Figural Form concerning originality, resistance to premature closure and extending or breaking boundaries, the average of the points that the students obtained from each sub-dimension were calculated, after which a paired sample t test was performed for determining whether a meaningful difference existed between the points obtained by students from the pretest and posttest of each sub-dimension. The findings, which pertain to the results of the pretest and posttest for these sub-dimensions that show a normal distribution, were shown in Table 2.

When we look at Table 2, it is seen that the point average that the students participating in the research obtained from the pretest on the flexibility sub-dimension of the Verbal Form was 14.82 and their point average for the posttest was 20.82. The results of the paired sample t

Table 2. The Results of the Paired Sample T Test, which belongs to the Pretest - Posttest Averages Obtained from Sub-Dimensions, where TCTT Manifests a Normal Distribution.

Measurement	N	$\bar{X}$	SS	T	p
V.F.F.C.Pre.	22	14.82	3.43	-7.70	.000
V.F.F.C.Post.	22	20.82	4.29		
F.F.O.C.Pre.	22	11.14	4.46	-7.44	.000
F.F.O.C.Post.	22	17.45	5.19		
F.F.R.C.Pre.	22	1.91	1.60	-3.13	.005
F.F.R.C.Post.	22	3.59	3.30		
F.F.E.C.Pre.	22	1.36	1.13	-3.76	.001
F.F:E.C.Post.	22	2.68	1.88		

 * V.F.F.C.Pre.:Verbal Form flexibility category pretest, V.F.F.C.Post. : Verbal Form flexibility category posttest F.F.O.C.Pre.: Figural Form originality category pretest, F.F.O.C.Post.: Figural Form originality category posttest, F.F.R.C.Pre.: Figural Form resistance to premature closure category pretest, F.F.R.C.Post.: Figural Form resistance to premature closure category posttest, F.F.E.C.Pre.: Figural Form extending or breaking boundaries category pretest, F.F:E.C.Post.: Figural Form extending or breaking boundaries category posttest

test, which was performed for determining whether a meaningful difference existed between students' averages in this sub-dimension, show that statistically, it stands at a meaningful level in favor of the posttest (p= .00<.05). We can say that ABSL approach has a positive impact on the flexibility sub-dimension, which means creating many thoughts by passing from one thought to another. When we look at the results of the originality sub-dimension of the Figural Form. However, we see that whereas the pretest point average of the participants is 11.14, the posttest point average has increased to 17.45. The result of the analysis, which was performed for determining the statistical difference them, has shown that the meaningful difference identified was in favor of the posttest (p= .00<.05). We can say that the ABSL approach has a positive impact on the originality sub-dimension, which expresses the ability to think differently from those already known or thought by everyone. In the sub-dimension for resistance to premature closure, the point averages of the students for the pretest was identified as 1.91, and their point averages for the posttest was calculated as 3.59. Similarly, the results of the statistical analysis, which was performed to identify whether the development was important in statistical terms, show that it stands at a statistically meaningful level in favor of the posttest (p= .00<.05). Finally, when we look at the analyses that were performed for the sub-dimension of the Figural Form for extending or breaking boundaries, we saw that point average of the students from the pretest of this sub-dimension was 1.36 and their point average for the posttest was at 2.68. Also, the results of the paired sample t test performed has shown that between the pretest and posttest, a statistically meaningful difference existed in favor of the posttest (p= .00<.05). We can say that approach used has a positive impact on the sub-dimension for extending or breaking boundaries, which means the ability of obtaining a time

interval that is long enough to make the mental sequencing that is needed for moving away from the visible and ordinary.

In Verbal Form, which does not manifest a normal distribution, the Wilcoxon test was performed on its sub-dimensions of fluency and originality; and for the Figural Form, same was applied on its sub-dimensions of fluency, abstractness of titles, elaboration, emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of lines or circles, unusual visualization, internal visualization, humor, richness of imagery, colorfulness of imagery and fantasy. Table 3 shows the results of the Wilcoxon signed ranks test, which pertain to the sub-dimension of the Verbal Form concerning fluency, where TCTT does not show a normal distribution.

Table 3. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Sub-Dimension of Verbal Form Fluency, where TCTT Does Not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	0	.00	.00		
	21	11.00	231.00		
Positive sequence	1			-4.018	.00
Equal					

*p<.05

From the findings obtained from Table 3, it was seen that 21 students amongst 22, who were applied creativity test for fluency sub-dimension of the Verbal Form, had higher posttest points than the pretest points, and that one person scored equal points in the pretest and posttest in fluency sub-dimension of Verbal Form. The point-related sequence

average of 21 persons was 11.00, who had high posttest points. An 11 point difference was found between the averages, which is statistically meaningful (Z=-4.018; p=0.000<0.05). When the sequence average of the point differences and the total points are considered, we see that the difference observed is in favor of the positive sequences, meaning the posttest. According to these results, we can say that the ABSL approach increases the number of interpretable questions answered by the students. Table 4 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the sub-dimension of the Verbal Form concerning originality, where TCTT does not show a normal distribution.

Table 4. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Sub-Dimension Concerning Verbal Form Originality, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	0	.00	.00		
	22	11.50	253.00		
Positive sequence	0			-4.110	.00
Equal					

*p<.05

From the findings obtained from Table 4, it was seen that all 22 students, whom were applied creativity test for originality, a sub-dimension of the Verbal Form, had higher points in the posttest than the pretest. The point-related sequence average of 22 persons was 11.50, who had high posttest points. An 11.50 point difference was found between the averages, which is statistically meaningful (Z=-4.110; p=0.000<0.05). When the sequence average of the point differences and the total points are considered, we see that the difference

observed is in favor of the positive sequences, meaning the posttest. Looking at these results, we can say that the ABSL approach enables the students to develop a thinking ability that is remote from what is known and that is different from everyone. Table 5 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the fluency sub-dimension of Figural Form, where TCTT does not show a normal distribution.

Table 5. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Fluency Sub-Dimension of Figural Form, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	0	.00	.00		
Positive sequence	21	11.00	231.00	-4.018	.00
Equal	1				

*p<.05

From the findings obtained from Table 5, it was seen that 21 students amongst 22, who were applied creativity test for fluency sub-dimension of the Figural Form, had higher posttest points than the pretest points, and that one person scored equal points in the pretest and posttest for fluency sub-dimension. The point-related sequence average of 21 persons was 11.00, who had high posttest points. An 11 point difference was found between the averages, which is statistically meaningful (Z=-4.018; p=0.000<0.05). When the sequence average of the point differences and the total points are considered, we see that the difference observed is in favor of the positive sequences, meaning the posttest. According to

these results, we can say that the ABSL approach increases the number of interpretable questions answered by the students. Table 6 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the abstractness of titles sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 6. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Abstractness of Titles Sub-Dimension, where TCTT does not Show a Normal Distribution.

Final test Preliminary test	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	5	5.80	29.00		
Positive sequence	13	10.92	142.00	-2.471	.013
Equal	4				

*p<.05

According to the findings obtained from Table 6, 13 students amongst 22, whom were applied the creativity test for the abstractness of titles that represents a sub-dimension of the Figural Form, had higher points in the posttest than the pretest on the abstractness of titles, four persons had same points for pretest and posttest; and 5 persons had higher points in the pretest than the posttest. The point-related sequence average of 13 persons was 10.92, who had high posttest points. The average was 5.80 for 5 students that had high pretest points. A 5.12 point difference was found between the averages, which is statistically meaningful (Z=-2.471; p=0.013<0.05). When the sequence average of the point differences and the total points are considered, we see that the difference observed is in favor of the positive sequences, meaning the posttest. Looking at these results, we

can say that the ABSL approach enables the students to develop an ability to generate good titles. Table 7 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the elaboration sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 7. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Elaboration Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	2	7.50	15.00		
Positive sequence	8	5.00	40.00	-1.294	.196
Equal	12				

*p<.05

   According to the findings obtained from Table 7, 8 students amongst 22, whom were applied creativity test for elaboration sub-dimension of Figural Form, had higher points in the posttest than in the pretest for elaboration sub-dimension; 2 students had lower points in the posttest than in the pretest for elaboration sub-dimension; and that 12 students had identical points in the pretest and posttest. The sequence average was 5.00 for the points of 8 students persons that had high posttest points; and the average was 7.50 for 2 students that had high pretest points. A -2.5 point difference was found between the averages. However, this is not statistically meaningful (Z=-1.294; p=0.196>0.05). In other words, we can say that the students manifested similar results in the pretest and posttest during the research. Table 8 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the emotional expressiveness sub-dimension of

Figural Form, where TCTT does not show a normal distribution.

Table 8. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Emotional Expressiveness Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	3	6.00	18.00		
Positive sequence	10	7.30	73.00	-1.936	.053
Equal	9				

*p<.05

According to the findings obtained from Table 8, 10 students amongst 22, whom were applied creativity test for emotional expressiveness sub-dimension of the Figural Form, had higher points in the posttest than in the pretest for emotional expressiveness; 3 students had lower points in the posttest than in the pretest for emotional expressiveness; and that 9 students had identical points in the pretest and posttest. The sequence average was 7.30 for the points of 10 students that had high posttest points; and the average was 6.00 for 3 students that had high pretest points for emotional expressiveness sub-dimension. A 1.3 point difference was found between the averages. However, this is not statistically meaningful (Z=-1.936; p=0.053>0.05). In other words, we can say that the students manifested similar results in the pretest and posttest. When the sequence average of difference points is considered, we can say that the average of the positive sequences is higher than that of the negative sequences, but this difference is not sufficient to pose a statistically meaningful difference. Table 9 shows the results

of the Wilcoxon Signed Ranks Test, which pertain to the storytelling articulateness sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 9. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Storytelling Articulateness Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	Z	p
Negative sequence	2	5.25	10.50	-3.155	.002
Positive sequence	15	9.50	142.50		
Equal	5				

*p<.05

According to the findings obtained from Table 9, 15 students amongst 22, whom were applied the creativity test for storytelling articulateness sub-dimension of the Figural Form, had higher points in the posttest than the pretest on storytelling articulateness, 5 students had same points for the pretest and posttest; and 2 students had higher points in the pretest than posttest. The point-related sequence average of 15 students was 9.50, who had high posttest points. The average was 5.25 for 2 students that had high pretest points. A 4.25 point difference was found between the averages, which is statistically meaningful (Z=-3.155; p=0.002<0.05). When the sequence average of the point differences and the total points are considered, we see that the difference observed is in favor of the positive sequences, meaning the posttest. Looking at these results, we can say that the ABSL approach enables the students to develop an ability to express stories. Table 10 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the movement or action sub-

dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 10.The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Movement or Action Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	1	5.00	5.00		
Positive sequence	12	7.17	86.00	-2.853	.004
Equal	9				

*p<.05

According to the findings obtained from Table 10, 12 students amongst 22, whom were applied the creativity test for movement or action that represent sub-dimensions of Figural Form, had higher points in the posttest than the pretest on movement or action, 9 students had same points for the pretest and posttest; and 1 student had higher points in the pretest than the posttest. The point-related sequence average of 12 students was 7.17, who had high posttest points. The average was 5.00 for 1 student that had high pretest points. A 2.17 point difference was found between the averages, which is statistically meaningful (Z=-2.853; p=0.004<0.05). When the sequence average of the point differences and the total points are considered, we see that the difference observed is in favor of the positive sequences, meaning the posttest. Table 11 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the sub-dimension of the Figural Form concerning the expressiveness of titles, where TCTT does not show a normal distribution.

Table 11.The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Expressiveness of Titles Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	1	4.50	4.50		
Positive sequence	17	9.79	166.50	-3.566	.00
Equal	4				

*p<.05

According to the findings obtained from Table 11, 17 students amongst 22, whom were applied the creativity test for the expressiveness of titles that represents a sub-dimension of the Figural Form, had higher points in the posttest than the pretest on the expressiveness of titles, 4 students had same points for the pretest and posttest; and 1 student had higher points in the pretest than the posttest. The point-related sequence average of 17 students was 9.79, who had high posttest points. The average was 4.50 for 1 student that had high pretest points. A 5.29 point difference was found between the averages, which is statistically meaningful (Z=-3.566; p=0.000<0.05). When the sequence average of the point differences and the total points are considered, we see that the difference observed is in favor of the positive sequences, meaning the posttest. Looking at these results, we can say that the ABSL approach enables the students to develop an ability to verbalize emotions. Table 12 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the synthesis of incomplete figures sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 12. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Synthesis of Incomplete Figures Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	0	.00	.00		
Positive sequence	1	1.00	1.00	-1.000	.317
Equal	21				

*p<.05

According to the findings obtained from Table 12, 1 student amongst 22, who was applied creativity test for the synthesis of incomplete figures, a sub-dimension of the Figural Form, had higher points in the posttest than in the pretest; and that 21 students had identical points in the pretest and posttest. The point-related sequence average of 1 student was 1.00, who had high posttest points. A 1.00 point difference was found between the averages. However, this is not statistically meaningful (Z=-1.000; p=0.317>0.05). In other words, we can say that the students manifested similar results in the pretest and posttest. When the sequence average of difference points is considered, we can say that the average of the positive sequences is higher than that of the negative sequences, but this difference is not sufficient to pose a statistically meaningful difference. Table 13 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the synthesis of lines or circles sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 13.The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Synthesis of Lines or Circles Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	0	.00	.00		
	8	4.50	36.00		
Positive sequence	14			-2.536	.011
Equal					

*p<.05

According to the findings obtained from Table 13, 8 students amongst 22, who were applied creativity test for the synthesis of lines or circles, a sub-dimension of the formal form, had higher points in the posttest than in the pretest; and that 14 students had identical points in the pretest and posttest. The point-related sequence average of 8 students was 4.50, who had high posttest points. A 4.50 point difference was found between the averages, which is statistically meaningful (Z=-2.536; p=0.011<0.05). Table 14 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the unusual visualization sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

According to the findings obtained from Table 14, 10 students amongst 22, who were applied creativity test for unusual visualization, a sub-dimension of the Figural Form, had higher points in the posttest than in the pretest for unusual visualization; and that 12 students had identical points in the pretest and posttest. The point-related sequence average of 10 students was 5.50, who had high posttest points. A 5.50 point difference was found between the averages, which is statistically meaningful (Z=-2.913;

p=0.011<0.04). When the sequence average of the point differences and the total points are considered, we see that the difference observed is in favor of the positive sequences, meaning the posttest. Looking at these results, we can say that the ABSL approach enables the students to develop an ability to see from a different perspective.

Table 14.The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Sub-Dimension Concerning Unusual Visualization, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	0	.00	.00		
	10	5.50	55.00	-2.913	.004
Positive sequence	12				
Equal					

*p<.05

Table 15 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the internal visualization sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 15. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Internal Visualization Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	1	6.00	6.00		
	15	8.67	130.00	-3.334	.001
Positive sequence	6				
Equal					

*p<.05

According to the findings obtained from Table 15, 15 students amongst 22, whom were applied the creativity test for internal visualization that represents a sub-dimension of the Figural Form, had higher points in the posttest than the pretest on internal visualization, 6 students had same points for the pretest and posttest; and 1 student had higher points in the pretest than the posttest. The point-related sequence average of 15 students was 8.67, who had high posttest points. The average was 6.00 for 1 student that had high pretest points. A 2.67 point difference was found between the averages, which is statistically meaningful (Z=-3.334; p=0.001<0.05). When the sequence average of the point differences and the total points are considered, we see that the difference observed is in favor of the positive sequences, meaning the posttest. Looking at these results, we can say that the ABSL approach develops the ability to visualize the beyond-exterior better. Table 16 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the sub-dimension of the Figural Form concerning humor, where TCTT does not show a normal distribution.

Table 16. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Humor Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	5	7.00	35.00		
	12	9.83	118.00		
Positive sequence	5			-1.991	.047
Equal					

[*]p<.05

According to the findings obtained from Table 16, 12 students amongst 22, whom were applied the creativity test for humor that represents a sub-dimension of the Figural

Form, had higher points in the posttest than the pretest, 5 students had same points for the pretest and posttest; and 5 students had higher points in the pretest than the posttest. The point-related sequence average of 12 students was 9.83, who had high posttest points. The average was 7.00 for 5 students that had high pretest points. A 2.83 point difference was found between the averages, which is statistically meaningful (Z=-1.991; p=0.047<0.05). When the sequence average of the point differences and the total points are considered, we see that the difference observed is in favor of the positive sequences, meaning the posttest. Looking at these results, we can say that the ABSL approach improves the humor skill. Table 17 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the richness of imagery sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 17. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Richness of Imagery Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	0	.00	.00		
	8	4.50	36.00		
Positive sequence	14			-2.714	.007
Equal					

*p<.05

According to the findings obtained from Table 17, 8 students amongst 22, who were applied creativity test for the richness of imagery, a sub-dimension of the Figural Form, had higher points in the posttest than in the pretest for richness of imagery; and that 14 students had identical points

in the pretest and posttest. The point-related sequence average of 8 students was 4.50, who had high posttest points. A 4.50 point difference was found between the averages, which is statistically meaningful (Z=-2.717; p=0.007<0.04). Table 18 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the colorfulness of imagery sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 18. The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Colorfulness of Imagery Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	1	5.50	5.50		
	13	7.65	99.50		
Positive sequence	8			-3.082	.002
Equal					

*p<.05

According to the findings obtained from Table 18, 13 students amongst 22, whom were applied the creativity test for the colorfulness of imagery sub-dimension of the Figural Form, had higher points in the posttest than the pretest for the colorfulness of imagery sub-dimension, 8 students had same points for the pretest and posttest; and 1 student had higher points in the pretest than the posttest. The point-related sequence average of 13 students was 7.65, who had high posttest points. The average was 5.50 for 1 student that had high pretest points. A 2.15 point difference was found between the averages, which is statistically meaningful (Z=-3.082; p=0.002<0.05). When the sequence average of the point differences and the total points are considered, we see

that the difference observed is in favor of the positive sequences, meaning the posttest. Looking at these results, we can say that the ABSL approach improves the variegation of imaginative power. Table 19 shows the results of the Wilcoxon Signed Ranks Test, which pertain to the fantasy sub-dimension of the Figural Form, where TCTT does not show a normal distribution.

Table 19.The Results of the Wilcoxon Signed Ranks Test, which Pertain to the Fantasy Sub-Dimension, where TCTT does not Show a Normal Distribution.

Posttest Pretest	N	Mean Rank	Sum of Ranks	z	p
Negative sequence	0	.00	0.00		
	10	5.50	55.00		
Positive sequence	12			-2.972	.003
Equal					

*p<.05

According to the findings obtained from Table 19, 10 students amongst 22, who were applied creativity test for fantasy, a sub-dimension of the Figural Form, had higher points in the posttest than in the pretest for fantasy; and that 12 students had identical points in the pretest and posttest. The point-related sequence average of 10 students was 5.50, who had high posttest points. A 5.50 point difference was found between the averages, which is statistically meaningful (Z=-2.972; p=0,003<0.04).

Conclusion

According to the findings obtained from TCTT Verbal Form A and Figural Form A booklets that were applied as pretest and posttest on the students at the beginning and end of the semester, and as yielded by the comparison on the averages

of the creative thinking points, it was seen that both verbal and figural point averages of the students increased according to the pretest. Also, the analysis results has shown that between the pretest and posttest, a statistically meaningful difference existed for TCTT Verbal Form A (p= .00<.05). According to these findings, one can say that the ABSL approach used has a positive and meaningful impact on creative thinking. Likewise, a meaningful difference was identified within the Figural Form A in favor of the posttest (p=.00 <.05). Similarly, one can say that the ABSL approach used has a positive and meaningful impact on creative thinking.

Whereas no meaningful difference was seen between the pretest and posttest at the sub-dimensions of the Figural Form concerning elaboration, emotional expressiveness and synthesis of incomplete figures, a meaningful difference that is in favor of the posttest was seen in all remaining sub-dimensions when each dimension was examined separately for the Verbal and Figural Form A of the Torrance Creative Thinking Test. When the results of each sub-dimension are examined:

A meaningful difference was identified in favor of the posttest in the fluency category, which is one sub-dimension of Verbal Form A (p=.00<.05). The number of questions answered in the posttest by 21 students amongst 22 showed an increase according to the pretest. The number of questions answered by one student remained same. Relying on this finding obtained, we can say that the ABSL approach has a positive impact on the fluency sub-dimension, which based on generating numerous ideas within a certain time limit.

A meaningful difference was identified in favor of the posttest in the flexibility category, which is one sub-dimension of the Verbal Form (p=.00<.05). We can state that the ABSL approach has a positive impact on the flexibility

category, which is based on using approaches that are different from each other.

Likewise, a meaningful difference was identified in favor of the posttest in the originality category of the Verbal Form (p=.00<.05). The originality points of all 22 students in the posttest showed an increase according to the pretest. According to this finding, we can state that the ABSL approach has a positive impact all students participating in the application for the generation of unusual ideas.

A meaningful difference, in favor of the posttest, was identified between the pretest and the posttest in the fluency category, which is one sub-dimension of Figural Form A of the Torrance Creative Thinking Test (p=.00<.05). The number of questions answered in the posttest by 21 students amongst 22, showed an increase according to the pretest. As in the fluency sub-dimension of the Verbal Form, we can say that the ABSL approach has a positive impact on the fluency sub-dimension, which based on generating numerous ideas within a certain time limit.

In the originality sub-dimension, a meaningful difference was also identified in favor of the posttest (p=.00<.05). We can state the approach used within the originality sub-dimension, which hosts an interim relation between the pretest and the posttest, has a positive impact on the students to generate unusual ideas.

No meaningful difference could be found between the pretest and the posttest at the elaboration sub-dimension (p=.196>.05). We can state that the ABSL approach has no impact on the elaboration sub-dimension, which based on processing and developing a given product in detail.

Likewise, a meaningful difference was identified in favor of the posttest in the category concerning the abstractness of titles, which is another sub-dimension (p=.013<.05). It was seen that the majority of 22 students participating in the application had higher final test points

than the pretest points. We can state that the approach used has a positive impact on this category, which concerns creating a better title for the generated product.

In the sub-dimension that concerns resistance to premature closure, a meaningful difference was identified in favor of the posttest (p=.00<.05). We can state that the ABSL approach has a positive impact on the sub-dimension concerning resistance to premature closure, which is attributed to the feature of creatively thinking person where they postpone closure and keep they minds open during a timeframe that is long enough to make a mental bypass, which renders their original ideas possible.

No meaningful difference could be found between the pretest and the posttest in the sub-dimension concerning emotional expressiveness (p=.053>.05). We can state the ABSL approach has no impact on this sub-dimension, which shows the degree of lines or oral supplementations to reflect emotional expressiveness.

A meaningful difference was identified in favor of the posttest in the storytelling articulateness sub-dimension (p=.002<.05). This category, where the majority of 22 students scored higher points in the final test than in the pretest, is based on the ability to establish a strong and open communication in order that creativity can yield benefits; and we can state that the approach used has a positive impact on this sub-dimension.

In the sub-dimension concerning movement or action, a meaningful difference was identified in favor of the posttest (p=.004<.05). Sensing and reflecting the movement in drawings is accepted as a sign that the imaginative power is being used.

A meaningful difference was identified in favor of the posttest in the category concerning expressiveness of titles, which is another sub-dimension (p=.00<.05). It was seen that the majority of 22 students had higher posttest

points than the pretest points. We can state that the ABSL approach has a positive impact on this sub-dimension, where the abilities of verbalizing emotions and abstraction are accentuated.

No meaningful difference could be found between the pretest and the posttest in the sub-dimension concerning synthesis of incomplete figures (p=.317>.05). It was seen that only 1 student amongst 22 had higher posttest points than the pretest during the synthesis of incomplete figures. We can state that the approach has no impact on this sub-dimension, which can be accepted as an indicator of the ability to see relations between irrelevant objects.

A meaningful difference was identified in favor of the posttest in the sub-dimension concerning synthesis of lines or circles (p=.011<.05). We can state that the ABSL approach has a positive impact on this sub-dimension, which means moving away from the ordinary or the already known by joining two or more lines.

In the sub-dimension concerning unusual visualization, a meaningful difference was also identified in favor of the posttest (p=.011<.04). We can state that the ABSL approach has a positive impact on this sub-dimension, which is based on seeing objects through an unusual perspective.

In the sub-dimension concerning internal visualization, a meaningful difference was also identified in favor of the posttest (p=.001<.05). It was seen that the majority of 22 students had higher posttest points than the pretest points. We can state that the ABSL approach has a positive impact on this sub-dimension, which includes indicators to the effect that creative persons can better visualize the beyond-exterior compared to other individuals and that they pay attention to the internal & dynamic operation of the objects.

A meaningful difference was identified in favor of the posttest in the category that concerns extending or breaking boundaries, which is another sub-dimension (p=.00<.05). We can state that the ABSL approach has a positive impact on this category, which host an interim relation between the pretest and posttest and where actions like expanding or exceeding defined borders are assessed.

Likewise, a meaningful difference was identified in favor of the posttest in the humor category (p=.047<.05). We can state that the ABSL approach has a positive impact on this dimension, which hosts unusual unifications & surprises and where creativity is thought lie at the bottom of humor.

A meaningful difference was identified in favor of the posttest in the sub-dimension that concerns richness of imagery (p=.007<.04). We can state that the ABSL approach has a positive impact on the category concerning richness of imagery, which is based on the variety, liveliness and vitality manifested by the answers given.

A meaningful difference was identified in favor of the posttest in the category that concerns colorfulness of imagery, which is another sub-dimension (p=.002<.05). We can state that the ABSL approach has a positive impact on the dimension concerning the colorfulness of imagery, which expresses the exciting feature of answers in terms of addressing five senses.

Finally, a meaningful difference was identified in favor of the posttest fantasy sub-dimension (p=.003<.04). We can state that the ABSL approach has a positive impact on this sub-dimension, which will provide a limitless amount of analogies that are useful for creatively identifying and solving problems known in mythology like models and images.

Recommendations

Some recommendations that are based on the research results are below:

Teachers should use methods, techniques or approaches that enable them to render the mathematic courses more interesting & joyful and to process them in more connection with the contemporary life. One of them is the ABSL approach.

The effectiveness of the approach can be examined also in different disciplines (in verbal and math courses).

The argument model, the efficiency of which was observed during many domestic and foreign studies, should be taught to the teacher candidates and one should exert efforts to improve the argumentation skills of these candidates.

We should attach importance to creative thinking in our educational system, incline to use methods that render students more active and help them to improve & give prominence to creativity, and provide the students with liberal learning environments where they can express them comfortably.

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