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The Effects of Authentic Learning Practices on Problem-Solving Skills and Attitude towards Science Courses

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Abstract: This study aims to investigate the effects of authentic learning methods — applied in science courses — on the problem-solving skills and attitudes towards those courses. As a research design, a quasi-experimental design with pre-test and post-test control groups was used in the study. The data of the study were collected from 92 students at the level of 6th grade in Van, Turkey in the 2017-2018 academic year. As data collection tools, the Problem-Solving Skills Test and Science Attitude Scale were used throughout the study. During the data analysis phase, descriptive statistics, one-factor analysis of variance for unrelated samples, t-test for related samples, Kruskal Wallis-H and Wilcoxon Signed Rank Test were used. As a result of the study, it was realised that there was a significant difference between the experimental group and control groups' problem-solving skills total scores in favour of the experimental group. Furthermore, it was ascertained that authentic learning practices improved the problem-solving skills of the experimental group students to a significant extent. In terms of attitude points towards science, it was determined that the post-test scores of the experimental group were significantly higher than the control groups and authentic learning practices had a positive effect on attitude.

Keywords: authentic learning, authentic task, problem-solving skills, the curriculum of science courses, attitudes towards science courses.

Introduction

The constructivist learning approach that has been put forward against the traditional education system in Turkey since 2005 could be deemed as one of the crucial reforms of the Turkish education system. The constructivist approach has brought about significant changes in the curriculum by placing students at the centre of the educational process. Besides, it seems that new approaches complementing the constructivist approach in education continue to emerge and one such approach is the authentic learning that has gained importance in recent years. Authentic literally means "the one with the features that have existed in the past, the original" (Turkish Language Association, 2019). Considering this concept in terms of learning, it is seen that real-life objects used for the teaching process in the class are meant. Moreover, real-life cases and problems could be dealt with in this sense (Cholewinski, 2009). In this regard, authentic learning is defined as a learning approach that involves students' discovering, discussing and meaningfully structuring the concepts related to real-life problems and projects. (Donovan, Bransford & Pellegrino, 1999).

Authentic learning allows teachers to bring the outside and class environments together. In this way, students can connect to real life so that their knowledge and, thus, their skills become more permanent and meaningful (Caseley, 2004). In this learning style, students try and use the information they construct rather than just memorise the knowledge (Mehlinger, 1995). Bektaş and Horzum (2014) argue that it is possible for authentic learning to provide students with such learning qualified to prepare them for real life since it includes real-life problems, activities, experiences, and tasks. The main objective of authentic learning is not to learn subjects directly but to develop solutions to the problems they may encounter in real life. Authentic problems should be given enough attention in a planned learning environment and students should be taught how to solve complex, open-ended and often real-life related problems (Paavola & Lakkala, 2004; Tynjala, 1999).

Authentic learning is defined as meaningful learning that is perfectly integrated or transported into real-life situations (Jonassen, Howland, Marra & Crismond, 2008). Each student combines real-life information with an existing knowledge base built on a social context (Fry, Ketteridge & Marshall, 2009). For what is learned to be functional, what students learn must be true (Aina, Aboyeji & Aboyeji, 2015). Authentic learning has other characteristics in addition to involving real-life problems in the teaching-learning process. These main characteristics could be listed as follows (Mims, 2003; Rule, 2006):

- It is task-based.
- It has an interdisciplinary nature.
- It requires students to share the outputs they acquire during the learning process with the audience outside the classroom.
- Students should conduct research and inquiry.
- Students should demonstrate high-level thinking skills such as analysis, synthesis, design, and evaluation in complex tasks.
- It is conducted in a social environment with teachers, other students, experts, family, and the environment.
- It ensures that students are responsible for their learning in project work.
- Its effect increases when resource use is adequate.
- It enables students to receive structured support in this process.

Authentic learning activities are designed to provide students with real-life experiences. It is important to provide students with an authentic environment to bridge the gap between classroom learning experience and real-life complexity (Hui & Koplin, 2011). This learning approach, which allows students to enter realistic tasks using real-life resources and tools, also allows students to think and act like professionals when dealing with real problems (Herrington, Parker & Boase-Jelinek, 2014). It provides a research opportunity that allows them to improve their knowledge and skills. In the authentic learning process, students are active and learn by doing (Aina et al, 2015). Yeen-Ju, Mai and Selvaretnam (2015) state that authentic learning strategies create learning environments that not only provide students with a connection to real life but also encourage the development of higher-order thinking skills.

Creating learning environments suitable for authentic learning is possible by including some basic components. According to Herrington and Oliver (2000), authentic learning has nine components. These components are: (1) authentic context, (2) authentic activity (3) expert performance (4) multiple perspectives, (5) cooperation, (6) reflection, (7) explicit articulation, (8) one-to-one training and structured support, (9) authentic assessment. In an authentic context, it is possible to include real-life cases. The cases should be comprehensive and appropriate for the learning purpose and students. The authentic activity component includes all the practices in which students are active in solving the problems addressed in real life. In expert performance, students are expected to interact with experts from different occupational groups and to try to act in a similar way to those experts as an apprentice. In multiple perspectives, students can incorporate different perspectives into the process by making use of various sources. Whereas students are asked to collaborate in the cooperation component; the reflection component requires them to reflect the information they have obtained from different sources to their friends and transfer this information to their own lives. In the explicit articulation component, it is aimed to share the information obtained as a result of authentic activities with other people and to increase their widespread effect. When it comes to the one-to-one training and structured support component, the role of the teacher is emphasised. In a sense of authentic learning, teachers are expected to raise students' levels to the level of independent learners by providing guidance. Finally, performance-based assessments mainly focused on students are a matter of the authentic assessment component. In this context, it is recommended to conduct a process evaluation and to use alternative assessment methods such as self-assessment, peer assessment, etc. (Bektaş & Horzum, 2014; Gökdaş, 2003; Herrington & Oliver, 2000; Herrington, 2006; Lombardi, 2007).

Studies on authentic learning demonstrate that this approach is beneficial in terms of several features. According to these studies, authentic learning is effective in academic success (Ayar & Yalvaç, 2010; Aydın, 2019; Bruffy, 2012; Dadlı, 2017; Çakır, 2019; Finch & Jefferson, 2013; Gençoğlan, 2017; Gürgül, 2018; Hürsen, 2016; İneç, 2017; Karakoç, 2016; Koçyiğit, 2011; Maddox & Saye, 2014) and motivation (Aydın-Aşk, 2016; Grace & Lee, 2014; Güner, 2016; Gürdoğan, 2014; Lichtinger & Kaplan, 2015; Önger, 2019; Zohoorian, 2015). Looking at the literature on authentic learning, it is seen that problem solving is another issue that is emphasised in the updated curricula in Turkey (Ministry of National Education [MONE], 2005; 2013; 2017; 2018). Therefore, one of the basic outputs of an authentic learning approach could be expected to be problem-solving skills. Besides, since authentic learning provides direct contact with students' lives and allows them to solve their problems, it is possible to argue that students will have more optimistic attitudes towards their courses. As a matter of fact, it is possible to mention the existence of studies that conclude that authentic learning has a positive effect on problem solving skills (Aydın-Aşk, 2016; Hamurcu, 2016; Koçyiğit, 2011; Loyens, Rikers & Schmidt, 2009; Pullu, 2019; Risko, Osterman & Schusster, 2002; Rule & Arthur, 2007; Yeen-Ju, Mai & Selvaretnam, 2015) and on attitude towards the courses (Baştürk, 2019; Dadlı, 2017; Gündoğan, 2017; Hamurcu, 2016; Horzum & Bektaş, 2012; İneç, 2017; Karabulut, 2018; Koçyiğit, 2011). However, no studies have examined the effect of authentic learning on students' problem-solving skills and their attitude towards science courses that are intertwined with real life. Thus, it is of significance to conduct scientific studies in this regard.

The Purpose and Importance of the Research

This study is aimed to determine and analyse the effects of authentic learning practices on students' problem-solving abilities and attitudes towards science courses. For this general objective, the following questions were used:

1. Is there a significant difference between the experimental, Control I and Control II groups' pre-test problem solving skills scores?
2. Is there a significant difference between the experimental, Control I and Control II groups' post-test problem solving skills scores?
3. Is there a significant difference between the pre-test and post-test problem solving skills scores of the experimental group?
4. Is there a significant difference between the experimental, Control I and Control II groups' pre-test attitudes towards science course scores?
5. Is there a significant difference between the experimental, Control I and Control II groups' post-test attitudes towards science course scores?
6. Is there a significant difference between the pre-test and post-test attitudes towards science course scores of the experimental group?

It is one of the primary goals of education to give the learner the ability to deal with the problems he / she may encounter in his real life. Indeed, one of the basic skills emphasised in the science curriculum is problem solving skills. However, it is observed that students' problem-solving skills are not sufficient (Ünsal & Moğol, 2008). One dimension of this study is to investigate the effect of authentic learning on problem solving skills. This is an important factor for the study. In addition, attitude towards science, which is one of the affective domains, is another important factor in the science curricula applied or being applied in Turkey (MONE, 2005; 2013; 2017; 2018). As it is valid for many courses, the development of properties, such as success and skill in science courses, is closely related to students' attitudes towards their course. In this context, this study is important in determining the effect of authentic learning on students' attitude towards science courses.

Methods

Research Design

A pre-test-post-test quasi-experimental design was performed in the study. The aim of the quasi-experimental design is the same as the experimental method. Namely, in this pattern, any event, phenomenon, object, person, and factor are examined to determine cause-effect relationships between variables and to compare and measure the results. Yet, the difference is that the experimental and control groups cannot be randomly selected in a quasi-experimental design (Ekiz, 2003). Since student distribution is conducted by school administrations in the schools where this study was carried out and the researchers do not have the chance to intervene in this application, this study requires the use of the abovementioned pattern.

Study Group

The study group consisted of 92 sixth-grade students studying in two secondary schools affiliated to the Directorate of National Education of the İpekyolu district of Van. In the process of determining the study group, the schools to be included in the study were first determined. In this context, it was taken into consideration that the students to be included in the study group should be similar in terms of academic success and socio-economic profile. Besides, the physical infrastructures of the schools should be similar and to be suitable for authentic learning practices. In line with these criteria two schools in the city center were determined by obtaining information from the Directorate of National Education of İpekyolu. In addition, volunteering of the participants in the determined schools was also taken into consideration. Experimental and Control I groups were selected in one of these schools and the Control II group was selected in the other one. The reason for choosing the second control group in the study and the reason for choosing it from a different school was the possibility of the John Henry effect (Heinich, 1970; Saretsky, 1972, cited in Kocakaya, 2012), defined as the subconscious competition of the control group in the same school as the experimental group or of the teacher conducting the application in this control group.

Data Collection Tools

In the research, the Problem-Solving Skills Test and Science Attitude Scale were used as data collection tools. Detailed information about data collection tools were given below.

Problem-Solving Skills Test

In this study, the Problem-Solving Skills Test developed by researchers was used as a data collection tool. In the process of developing the Problem-Solving Skills Test, the relevant literature was first examined. In this context, tests, scales and surveys related to problem solving skills were analysed. In line with the examinations, four problem situations (scenarios) related to the systems unit in our body where authentic learning practices are realised, were created. Problem-solving stages were written under each scenario to measure problem-solving skills. Subsequently, for the validity studies of the test, in terms of the suitability of problem situations and questions for objectives, the opinions of four curriculum and instruction field experts and two science field experts and four science teachers were gathered, and two Turkish teachers were utilised to assess the appropriateness of the language level to the target audience.

For the reliability studies of the test, pilot application was carried out for 15 sixth-grade students who had been taught the related unit before. After the practice, these students' remarks and opinions about the test were noted. In the evaluation of the students' responses for the problem-solving skills test finalised with the necessary corrections in line with the feedbacks, the graded scoring levels developed by Aşiroğlu (2014) and adapted by the researchers were regarded as criteria. By considering the stages of problem-solving, the scoring key was classified as: (i) defining the problem, (ii) collecting data about the problem, (iii) proposing appropriate solutions to the problem, (iv) evaluating the possible solutions and (v) explaining the solutions. After the pilot application, the student responses were evaluated by two separate raters. The proximity of the scores given by different raters provides reliable and consistent scoring; the difference between the scores indicates an unreliable inconsistent scoring (Kutlu, Doğan & Karakaya, 2010). In this regard, Spearman-Rho analysis results were evaluated to determine for inter-rater reliability, and it was determined as 0.71. Therefore, it could be argued that there is a consistency between the raters in this study.

Science Attitude Scale

In this study, the Science Attitude Scale developed by Akınoğlu (2001) to determine target audience attitudes towards science courses was used. The scale is a Likert type and consists of 20 items, 10 positive and 10 negative ones. Each item includes five options in which students can express their opinions as "I fully agree", "I agree", "I am undecided", "I do not agree" and "I do not agree at all". The scale is one-dimensional, and its reliability coefficient (Cronbach Alpha) was determined as 0.89 (Akınoğlu, 2001).

Data Collection and Analysis

The science attitude scale has been applied to both experimental and control groups as a pre-test and post-test before and after the experimental procedure and the data were analyzed in SPSS 24 (Statistical Package for Social Sciences). In the same way, the problem-solving skills test was applied to the experimental and control groups as a pre-test before the experimental application and post-test after the experimental application. The data obtained from the problem-solving skills test were scored by two raters. To determine the level of agreement between the two raters, the Pearson Product Moment Correlation Coefficient was examined, and it was determined that there was a 0.89 agreement between the two raters. Then, the scores given by both raters were transferred to the SPSS 24 package program, averaged and analyses were performed on these average scores. To determine whether students' problem-solving skills tests and science attitude scale pre-test and post-test scores demonstrated normal distribution, skewness, kurtosis values, and distribution graphs were examined. These values are presented in Table 1.

Table 1: Problem-Solving Skills and Science Attitude Scale pre-test and post-test normality analysis results

Investigated Variable	Test	Skewness	Kurtosis
Problem-Solving Skills	Pre-test	.219	-.255
	Post-test	.365	.470
Attitudes towards Science	Pre-test	-.511	-.282
	Post-test	-1.549	2.908

As seen in Table 1, skewness and kurtosis values related to problem-solving skills vary between -.255 and +.470. Thus, it could be argued that the data obtained from the pre-test and post-test applications of problem-solving skills demonstrate normal distribution. For this reason, parametric tests were used in the analysis of the data obtained from the problem-solving skills test. It was also found that the values related to attitude scores towards science ranged between -1.549 and 2.908. These values indicate that the attitude test towards science is not normally disturbed. Therefore, non-parametric tests were used in the analysis of post-test scores of the attitude towards science.

In line with normality analyses, for comparing of the problem-solving skills pre-test and post-test scores and the attitude towards science pre-test scores of the experimental, Control I and Control II groups, One Way ANOVA was used. The Kruskal Wallis-H Test was used to determine the difference between the groups' attitude towards science post-test scores. In order to compare the pre-test and post-test scores of the experimental group's problem-solving skills Paired Samples T Test was used, and Wilcoxon Signed Ranks Test was used to compare pre-test and post-test attitude towards science scores.

Experimental Procedure

In this study, authentic learning-based activities were designed by the researchers for the "Systems in Our Body" unit consisting of four subjects and 14 objectives to be applied in the experimental group. During the preparation process of these activities, the components of authentic learning were taken into consideration and the present literature was also utilised. The activities were presented to two experts who worked on authentic learning, three curriculum and instruction experts and two science experts. The activities were revised in line with the feedback and suggestions of these experts and they were finalised for the practices.

First, the activities were framed under the authentic cases (a scenario, a newspaper article, etc.) to enable students to establish an authentic context, which is one of the key components of authentic learning. Then, as a result of presenting these cases to students, it was ensured that the other components of authentic learning were put forward by the students. The practices included in the components of authentic learning in the activities are given below.

Within the scope of the study, cases involving real-life problems were created for each subject in the "Systems in our Body" unit. These were presented to the students in the form of a script, TV news broadcast or a news column, and students could connect with their own lives in the context of these problem situations (Authentic Context). Several tasks were assigned for these problems presented to students (Authentic Activity) and they were asked to perform these tasks in groups (Cooperation). In these tasks, regarded as authentic tasks, the students received the information they needed from the field experts, observed their performance and tried to perceive them as an apprentice (Expert Performance). Besides the information they obtained from the experts, the students took advantage of various sources (Internet, books, magazines, encyclopedias, etc.) to address the issue from different perspectives (Multiple Perspectives). All these activities were practiced in collaboration by groups.

The group members shared the information they obtained with other groups in the class and their teachers and transferred the information to their own lives (Reflection). Then, they turned the written and visual information they collected about the subjects into designs such as posters and brochures. They posted these posters and brochures on school bulletin boards to share them with a wider audience. They also shared the flyers in areas where there are more people such as hospitals, parks and shopping malls (Explicit Articulation).

During all these practices, the teacher guided the students on how to proceed and advised them when needed (One-to-One Training and Support). The fact that all the activities carried out throughout the study are based on authentic learning necessitated that the assessments be authentic, too. Indeed, a significant component of authentic learning is authentic assessment. At this stage, authentic assessment methods were applied to the students at the end of each activity. These are authentic evaluation methods such as structured grids and worksheets which measure the outcomes of the course, peer assessment, self-assessment and group self-assessment (Authentic Evaluation).

Results

Results of the Problem-Solving Skills

Table 2 demonstrates the results of One-Way ANOVA of the experimental, control-I and control-II groups' problem-solving skills pre-test scores.

Table 2: ANOVA pre-test results on the Problem-Solving Skills of Experimental, Control I and Control II Groups

Group	n	Mean	Sd		Sum of Squares	df	Mean Square	F	p
Experimental	31	30.06	5.82	Between Groups	63.461	2	31.730		
Control-I	31	32.06	6.24	Within Groups	3126.409	89	35.128	.903	.409
Control-II	30	31.33	5.68	Total	3189.870	91			

According to Table 2, there was no significant difference between the experimental, Control I and Control II groups' problem-solving skills pre-test scores ($p > .05$). This finding shows that all three groups are at similar levels in terms of problem-solving skills before starting the unit.

One-Way ANOVA was used to determine whether there was a significant difference between the experimental, Control I and Control II groups' problem-solving skills test scores and Table 3 indicates the relevant results.

Table 3: ANOVA post-test results related to Problem-Solving Skills Test of Experimental, Control I and Control II Groups

Group	n	M	Sd		Sum of Squares	df	Mean Square	F	p	Significant Difference
Experimental	31	47.41	8.57	Between Groups	596.395	2	298.198			
Control-I	31	41.87	8.76	Within Groups	5517.874	89	61.999	4.810	.010	1-2, 1-3
Control-II	30	42.21	5.88	Total	6114.269	91				

Level of significance $p < .05$ 1: Experimental Group 2: Control I 3: Control II

As seen in Table 3, there is a significant difference between experimental, Control I and Control II groups' problem-solving skills post-test scores ($p < .05$). According to the results of the Bonferroni test performed to determine the source of the difference, there is a significant difference between the experimental group ($M = 47.41$) and the Control I ($M = 41.87$) and the Control II ($M = 42.21$) groups in favor of the experimental group. This finding shows that students in the experimental group have higher problem-solving skills than the control groups as a result of authentic learning activities.

Table 4 demonstrates paired samples t-test results to determine whether there is a significant difference between the pre-test and post-test scores of the experimental group's problem-solving skills.

Table 4. Paired Samples T-Test results on the pre-test and post-test scores of the Experimental Group's problem-solving skills

Measurement	n	M	Sd	df	t	p	Cohen's d
Pre-test	31	30.06	5.82				
				30	-10.572	.000	2.37
Post-test	31	47.41	8.57				

As seen in Table 4, there is a significant difference between the pre-test and post-test scores of the experimental group's problem-solving skills ($p < .05$). Examining the average of the problem-solving skills pre-test score ($M = 30.06$) and post-test score ($M = 47.41$) of the experimental group, it is seen that the difference was in favor of the post-test. In addition, Cohen's d value was found as 2.37. This value shows that authentic learning practices have a large effect on problem solving skills.

Results on the Attitude towards Science

Table 5 highlights the results of a One-Way ANOVA of experimental, Control I and Control II groups' attitude pre-test scores towards science.

Table 5: ANOVA results of Experimental, Control I and Control II Groups' pre-test attitudes scores towards science

Group	n	Mean	Sd		Sum of Squares	df	Mean Square	F	p
Experimental	31	86.32	7.73	Between Groups	68.799	2	34.399		
Control-I	31	84.64	7.83	Within Groups	6113.071	89	68.686	.501	.608
Control-II	30	86.60	9.23	Total	6181.870	91			

Level of significance $p < .05$ 1: Experimental Group 2: Control I 3: Control II

As Table 5 shows, there was no significant difference between the pre-test scores of attitude scale of experimental, Control I and Control II groups ($p > .05$). According to this finding, it can be said that all three groups have a similar attitude towards science courses before application.

Table 6 indicates the results of the Kruskal Wallis-H test used to determine whether there was a significant difference between experimental, Control I and Control II groups' post-test attitude scores towards science.

Table 6: Kruskal Wallis-H Test Results of the Experimental, Control I and Control II Groups' post-test attitudes scores towards science

Groups	n	Mean rank	df	X^2	p	Significant difference
Experimental	31	63.90				
Control-I	31	47.84	2	29.13	.000	1-2, 1-3, 2-3
Control-II	30	27.13				

Level of significance $p < .05$ 1: Experimental Group 2: Control I 3: Control II

As seen in Table 6, there is a significant difference between the pre-test scores of the attitude toward science scale of experimental, Control I and Control II groups ($p < .05$). A non-parametric multiple comparison test was performed to determine the source of the difference. According to test results, in terms of attitude towards science, a significant difference was found between the experimental group and control groups in favor of the experimental group. In addition, it was determined that there was a significant difference between the Control I and Control II groups in favor of the Control I group.

Table 7 highlights the results of the Wilcoxon Signed Ranks Test applied to determine whether there is a significant difference between the pre-test and post-test scores of the attitude towards science of the experimental group.

Table 7: Wilcoxon test results of Experimental Group's pre-test and post-test scores on attitudes towards science

Test	n	Post-test/ Pre-test	Mean Rank	Rank sum	z	p	Cohen's d
Science		Negative rank	5	23.00			
				412.00			
Attitude	31	Positive rank	24		4.20*	.000	0.14
Scale		Equal	2				

Level of significance $p < .05$ *Based-on negative ranks

As seen in Table 7, there is a significant difference between the pre-test and post-test scores of the attitude towards science of the experimental group ($p < .05$). When the average and sum of the different points are taken into consideration, it is seen that this difference is in favour of positive rankings, in other words, the final test score. Cohen's d value calculated to determine the effect level was found as 0.14. This value shows that authentic learning has a small effect on attitude towards science courses.

Conclusion

Conclusion and Discussion on Problem Solving Skills

Problem solving skills, which were emphasised in the definitions of authentic learning, has been determined as an important variable to be measured in this study. In the study, there was no significant difference found between the problem-solving skills pre-test results of the groups. When looking at the problem-solving skills post-test results, it was seen that the experimental group had higher scores than the Control I and Control II groups. This result shows that, as a result of the application of the authentic learning approach the students in the experimental group where the activities based on authentic learning practices are applied in terms of problem-solving abilities displayed better performance than the students in the control groups where the current program was applied. Considering that groups had similar problem-solving skills as seen in pre-test results, it could be argued that authentic learning improves problem-solving abilities more than the current formal curriculum. In the same way, Pullu (2019), in his study examining the effect of authentic task-oriented practices in programming teaching, noted that the problem-solving skills of the experimental group was higher than that of the control group. Hamurcu (2016) concluded that authentic learning practices in the seventh-grade Turkish course increased the problem-solving skills of the students in the experimental group. In the study carried out by Koçyiğit and Zembat (2013), it was found that the curriculum prepared in accordance with authentic tasks, made a positive and meaningful difference in the prospective teachers' perceptions on problem-solving abilities.

When the pre-test and post-test scores of the experimental group's problem-solving abilities were compared, it was determined that the post-test scores were significantly higher than the pre-test scores. In other words, the authentic learning practices had a large and positive effect on students' problem-solving abilities. This result gained in the research is consistent with the results of various studies in the related literature. Hamurcu (2016) concluded that authentic learning practices in the seventh-grade Turkish course increased the problem-solving abilities of the students. Aydın-Aşk (2016), in her study, concluded that authentic task-oriented learning processes revealed that students' motivation and self-confidence levels increased in the problem-solving phases. Moreover, Lee and Goh (2012), in their research, revealed that authentic learning experiences allow the solving of real-life problems. It is emphasised in various studies (Hamurcu, 2016; Koçyiğit, 2011; Loyens, Rikers & Schmidt, 2009; Pullu, 2019; Risko, Osterman & Schusster, 2002; Rule et al, 2007) that authentic learning activities are directed towards real-life problems and contribute to problem solving skills. It can be said that this result, which is also supported by related research, proves that real-life cases and authentic learning practices applied in a science course are an indication that students improve their problem-solving skills.

Conclusion and Discussion on the Attitudes toward Science

Considering that students' attitudes towards their course / program are effective in reaching the objectives of that course the attitude was another variable dealt with in this study. As a result of the research, a significant difference was found between post-test scores attitude towards science of the experimental and control groups in favor of the experimental group. In other words, as a result of authentic learning practices, the experimental group developed a more positive attitude towards science than the control group. Considering that the groups have similar pre-test scores, it could be said that the authentic learning practices applied in the experimental group are more effective in developing positive attitudes towards the course compared to the current formal curriculum applied in the control groups. Similarly, it has been revealed in various studies (Baştürk, 2019; Horzum & Bektaş, 2012; İneç, 2017; Karabulut, 2018; Koçyiğit, 2011) that authentic learning practices are more effective in developing positive attitudes towards the course compared to current curricula. When the attitude post-test scores of the control groups were compared, it was found that the Control I group had a significantly more positive attitude than the Control II group. Whereas the experimental group's having a more positive attitude than the control groups is associated with authentic learning practices, the fact that Control I group had a more positive attitude than the Control II group could be related to the John Henry Effect.

When the pre-test and post-test attitude towards the science course scores of the experimental group were compared, it was seen that the post-test scores were significantly higher. This result shows that authentic learning practices are effective in students' positive attitude towards the course. Besides, this result is in line with the results of various studies (Dadlı, 2017; Gündoğan, 2017; Güner, 2016; Hamurcu, 2016; Horzum & Bektaş, 2012; Hürsen, 2016; İneç, 2017) in the literature. Belaid and Murray (2015) have concluded that the use of authentic materials in teaching English improved teachers' attitudes towards their course. Lee and Goh (2012) concluded that authentic learning used in the starting primary school was effective in developing positive attitudes towards the school. In the research in the context of an authentic learning approach, Dabbaqh and Blijd (2010) concluded that students' perception of learning experiences was positive. As can be seen, the result of the study showing that authentic learning has a positive effect on attitude coincides with the results of the studies mentioned above. These results show that authentic learning practices contribute to the students' affective domain and develop more positive feelings towards their course. Despite the conclusion that authentic learning positively affects attitude, Gençoğlan (2017) concluded that authentic learning does not affect attitude. Similarly, Williams (1999) has also concluded that authentic learning did not make a significant difference in students' attitudes towards their course. Therefore, it could be claimed that the result of the current study is not consistent with the results of these two studies.

This research is limited to the "Systems in Our Body" unit included in the sixth-grade science curriculum. It can be suggested that similar applications be carried out in different units of a science course at different grade levels and in different courses. This study focused on the effect of authentic learning practices on problem solving and attitude towards science. Determining the effect of authentic learning on different variables (motivation, self-confidence, etc.) other than these variables will make important contributions to the literature.

In the experimental study that was performed and whose effectiveness was determined, it was seen that the education given to the teacher before the application of the authentic learning approach had a critical function. Therefore, in order for the authentic learning approach whose effectiveness has been demonstrated to be applied in schools, teacher training must be provided. In this context, it would be beneficial to carry out applied in-service training activities for teachers who are on duty. In addition, it would be beneficial to provide pre-service teacher candidates with training about the authentic learning approach.

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