How Portfolio Use Affects Students' Learning and Their Attitudes toward 6th Grade Science Lesson

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Abstract

The study examined that whether process of portfolio use enhances students' learning in 6th grade science lesson and whether portfolio use effects attitudes of the students toward the science subject. At the research, pretest-posttest control group design was applied to 114 6th grade students during 2006 in a southern city of Turkey. The experimental group attended science lessons supported with portfolio use as a teaching approach whereas no change was made in the way of teaching of the control group. An achievement test and attitude scales of science were applied to the both groups as pre- and post-tests. The experimental group demonstrated higher achievement and better attitude toward the science lesson than the control group demonstrated. The students in experimental group commented that portfolios made their learning meaningful and helped them to learn better.

Key Words: Portfolio, achievement, attitude, learning, science teaching

Introduction

Socio-cultural, economic, and technological changes, new developments and inventions on the science, and especially democratic thoughts and developments on the human rights lead to increase in educational expectations. They also force the education to be changed for the benefit of individuals by pressuring on the traditional education. In recent years, one of the authentic, or as some calls alternative, assessment techniques consistent with the philosophy of the social constructivist and cognitive learning theory is the portfolio assessment. Portfolio assessment is started to be used commonly in the education area and used for the performance assessment of an individual and group in the process of student learning (Birgin 2003; Kaptan & Korkmaz, 2000; Kush, 1994; Norman, 1998).

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Nowadays, portfolio application which tries to assess the ability of students and which is an alternative assessment application is regarded also as the most important teaching and assessment application, as well (Glasgow, 1997; Korkmaz & Kaptan, 2005; Stinggins, 1994; Sweet, 1993). Portfolio is used in the educational area as both teaching material and as a means of assessment. Portfolios include collecting samples from the students' works and reflecting them. Portfolios both guide learner and present suitable possibilities for realistic assessment. If they are organized carefully, they create an agreement in terms of assessment and learning (Korkmaz & Kaptan, 2005).

It can be said that portfolio is a supporter for the new teaching approach emphasizing the role of a student in constructive learning and the role of a teacher in increase of comprehension. For instance, while writing instructions, portfolio can be used to show the order of works, objectives, and written materials by students. In addition, portfolios can be a record of the activities completed during a certain time. Also, they can be used to share and comment on one another's works so they support collaborative working (Sweet, 1993). Collins (1991) emphasizes that portfolio is centered on students so it allows the students to reveal their individual efforts, developments, and successes in one or more learning periods. According to Paulson, Paulson, and Meyer (1991) portfolio is a target collection of student's working which exhibits student's attempts, developments, and successes in one or more areas. The collection should include evidence of parts in chosen content for students, the criteria for choosing and judging, and student's self-reflection.

According to Wiggins (1993), if a written exam is a photograph of what have been learned in a certain period, portfolio can be assumed as a photograph album which exhibits the change and the development in time. Portfolios can improve the series of abilities and process of assessment by revealing student's parts of works. Also, can support educational goals, show development and changes in time, can support the reflection of student, teacher and family, and provide continuity of the education year by year (Korkmaz & Kaptan, 2005).

By taking into consideration the definitions made by the researchers; portfolio is known to be used both as a teaching approach and as a means of assessment in education and

teaching period. In a study, Grenchik, O'Connor, and Postelli (1999) emphasized that arranging learning environment or activities to meet the students' needs helps students to increase their motivation level toward learning. In their study, portfolios were used as one of the tool to provide adequate learning environment for students and to assess student responsibility and motivation for learning. Portfolio can be seen as one way of arranging suitable learning environment for students.

How portfolio assessment or use effect students' learning is a significant question to be answered. Biggs (1999) indicated that portfolios, as a form of assessment, are capable of increasing students' learning. It has been emphasized that what students learn and how they learn is very much depends on what they think they will be assessed on (Biggs, 1999; Tiwari & Tang, 2003). If students think that they will be assessed on low order cognitive skills then they learn those skills, if they think they will be assessed on higher order cognitive skills then they learn those skills and they feel that they need to have better understanding of the subjects. In seeking effects of portfolios on students' learning, Tiwari and Tang (2003) found that process of preparing portfolios lead students to positive academic and effective outcomes for nursing students. The students reported that they gained much better understanding, they learned deeply and meaningfully, conceptualized high cognitive level, and could apply what they learn to their professional practice.

Attitude is another significant factor associated with academic achievement. With positive attitude toward any school subject, it is easier for students to obtain better achievement at school. In a study, Lee, Yeh, Kung, and Hsu (2007) found that attitude is one of the factors affecting students' examination scores. Considering how students feel about portfolio use, Janssens, Boes, and Wante (2002), Slater (1996), and Tiwari and Tang (2003) reported that students tend to like portfolio assessment and they think that portfolio is beneficial for their learning outcomes. Similarly, in a study of Ucak and Kose (2009), pre-service teachers indicated that portfolio use affected their science learning outcomes positively. They also believed that portfolio use reflects their progress more efficiently and made them to be more organized in the science class.

Portfolio use in Turkey has not been common until recent years although many countries have used portfolios in their schools as a teaching approach and assessment tool for years. Portfolio has gained importance to reach universal standards in Turkey's educational system to present qualified teaching. This research is the first in our country's educational literature in terms of the application of portfolio in the science lesson as a teaching approach.

Purpose of the study

In this study, portfolio is considered as a teaching approach. In that aspect, the study aims to find out effects of portfolio application and preparation process on science achievement and attitudes towards science in primary schools. The following research questions were addressed throughout the study:

1. Does portfolio use affect science achievement scores of the students?

2. Does portfolio use affect science attitude scores of the students?

Method

Sample

Participants were 114 sixth grade students from 4 public schools in a southern city of Turkey during 2006. The schools were chosen on the criterion of socio-economical status and their willingness for participation. That is schools with different socio-economical status were represented in the sample. From the schools, 7 classes with equal science pre-knowledge level were chosen for the study.   Schools were randomly assigned to the experimental and control groups (n=57 for each group). Three classes from two schools were assigned to the control group and 4 classes from the other two schools, were assigned to the experimental group. There were 32 (% 56) girls versus 25 (% 44) boys in the experimental group and 35 (% 61) girls versus 22 (% 39) boys in the control group.

Research Design

In the study, pretest - posttest control group design was applied. A science achievement test and a science attitude scale were applied to the experimental and control groups at the beginning and at the end of the study.

At the beginning of the study, for defining study groups, an achievement test developed by the researchers was applied to the 4 primary schools. Based on the test scores, 7 classes with equal science pre-knowledge level were chosen for the study. The classes were randomly assigned to the experimental and control groups.

The experimental group attended to the science lesson supported with portfolio use as a teaching method with the guidance of their teachers and one of the researchers. Although all the participants were guided by the same researcher, they had different teachers. This can be treated as a limitation of the study.

At the beginning of the semester, students in the experimental group were instructed about how to prepare portfolios and what kinds of works they can include in their portfolios, such as dairies, poems, experiments, observations, essays etc. regarding the science subjects. It was also discussed with the students that what other works they wanted to do in the class. The students had chances to complete individual works and group works, as well. Also, a handbook regarding portfolio preparation was distributed to the students. The students received guiding from their teachers for preparing portfolios through out the semester. The teachers were experienced before regarding portfolio use.

No change was made in the way of teaching of the control group, that is, they went on with the regular teaching processes (question and answer, problem solving, experiment, observation, etc.) and did not receive portfolio use as a teaching or assessment method.

During the science lessons, the teachers carried the teaching activities and they were accompanied by the same researcher to make sure that the teaching process and activities were go on as planed and to help the teachers in both groups.

Instruments

Two instruments were applied at the study: The science achievement test and The Science Attitude Scale.

The science achievement test. In order to assess the 6th grade students' science pre- and post- test achievements, a science achievement test was developed by the researchers. Before developing the test, target behaviors of the 6th grade science lesson was defined in accordance with the curriculum determined by the Ministry of Education for the 2nd semester of 2005-2006 academic year.

Total of 27 multiple-choice items were developed with the guidance of 5 science textbooks and 2 different guidebooks which were published by the Ministry of Education. The achievement test was reviewed by 5 science teachers in terms of content validity and level of the questions. Then, the test was prepared for the application. Based on the Bloom's Taxonomy, 8 questions were at knowledge level, 9 were at comprehension level, 7 were at application level, and 3 were at analysis level. For the pilot study, the test was applied to 62 7th grade students who were selected from two different primary schools. Based on item and test analysis and students' comments, some items were revised. All the items were included in the revised version of the test. Item difficulty indices were ranging between .32 to .85 values. For the study, Kuder-Richardson reliability coefficient of internal consistency was found as .85.

As examples, question 9 and 27 are presented in below:

9.
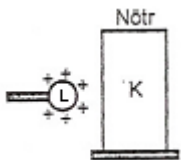
Which of the following can be K's charge distribution when neutral K object approximates to L sphere like in the figure?

27. What would happen if the distance of our World to the Sun were <u>longer</u>?

    A. Glaciers would melt.

    B. Water would freeze.

    C. The World would crash into the Sun.

    D. Speed of the World would increase.

    The science attitude scale. The Science Attitude Scale developed by Akçay, Tüysüz, and Feyzioğlu (2003) was applied to determine the students' attitude and interest for the science lesson. The attitude scale is consisted of 20 items and it is 5 scales Likert type instrument. Out of 20, 11 items were positive statements and 9 were negative statements. The minimum score one can get from the scale is 20 and the maximum is 100. The instrument is a single factor scale and factor loadings of the items were ranging from .47 to .67 (Akçay et al., 2003). The Cronbach alpha reliability coefficient of the instrument was reported to be .89 by Akçay et al. (2003).

In the present study, Cronbach Alpha coefficient was found to be .57 for the pre-test application and .54 for the post-test application.

Data Collection procedure

After defining the study groups, permission for conducting the study at the selected schools was obtained from the Ministry of National Education. Then, permissions from the schools' administer and teachers were obtained. At the beginning of the semester, the Science Achievement Test and the Science Attitude Scale were applied to the experimental and control groups. Then, the experimental and control groups went on the planed educational processes. At the end of the semester, both instruments were re-applied to the groups.

Data Analysis

For the analysis, split-plot ANOVA (2X2) design was applied; experimental design with two factors. One factor was the groups and the other was the pre- and post-test scores as a repeated measure. The data was analyzed by using SPSS 11 statistic program.

Findings

Before answering the first research question, mean and standard deviation of the science achievement test scores for the control and experimental groups were presented in Table 1.

Table 1. Descriptive statistics for the science achievement scores

Groups	Pre-test			Post-test		
	N	Mean	Sd	N	Mean	Sd
Experimental	57	9.84	2.21	57	16.58	3.74
Control	57	9.93	2.92	57	14.46	4.04
Total	114	9.89	2.58	114	15.52	4.02

As the table indicates, the control group increased their mean achievement score from 9.93 to 14.46. The experimental group also increased their achievement scores from 9.84 to 16.58, after being exposed to portfolio preparation process during the science lesson.

For testing whether pre- and post-test science achievement score differences change based on treatment groups, split-plot two-factor ANOVA was performed. Before the test, assumptions of the ANOVA were tested. Homogeneity of variances was tested for the achievement scores. Levene's test indicated equality of variance for the groups (Levene:3.33, $p > .05$ for pretest, Levene: .002, $p > .05$ for posttest). Distribution of the achievement scores of the control and the experimental groups met the normality assumption, Kolmagorov-Smirnov test was insignificant ($p > .05$), as well. Table 2 presents the results of the two-factor ANOVA.

Table 2. Science achievement score differences of the control and experimental groups: ANOVA results

Source	Sum of Squares	df	Mean Square	F	Sig.	P. Eta Square
Between Subjects	1593.72	113				
Groups (Exp./ Cont.)	59.02	1	59.02	4.31	.040	.037
Error	1534.70	112	13.70			
Within Subjects	2788.00	114				
Measures (Pre./ Post.)	1807.74	1	1807.74	222.34	.000	.665
Group*measures	69.63	1	69.63	8.56	.004	.071
Error	910.63	112	8.13			

Table 2 indicates a significant interaction effect between the treatments students had received and the repeated test scores [$F(1, 112) = 8.56$, $p < .01$]. Students demonstrated different progress from pretest to post test based on whether they were in the control group or in the experimental group. The students in the experiment group increased their scores significantly compare to the students in the control group. Portfolio application and preparation process appeared to lead the students to better learning.

In terms of the Partial Eta-Square value ($h_P^{2)}$), the interaction between the treatments students had received and the repeated science achievement test accounted for 7.1 % of the total variability in the science achievement score.

As for the attitude scores, Table 3 presents mean and standard deviation of the science attitude scores for the control and the experimental groups. Control group received all most the same mean attitude score on pre-test (77.09) and post test (77.07). However mean attitude score of the experimental group was increased from 76.76 to 88.63 after experiencing portfolio preperation prosess during the science class.

Table 3. Descriptive statistics for the science attitude scores

Groups	Pre-test			Post-test		
	N	Mean	Sd	N	Mean	Sd
Experimental	57	76.76	12.50	57	88.63	10.35
Control	57	77.09	12.40	57	77.07	13.19
Total	114	76.92	12.40	114	82.85	13.15

Similarly, to test whether pre- and post-test science attitude score differences change based on the treatment groups; split-plot two-factor ANOVA was performed. Again before the test, assumptions of the ANOVA were tested. Levene's test indicated equality of variance for the attitude scores of the groups (Levene: .051, $p > .05$ for pretest, Levene: .3.42, $p > .05$ for posttest). Distribution of the attitude scores for the groups met the normality assumption for pre-attitude scores, Kolmagorov-Smirnov test was insignificant ($p > .05$). Although post-attitude scores were violating normality assumption, it was at tolerable level with equal n's in both groups. The results of the two- factor ANOVA was presented on Table 4.

Table 4. Science attitude score differences of the control and experimental groups: ANOVA results

Source	Sum of Squares	df	Mean Square	F	Sig.	P. Eta Square
Between Subjects	17004.04	113				
Groups (Exp./ Cont.)	1796.49	1	1796.49	13.23	.000	.106
Error	15207.54	112	135.78			
Within Subjects	21917	114				
Measures (Pre./ Post.)	2004.28	1	2004.28	12.54	.001	.101
Group*measures	2016.16	1	2016.16	12.62	.001	.101
Error	17896.56	112	159.79			

The results revealed a significant interaction effect between the treatments students had received and the repeated attitude scale [$F(1, 112) = 12.62$, $p < .01$]. Being in the experimental or in the control group affected attitude score increases of the students.

Attitude scores of the students in the experimental group were increased significantly from pre-test to post test. Portfolio application, preparation process increased attitude scores of the students toward the science subject. Considering the partial Eta-Square value ($h_P^{2)}$, the interaction between the treatments students had received and the repeated attitude scale accounted for 10.1% of the total variability in the science attitude score.

Portfolio use seemed to help the students to enjoy the science subjects even more.

Results and Discussion

The findings suggest that portfolio use as a teaching technique helps students to improve science achievement levels. After completing one-semester long educational period, the students in the experimental group become more successful than the students in the control group. Experimental group increased their achievement score by 8.32 points whereas control group increased by 6.21 points from pre- test to post- test. This result is consistent with previous researches (Biggs, 1999; Collins, 1991; Tiwari & Tang, 2003; Ucan & Kose, 2009). In their study Tiwari and Tang (2003) emphasize that portfolio preparation process leads to better achievement and learning. In the present study, the experimental group had opportunity to use all kind of educational strategies, methods, and techniques which are up to the imagination of the students during preparation of the portfolios. In Tiwari & Tang (2003) study, it was emphasized that process of preparing portfolios yield "positive academic and affective outcomes" (p.269).

Besides, supplement of the expressive learning that are useful for education brings a very high alternative for the students. During the application, freedom of the students for performing the task they wanted and teacher's guidance of students in accordance with the task they were performing were able students to become more active for studying

towards their own intelligence and interest areas. Thus, students made successful products in the style they choose and related them to their daily life, and they study more effectively.

Students in the experimental group commented that they learned the lesson more effectively and visualized the works of themselves and their friends. Also, they learned the lesson better with the activities they could do. As a result of these, the overall achievement level of the students who received the lesson with portfolio use as a way of learning found the lesson more meaningful and obtained higher achievement than the students in control group. Earlier studies indicated the similar findings reporting that students found portfolios as beneficial for their learning outcomes (Janssens, Boes, & Wante, 2002; Slater, 1996; Tiwari & Tang, 2003; Ucan & Kose, 2009).

Students in the experimental group, had chance to observe the events more carefully and explain their observations in their studies. At the end of the semester, students in experimental group exhibited their works to their friends, teachers, and parents (Appendix 1).

Students in the control group studied their lessons with fewer techniques and teachers' interferences were higher. This situation may lead the students to have lower motivation and enthusiasm for the lesson, attending the class in more limited format, and not having much chance to find examples by themselves that were related with their daily lives. These might affected their success negatively compared to the students in the experimental group.

In terms of the attitude, at the beginning of the study, both groups had similar attitudes toward the science class. However at the end of the study, experimental group displayed more positive attitude toward the lesson. Again literature points to the similar results; that is, students tend to have positive thoughts regarding portfolio use (Janssens, Boes, & Wante, 2002; Slater, 1996; Tiwari & Tang, 2003; Ucan & Kose, 2009) and such experiment motivates students more toward the class which leads to better achievement.

Portfolio use seemed to be an effective way of improving students' attitude for the science subject. Similarly, in earlier study, Grenchik, O'Connor, and Postelli (1999) indicated that arranging learning environment or activities that meet the students' needs helps students to increase their motivation for learning the subjects. In the present study, portfolio was a way of creating learning environment and situation for the students that meets their needs and lead them to learn and enjoy the lesson more. The students in experimental group commented that they enjoyed their studies and these studies made them like the lesson. Due to the different activities, students could relate their studies to daily lives and made successful studies by using their best intelligence and interest areas to understand the subject in better and positive environmental input that improves their self confidence.

Teachers of the experimental group guided students in their studies, set students into action to create more original and enjoyable products by using brain-storming and this made students more active and productive during portfolio preparation process. During their studies, students were free to produce products based on their talents and interests. Also, it can be said that group work, as part of producing portfolio materials, increased their cooperative success perception and thus increased their willingness that leads to better success. Johnson and Johnson (1999) also reported that group work lead students to higher achievement.

As a result of the study, portfolio application and preparation process as a way of teaching is strongly suggested in science program at primary schools.

For future studies, effects of portfolio use in different subject areas and for different age groups should be investigated to further verify the previous findings and enhance the applications.

Also, for increasing validity of the outcomes, a third group as a placebo group can be added to similar studies to justify how much of the founded effect of portfolio is attributable to portfolio use other than the group study, brain-storming, etc. activities that being used during portfolio preparation process.

Moreover, similar studies can be repeated with a same teacher instruct ring all the groups to totally remove variation might have been caused from any teacher application differences.

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Appendix 1.

Pictures from the Portfolio Exhibition of the Experimental Group