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THE EFFECT OF EDUCATION INFORMATION NETWORK (EBA) AND EXPERIMENTAL-BASED ACTIVITIES ON 7TH GRADE STUDENTS' SCIENCE ATTITUDE AND THEIR VIEWS ABOUT THESE ACTIVITIES IN THE ELECTRICAL CIRCUITS UNIT

(Research article)

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THE EFFECT OF EDUCATION INFORMATION NETWORK (EBA) AND EXPERIMENTAL-BASED ACTIVITIES ON 7TH GRADE STUDENTS' SCIENCE ATTITUDE AND THEIR VIEWS ABOUT THESE ACTIVITIES IN THE ELECTRICAL CIRCUITS UNIT

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Abstract

The aim of this study is to investigate the effectiveness of the Education Information Network (EBA) and experimental supported activities on students' science attitude and 7th grade students' views about these activities in the teaching of the electrical circuits unit. The research was carried out with 73 students studying at a state secondary school in the Daday district of Kastamonu Province, Turkey. Two experimental groups and one control group were randomly selected from this school. While the courses of the experimental-1 group were taught with the EBA supported activities, the experimental-2 group were taught with the EBA and experimental activities, the courses of the control group were taught in compliance with the 2018 Science Curriculum. In research, quantitative data were collected with the Science Course Attitude Scale (SCAS) and qualitative data were collected with the Semi-Structured Interview Form (SSIF). As a result of this study, while there was no significant difference between the experimental-1 group and the control group, it was observed that there is a significant difference between experimental-2 group and control group, and experimental-2 group and experimental-1 group. In other words, EBA and experimental-supported teaching improved positively students' attitudes towards the science course. The data obtained from SSIF applied only to six students from the experimental-2 group support this result. Based on the results of the study, science teachers are recommended to do experimental with EBA in their courses.

Keywords: EBA, electrical circuits, experimental, interview form, science attitude

1. Introduction

Developments in science and technology have affected education as in other fields, and countries have entered the race to make a breakthrough with education (Benek & Kocakaya, 2012). Education is enriched day by day with both technology and new teaching methods and techniques. With the development of technology, education takes a different dimension. Because the support of teaching activities with tools and materials increases with technology. As in all countries, interest in using technology in education has increased in Turkey.

The State Planning Organization prepared a report for the years 2006-2010, and the FATIH project was initiated by the Ministry of National Education (MoNE) to ensure that students and teachers use technology actively. The purpose of FATIH project is to provide equal opportunity in education and training. At the same time, it is to use information technology products more effectively in courses in order for each student to have the best education in the learning and teaching process by addressing more than one sense organ (URL-1). The FATIH Project is the largest educational movement in the world that has been put into practice and used in education.

Thanks to the secure internet project, a secure and limited internet infrastructure has been established. In this way, all classes are equipped with information technology. In order to equip all classes with technology and increase the use of technology in education, e-content has been prepared in accordance with the curriculum in all branches. E-contents; it is equipped with rich content such as audio, video and animation. All teachers were taken to in-service training and were informed about the project. All students are expected to use the application in accordance with their interests, development levels and grade levels through the system. In short, FATIH Project aims to increase the success of students in courses, but also aims to develop students' interests and abilities by providing various opportunities (Ince, 2018).

Many methods and techniques are used in science teaching. In order for students to benefit most effectively in science courses, learning environments should appeal to too many sensory organs and too many mental functions. In other words, students cannot get enough science education just by reading or seeing (watching) (Dewaters & Powers, 2006). In order to meet the needs for new content in the Ministry of National Education, a sub-project called Education Information Network (EBA) has been prepared with the FATIH Project (Gucukoglu, Ceylan & Dursun, 2013).

EBA offers reliable, accurate and rich content for all grade levels and all courses. EBA is an educational platform organized for everyone to benefit. Therefore, students, teachers and parents can also log in. The main purpose of EBA, whose users and shares are increasing, is to contribute to the courses by providing effective material and rich content to everyone, wherever they are needed. EBA is a widely used education platform in Turkey during the pandemic process.

As can be seen from the researches in the literature (Aydogan, 2014; Kaur & Hussein, 2015), in addition to the positive aspects of using EBA in education, it is also encountered with a few negative aspects. Generally, technical difficulties are mentioned as a negative aspect. This makes learning difficult. Again, as can be understood from the researches, students sometimes cannot understand the subjects while teaching with EBA. In these cases, students can learn concepts or subjects that they cannot understand by doing experiments in the laboratory. For science teaching, laboratories are places where activities are carried out with special equipment. The study areas or the classroom where scientific applications, that is, demonstrations and experiments, are taught to the student through experience, and where there are special tools and equipment according to the purpose, is called a laboratory (Karsli, Sahin, Aygun & Cavus-Gungoren, 2015).

Experiments make it easier to understand the subjects of the science course. Because students learn more meaningfully, permanently and effectively as they do activities based on learning by doing with the experiments they have done in the laboratory environment. Therefore, they participate in the course more effectively and can relate what they learn to daily life. The students had a positive attitude towards science and they stated that the students liked and were more interested in the experimental activities (Bahar, Aydin, Polat & Bertiz, 2008; Cepni & Ayvaci, 2006; Hofstein & Lunetta,1982; Kibirige & Hodi, 2013; Wellington, 1998).

1.1. The Aim of the Study

There are separate studies on EBA and experiments in the literature. However, no research was found in which the two were used together. In this study, both EBA and experimental supported teaching were used and it was aimed to examine the change in students' attitudes towards science course and their views about this teaching process. Within the scope of this study, the following research questions were tried to be responded:

1. Is there a significant difference between the pre-test and post-test mean attitude scores of the control group students towards the science course?
2. Is there a significant difference between the pre-test and post-test mean attitude scores of the experimental-1 group students towards science course?
3. Is there a significant difference between the pre-test and post-test mean attitude scores of the experimental-2 group students towards science course?
4. Is there a significant difference between control, experimental-1 and experiment-2 group students' post-test mean attitude scores towards science course?
5. What are the views of the students in the Experimental-2 group about the application?

2. Methods

2.1. Model of the Study

In this study, a mixed research design in which quantitative and qualitative research methods are used together was preferred. Onwuegbuzie & Leech (2004) stated in their study that the purpose of the mixed research design is to broaden a person's understanding of the event rather than validating or supporting an idea in many cases. In this research design, quantitative data are collected as the first step and then qualitative data are collected to detail and explain these collected quantitative data as the second step (Cresswell, 2008). In the study, a quasi-experimental model with pre-test post-test control group was used to examine the effect of EBA and experimental-based activities used in teaching the 7th grade electrical circuits unit on students' attitudes towards science course. The experimental model of the research is provided in Table 1.

Table 1. *Experimental design of the study*

Group	Pre-test	Process	Post-test
Control	SCAS	*Teaching the Subjects in Electrical Circuits Unit in Accordance with 2018 Science Curriculum*	SCAS
Experimental-1	SCAS	*Teaching the Subjects in Electrical Circuits Unit in Accordance with the EBA Activities*	SCAS
Experimental-2	SCAS	*Teaching the Subjects in Electrical Circuits Unit in Accordance with the EBA and Experimental-Based Activities*	SCAS and SSIF

According to Table 1, SCAS was applied to all three groups as pre-test and post-test. SSIF was applied only to the experimental-2 group to get their views about the post-application activities.

2.2. Study Group

The research was carried out with 73 students studying at a state secondary school in the Daday district of Kastamonu Province in Turkey. Two experimental and one control group were randomly selected from this school. Class 7-A (N=23) was chosen as the control group, class 7-B (N=25) as the experimental-2 and class 7-C (N=25) as the experimental-1. In order to determine whether the science attitude scores of the students in all three groups are close to each other, a pre-test was performed before the application and it was checked whether there was a significant difference between the attitude scores towards the science course. Descriptive statistics of the mean SCAS pre-test scores of the control and experimental groups are provided in Table 2.

Table 2. *Descriptive statistical results of SCAS pre-test data*

Group	*N*	$\bar{X}$	*SD*
Control	23	42.13	4.45
Experimental-1	25	41.68	3.69
Experimental-2	25	43.00	4.17

According to the Table 2, The mean SCAS pre-test scores of all three groups were quite close to each other. The homogeneity of the variances of group distributions was examined with the Levene's test and because it was observed that the variances were homogeneous (p = .41> .05), one-way analysis of variance (ANOVA) was conducted to determine whether there was a statistically significant difference between the groups' SCAS pre-test mean scores (see Table 3).

Table 3. *ANOVA results of SCAS pre-test scores*

Source of variance	Sum of Squares	*DF*	Squares average	*F*	*p*
Inter group	22.47	2	11.24	.67	.52
In group	1182.05	70	16.89		
Total	1204.52	72			

p> .05

According to the Table 3, There is no statistically significant difference between the mean SCAS pre-test scores of all three groups [F(2-70) = .67; p> .05]. In other words, the science attitude mean scores of the students in all three groups at the beginning were at the same level. This result shows that the groups selected at the beginning almost close to each other.

2.3. Data Collection Tools

In the research, a mixed method including quantitative and qualitative research designs was used. The Science Course Attitude Scale (SCAS) was used as a quantitative data collection tool, and Semi-Structured Interview Form (SSIF) was used as a qualitative data collection tool.

2.3.1. Science course attitude scale

In the study, SCAS developed by Nuhoglu (2008) was used. The validity and reliability of the study conducted by Nuhoglu (2008) contains a total of 20 items. Brief introductory information about the scale are provided in Table 4.

Table 4. *Information about the SCAS (Nuhoglu, 2008)*

Data	Analysis results
Target group	*6th, 7th, and 8th grades*
Number of students	*422*
Likert type	*Triple* *(Agree, Disagree, Neutral)*
Number of items	*20 (10 positive, 10 negative)*
Structure validity (experts)	*10 primary school teacher* *6 teaching staff* *3 linguist* *3 education statistics expert*
Reliability value	*α=0.8739* *Spearman Brown two halves equal= 0.89*
KMO value	*0.8679*

Number of factors	*5* *2nd, 3rd, and 5th factors-attitudes towards science course* *1st and 4th factors-attitudes towards activities in science course*
Common variance range of attitude items after Equamax rotation	*0.16-0.75*
Factor load values range	*0.42-0.90*
Percentage of variance explained	*56*

The SCAS that its brief information is given in Table 4, was applied to control, experimental-1 and experimental-2 groups as a pre-test before the application and as a post-test after the application.

2.3.2. Semi-structured interview form

In order to support the quantitative data collected in the study, SSIF was applied to six students in the experimental-2 group in order to learn their views about EBA and experiment-supported activities. The volunteerism principle was taken into consideration for the students participating in the interviews and it was accepted that they were sincere in their answers to the questions. In the process of developing the SSIF, questions about EBA and experimental supported teaching were primarily created. While creating the questions, criteria such as, which can be easily understood by the participants, do not direct them, do not contain multiple dimensions, were taken into consideration (Yildirim & Simsek, 2018). Interview questions created in line with these criteria were presented to expert views and content validity was ensured. Considering the academic achievement post-test mean scores of the students are provided in Table 5, SSIF was applied to a total of six students, two of whom had lower-middle-upper score averages from the experimental-2 group.

Table 5. *Academic achievement post-test scores of students determined for SSIF*

Student	Achievement level	Score
U1	Upper	18
U2	Upper	16
M1	Middle	12
M2	Middle	12
L1	Lower	7
L2	Lower	6

U: *Upper achievement student*, **M:** *Middle achievement student*, **L:** *Lower achievement student*

According to Table 5, the highest score is 18. The lowest score is 6. Two students with upper achievement level are U1 and U2, middle achievement level are M1 and M2, and lower achievement level are L1 and L2.

2.4. Developing Activities Based on the EBA and Experimental

According to the 2018 Science Curriculum, the 7th grade electrical circuits unit includes one topic: "connecting the bulbs" (connecting in series, connecting in parallel, electrical current and voltage). In the unit, there are a total of 6 acquisitions. The research was planned by dividing it into four subjects. It was apparent from the subject and acquisition ranking in the curriculum that the students were expected first to discover the circuits consisting of bulbs connected in series and parallel, and then to observe abd interpret the luminosity differnces in the cases in which the bulbs were connected in series and parallel (MoNE, 2018). The subjects inculed in the unit and acquisitions per subject are provided in Table 6.

Table 6. *Number of acquisitions in the 7th grade electrical circuits unit*

Subject	Acquisition
Connecting in series, Connecting in parallel, Electrical current, Voltage	*1. Draw curciut diagram consist of light bulbs connecting in series and parallel.*
	2. Make inferences by observing the brightness of the bulbs connecting in series and parallel situations on the circuit.
	3. Define electrical current.
	4. Explain that electrical energy is transferred to circuits through current.
	5. Relates the voltage between the ends of a circuit element with the current passing through it. *a) The concept of voltage is explained through batteries* *b) The relationship between voltage, current and resistance in a conductor is explained through OHM's law. Mathematical calculations are not entered.*
	6. Design an original lighting tool. *First of all, request to express his/her design with drawing. If the conditions are suitable, it may be asked to transform it into a three-dimensional model.*

2.5. Teaching Intervention

The implementation lasted 3 weeks both for experimental and control groups. While courses were based on present 2018 Science Curriculum in the control group, they were based on the EBA and experimental supported activities in the experimental groups. In the research, the electrical circuits unit (ECU) in the 7th grade science course was selected. The reasons for choosing the unit are that it is difficult for students to understand concepts such as current, voltage, resistance, connecting in series and parallel, and that it is a suitable unit for EBA and experiment activities. The subjects in the unit were taught to all groups in the same weeks, in some order. The same timetable was obdersved in all groups. In addition, pre-test and pos-test were performed on the same day, the same week. The application lasted three weeks (12 course hours). However, more knowledge can be given to the research for a few weeks in order to provide as much knowledge as possible at the beginning and end of the study.

2.5.1. Teaching in the control group

The first author taught the control group with 2018 Science Curriculum involving lectures. The principle of teaching adopted in this class was that knowledge resides with the researcher and that it is the researcher's responsibility to transfer that knowledge as facts to students. The researcher explained the knowledge structures in following the prescribed textbook. At the end of each class, the researcher asked direct questions on important concepts. The researcher dictated notes while the students copied. The demonstration experiments were carried out on the subjects of the unit and homework assignments were given. In addition, the Electrical Circuit Unit Worksheets (ECUW) prepared by the researchers were used for the students (Appendix 4). A course plan for control group is shown in Appendix 1, Table 19.

2.5.2. Teaching in the experimental-1 group

The courses for the students in the Experimental-1 group were taught for three weeks by adhering to the current curriculum and additionally supported by EBA. The course videos in EBA for the experimental-1 group were prepared by downloading from www.eba.gov.tr. In the experimental-1 group, the contents such as videos, slides, pictures, questions about the acquisitions of the unit in the EBA course section were presented to the students with the help

of an interactive board. A course plan for experimental-1 group is shown in Appendix 2, Table 20.

2.5.2.1. First week teaching in the experimental-1 group

In the first week of the experimental-1 group, subjects named *"connecting in series and parallel bulbs"* were taught by supporting EBA in addition to the current curriculum. In the second hour of the course, EBA 1-2-3 activities were made as indicated in Table 20 (Figure 1). In the last two hours of the course, the textbook was used, the activities in the book were made and notes were given to the students where necessary. In addition, worksheets prepared by the researchers were used as in the control group. Activity-1 in the worksheets (Appendix 4) was distributed to the students and answered with the researcher.

Figure 1. EBA supported teaching in experimental-1 group

Similar procedures were performed in the second and third weeks. Some of the activities held during these weeks are given in Figure 2.

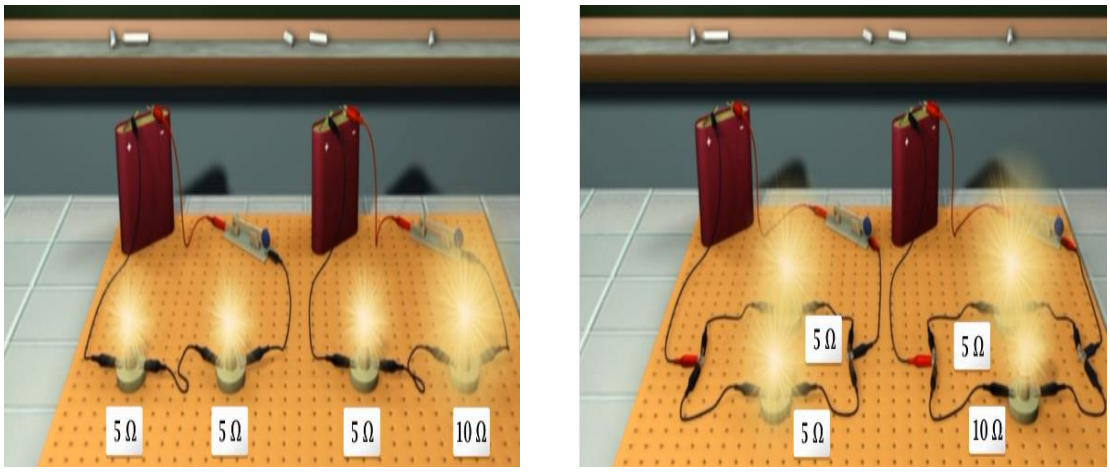


Figure 2. Brightness connecting in series and parallel bulbs

2.5.3. Teaching in the experimental-2 group

The courses were conducted simultaneously with the other two groups for three weeks. The courses for the students in the Experimental-2 group were taught by adhering to the current curriculum and additionally supported by EBA and experiments. The course videos in EBA for the experimental-2 group were prepared by downloading from www.eba.gov.tr.

The Electric Circuits Unit Experimental Activities (ECUEA) were prepared by using the science and technology laboratory applications book prepared by Cepni, Ayvaci and Cil (2012) in order to facilitate the students' learning in the laboratory (Appendix 5). The experiments prepared for students; it consists of parts such as generalization, relating to daily life and let's evaluate ourselves, and experiment result. There are also open-ended questions in these sections. In addition to the EBA activities, a total of five experiments were conducted for the students in the experimental-2 group. A course plan for experimental-2 group is shown in Appendix 3, Table 21.

2.5.3.1. First week teaching in the experimental-2 group

In the first hour of the course, the research divided the students in the experimental-2 into five groups for their collaborative working and named as group 1, group 2, ……, group 5. Care was taken to ensure that all groups were homogeneous but heterogeneous within themselves. The rules to be applied in the laboratory were determined together with the students in order for the group members to constantly control themselves and to ensure in-class discipline. The EBA activities in the experimental-1 group were exactly made. After these activities, the experiments were conducted to consolidate the subjects they learned in EBA. Before starting the experimenal, the materials to be used in the experiments were introduced to the students and they talked about the functions of the materials. Before the course, the groups were given the experimental activity named *"Experimental-1: connecting in series the bulbs"* in ECUEA and they were asked to examine this activity before coming to the course. Each group was asked to set up their own circuits in which the bulbs were connected in series and observe how the brightness of the bulb in the circuit may change accordingly. They were asked to observe how the bulb brightness changed. An example of the connecting in series bulbs circuits established by the students is given in Figure 3. After the experimental was completed, each group was asked to fill in the gaps in the experimental-1 activity by discussing it among themselves.

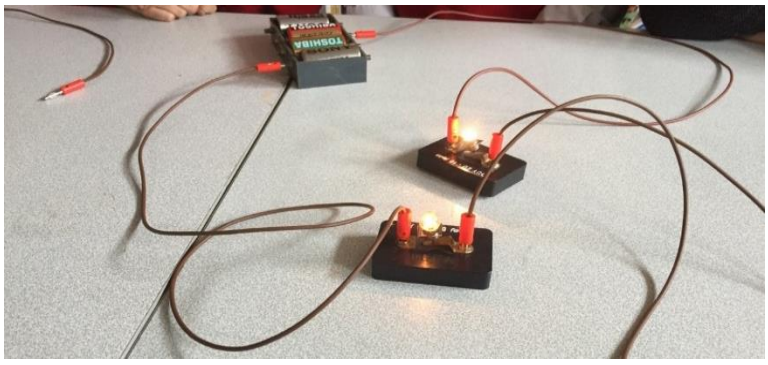
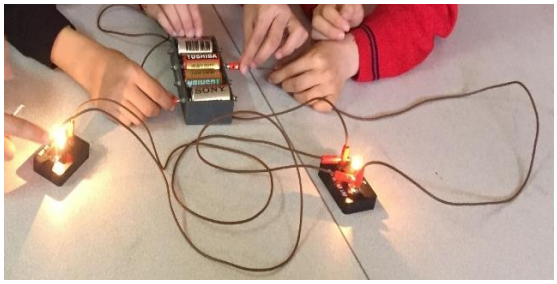


Figure 3. Connecting in series bulbs

In the second hour of the course, the activity-1 in ECUW prepared by the researchers was distributed to the students and was answered with the students under the control of the researcher. Similar procedures were performed in the second and third weeks. Some of the activities held during these weeks are given Figure 4.



(a)

(b)

Figure 4. a) Connecting in parallel bulbs, *b)* The voltage modeling activity of the students in the experimental-2 group

2.6. Analysis of the Data

2.6.1. Analysis of the data obtained from SCAS

The SCAS consists of 20 items. 10 of these items are positive and 10 are negative. The SCAS was applied as pre-test and pos-test in all groups. The data obtained from the attitude scale were analysed using SPSS program in the control, experimental-1 and experimental-2 groups.

It was first checked whether the data collected on which tests to use showed a normal distribution or not. Since the number of participants was less than 35, the Shapiro-Wilk test (Shapiro & Wilk, 1965) was used. The normality test results of SCAS used in the study are provided in Table 7.

Table 7. *Normality test results of data obtained from SCAS*

Test	Group	*N*	*p*
Pre-test	*Control*	23	.21
	Experimental-1	25	.17
	Experimental-2	25	.07
Post-test	*Control*	23	.06
	Experimental-1	25	.21
	Experimental-2	25	.08

p> .05

According to Table 7, as *p*> .05 according to both pre-test and post-test data, it was determined that the data obtained from SCAS showed normal distribution. Therefore, while independent samples t-test was used for comparisons between groups, dependent t-test was used for comparisons within groups in the next steps in the analysis of the data.

2.6.2. Analysis of the data obtained from SSIF

SSIF was applied to a total of six students, two upper, middle and lower achievement students, determined according to the academic achievement post-test score, in order to determine the views of the students in the experimental-2 group, who were given EBA and experimental-supported education, about the application process. The responses of the students to the questionnaire were evaluated both by the researcher and by a science specialist independently. The results of the assessment were compared, consensus and disagreement were calculated and the percentage of reliability was found via the formula proposed by Miles and Huberman (1994):

$$Percentage\ of\ Consistency\ (P) = \frac{Na\ (Consensus)}{Na\ (Consensus)+Nd\ (Dissensus)}\ \text{x}\ 100$$

The studies in the literature recommended this value be greater than 85% to describe this value as reliable (Miles, Huberman and Saldana, 2014; Patton, 2002). The agreement of two coders was found 91% and it was seen that this value is acknowledged reliable in the literature.

2.7. Ethical Statement of the Study

As authors of the research, we declare that the study has no unethical problem and we observed research and publication ethics. Ethical principles and rules were followed during the planning, data collection, analysis and reporting of the research. Ethical compliance approval was obtained for this research in accordance with the decision of Kastamonu University Social and Human Sciences Research and Publication Ethics Committee dated 02.07.2021 and numbered 03/01.

3. Results

In this section, the quantitative and qualitative data obtained from experimental-1, experimental-2 and control groups were analysed.

3.1. Results Related to the Quantitative Data

3.1.1. Findings concerning the first sub-problem of the study

A total three groups, one control, one experimental-1, and one experimental-2 group from the school participated in the study. Table 8 shows the comparison of the science attitude pre-test and post-test mean scores for the control group students with the dependent samples t-test.

Table 8. *Results of the t-test for control group students' science attitude pre- and post-test mean scores*

Group	Test	*N*	$\bar{X}$	*SD*	*DF*	*t*	*p*
Control	Pre-test	23	41.61	4.33	22	-3.73	.00
	Post-test	23	45.35	3.35			

$p < .05$

According to Table 8, there was a significant ($p < .05$) difference between science attitude pre-test and post-test mean scores for control group in favor of the post-test scores. This result showed that teaching in the control group according to the current curriculum improved positively the students' attitudes towards the science course.

3.1.2. Findings concerning the second sub-problem of the study

Table 9 shows the comparison of the science attitude pre-test and post-test mean scores for the experimental-1 group students with the dependent samples t-test.

Table 9. *Results of the t-test for experimental-1 group students' science attitude pre- and post-test mean scores*

Group	Test	*N*	$\bar{X}$	*SD*	*DF*	*t*	*p*
Experimental-1	Pre-test	25	41.91	3.32	21	-6.11	.00
	Post-test	25	45.41	2.17			

$p < .05$

According to Table 9, there was a significant ($p < .05$) difference between science attitude pre-test and post-test mean scores for experimental-1 in favor of the post-test scores. This result showed that teaching in the experimental-1 group according to the EBA improved positively the students' attitudes towards the science course.

3.1.3. Findings concerning the third sub-problem of the study

Table 10 shows the comparison of the science attitude pre-test and post-test mean scores for the experimental-2 group students with the dependent samples t-test.

Table 10. *Results of the t-test for experimental-2 group students' science attitude pre- and post-test mean scores*

Group	Test	*N*	$\bar{X}$	*SD*	*DF*	*t*	*p*
Experimental-2	Pre-test	25	41.16	4.00	24	-5.91	.00
	Post-test	25	47.08	2.01			

$p < .05$

According to Table 10, there was a significant ($p < .05$) difference between science attitude pre-test and post-test mean scores for experimental-2 in favor of the post-test scores. This result showed that teaching in the experimental-2 group according to the EBA and experimental activities improved positively the students' attitudes towards the science course.

3.1.4. Findings concerning the fourth sub-problem of the study

Table 11 shows the science attitude post-test mean scores for the control, experimental-1 and experimental-2 groups in comparison with the independent samples t-tests. Results of the t-test for control, experimental-1, and experimental-2 group students' science attitude post-test mean scores are provided in Table 11.

Table 11. *Results of the t-test for control, experimental-1 and experimental-2 group students' science attitude post-test mean scores*

Group	*N*	$\bar{X}$	*SD*	*DF*	*t*	*p*
Experimental-1	25	45.41	2.17	43	.02	.98
Control	23	45.35	3.35			
Experimental-2	25	47.08	2.02	46	2.10	.04
Control	23	45.35	3.35			
Experimental-1	25	45.41	2.17	45	-2.81	.01
Experimental-2	25	47.08	2.02			

According to Table 11, there was no statistically significant difference between the mean scores for the post-test control and experimental-1 groups [$t(43) = .02$; $p > .05$]. This result showed that teaching in the control and experimental-1 groups according to the current curriculum and EBA, respectively didn't affect the students' attitudes towards the science course. According to Table 11, there was a significant difference between the science attitude post-test mean scores for the control and experimental-2 groups [$t(45) = 2.10$; $p < .05$]. This result showed that teaching in the contol and experimental-2 groups according to the current curriculum and EBA and experimental activities, respectively affected positively the students' attitudes towards the science course in favor of the experimental-2.

According to Table 11, there was a significant difference between the science attitude post-test mean scores for the experimental-1 and experimental-2 groups [$t(46) = -2.81$; $p < .05$]. This result showed that teaching in the experimental-1 and experimental-2 groups according to EBA and EBA and experimental activities together, respectively affected positively the students' attitudes towards the science course in favor of the experimental-2.

3.2. Results Related to the Qualitative Data

3.2.1. Findings concerning the fifth sub-problem of the study

For this sub-problem, SSIF was applied to six students in the experimental-2 group and the themes and codes were determined by analyzing the data obtained. The results are presented as the frequency and percentage. In addition, through descritive analysis sample statements reflecting students' views on EBA and experimental activities were also included. The students at experimental-2 were taugh for 3 weeks via the instruction based on the EBA and experimental activities. The students' views in experimental-2 group concerning *"first question: what do you know about EBA?"* are provided in Table 12.

Table 12. *Student views on what they know about EBA*

Theme	Code	Participant	*f*	%
What are known about EBA	*There are videos*	U1, U2, M1, M2, L1, L2	6	100
	There are activities, tests and worksheets	U1, U2, M1, M2, L1, L2	6	100
	There are pictures	U2, M1, M2	3	50.0
	There are games	M2, L1	2	33.3
	There are ather activities	M1	1	16.7
	There are news	M2	1	16.7

U: *Upper achievement student*, **M:** *Middle achievement student*, **L:** *Lower achievement student*

According to Table 12, six codes were found for the question of what students are known about EBA. All of the students (100%) stated that there are videos, activities, tests and worksheets at EBA. The students' views in experimental-2 group concerning *"second question: were EBA or experimenting more effective in teaching electrical circuits unit subjects? Why is that?"* are provided in Table 13.

Table 13. *Student views on the effectiveness of EBA or experimentation while teaching ECU*

Theme	Code	Participant	*f*	%
Effectiveness of EBA or experimental while teaching ECU	*Experimental, because subjects are better learned by experimenting*	U1, U2, M1, M2, L1, L2	6	100
	Experimental, because it's so fun to experimental	U1, M1, M2, L1, L2	5	83.3
	Experimental, because encourages learning about the subject more easily	U2, M1, L1, L2	4	66.7
	Experimental, because activities at EBA are not opened sometimes during the course	M1	1	16.7

According to Table 13, four codes were found for the question of were EBA or experimenting more effective in teaching electrical circuits unit subjects? Why is that? All of the students (100%) stated that experimental, because subjects are better learned by experimenting. 83.3% of the students stated that the experiments were fun. The students' views in experimental-2 group concerning *"third question: were the knowledge sufficient on EBA?"* are provided in Table 14.

Table 14. *Student views on the adequacy of the knowledge in EBA*

Theme	Code	Participant	*f*	%
Sufficient of the knowledge in EBA	*EBA is not sufficient due to the students' learning by doing the experiments in the laboratory*	U2, M1, L1, L2	4	66.7
	Not enough due to activities and some videos not opening	U1, M2,	2	33.3
	It is not enough due to the complex narration of the subjects in the videos.	U1, M1	2	33.3
	Not enough because the topics are not explained in detail and the videos are too short	U1, M2	2	33.3

According to Table 14, four codes were found for the question of were the knowledge sufficient on EBA? 66.7% of the students stated that EBA wasn't sufficient due to the students' learning by doing the experiments in the laboratory. The students' views in experimental-2 group concerning *"fourth question: did you have any difficulties while learning ECU subjects by making experimental?"* are provided in Table 15.

Table 15. *Student views on the difficulties encountered in teaching ECU subjects with experimental*

Thema	Code	Participant	*f*	%
Difficulties encountered while teaching ECU subjects with the experimental support	*It's fun to experimental, no problem*	U1, U2, M1, M2, L2	5	83.3
	Because of learning by trying, doing-living, no problem	U1, M2, L1	3	50.0
	Because all experiments are made with understanding, no problem	M1, M2, L1	3	50.0
	Due to the bursting of some of the bulbs, time problem	U1, U2, L1	3	50.0

According to Table 15, four codes were found for the question of did you have any difficulties while learning ECU subjects by making experimental? 83.3% of the students stated that experimenting was enjoyable and there was no problem. 50.0% of the students stated that some bulbs burst during the experimental caused a waste of time. The students' views in experimental-2 group concerning *"fifth question: would you prefer to use EBA or experimental while learning other subjects of the science course? Why is that?"* are provided in Table 16.

Tablo 16. *Student views that they want to learn other subjects with the EBA or experimental*

Thema	Code	Participant	*f*	%
Students want to learn other science subjects with EBA or experimental	*Experimental, because better learning of subjects by making experimental*	U1, U2, M1, M2, L1, L2	6	100
	Experimental, because quick forgetting of knowledge as it is usually learned by listening in EBA	U2, M1, M2, L1, L2	5	83.3
	Experimental, because the teacher can explain the subject better with the experimental	U1, U2, M1, L1, L2	5	83.3
	Experimental, because the science course is based on experimental and observations	U1, M2, L2	3	50.0

	Experimental, because videos and activities in EBA are sometimes not opened at home or school	U1, M1, L1	3	50.0

According to Table 16, five codes were found for the question of would you prefer to use EBA or experimental while learning other subjects of the science course? All of the students (100%) stated that experimental, because better learning of subjects by making experimental 50.0% of the students stated that experimental, because the science course is based on experimental and observations. The students' views in experimental-2 group concerning *"sixth question: how did the use of EBA and experimental activities affect your attitude towards science course?"* are provided in Table 17.

Tablo 17. *Students' views on the effect of using EBA and experimental activities on their attitude science course*

Thema	Code	Participant	*f*	*%*
The effect of using EBA and experiment activities on students'attitudes towards science course	*Love the science course*	U1, U2, M1, M2, L1	5	83.3
	Loving the subject of electricity very much now	U1, U2, M2, L2	4	66.7
	Electricity is interesting	U1, M1, M2, L1	4	66.7
	Science course is now fun	U2, M1, M2, L2	4	67.7
	Be happy in science course	U2, M1, M2	3	50.0

According to Table 17, five codes were found for the question of how did the use of EBA and experimental activities affect your attitude towards science course? 83.3% the students stated that they loved the science course. 50.0% of the students stated that they were happy in science course. Sample expressions from the answers given by the students to the questions in SSIF are given in Table 18.

Table 18. *Sample expressions from the answers given by the students to the questions in SSIF*

Student	*Sample expression*
U1	*I learned the subject of electricity, which I had seen in the fifth grade before and had difficulty understanding, by doing experimental in the laboratory, solving worksheets, and watching lecture videos from EBA. Thanks to the experimental in the laboratory, I now love the subject of electricity, which I didn't like very much. I like the science course and my teacher.*
M2	*The use of EBA and experimental activities affected my attitude towards science course well. Without the experimental, I would never have understood the subject of electricity. When we made an experimental in the laboratory; All my fears were gone and I understood everything we were doing.*
L1	*While learning other subjects in science class, I would prefer to experiment. Because EBA is not opened only at school but sometimes at home. I understood the way our teacher told better with the experimental and activities carried out in the laboratory. The videos watched at EBA stay in our minds for a few days or a few months, but each experiment in the laboratory is a memory for me, making it longer for me.*

4. Conclusion and Discussion

The EBA and experimental activities have been to have an effect on science attitude and the 7th grade students' views on these activities as well as on their knowledge about connecting in series and parallel, resistance, electrical current, voltage, Ohm's law. The positive increase in science attitude of the experimental-2 group can be explained by the fact the EBA and experimental activities are the effective establishment of knowledge in relation to daily life. There were no statistically significant differences between the mean score of the science attitude pre-test of the experimental-1, experimental-2 and control groups before the application. In each of the groups, there was a significant difference between the science attitude pre-test and pos-test scores in favor of the post-test. Accordingly, teaching in each group increased the science attitude of the students. However, when the post-test mean scores of the science attitude were examined, there was no significant difference between the experimental-1 and the control groups, while there was a significant difference between the experimental-2 and the control groups and the experimental-1 and the experimental-2 in favor of the experimental-2 group. Accordingly, the EBA and experimental instruction in the ecperimental-2 group increased the attitude towards science course of the student. This can be interpreted to a great extent as the fact that the EBA and experimental-based instruction enables students to gain active participation in the course, conduct group activities, make comments, discuss and produce projects and develop their conceptal understanding.

EBA-based activities given to the students of the experimental-1 group increased the students' mean attitude scores towards the science course according to the pre-test results, but it was found that this increase was only a small percentage (about 3.5 points). The reasons for this may be some technological problems in EBA or boredom is the students because of the teachers often use technology such as EBA while teaching the subjects. In the literature, the results of some studies (Alabay, 2015; Kendirli, 2017; Ozbey, 2019) investigating the effect of the EBA-based instruction on science attitude support the results of this research. In addition, in some studies (Kelismail, 2019; Vahit, 2019) in the literature, it was concluded that EBA increased students' attitudes towards the course. In their studies, it was found that EBA-based instruction positively affected students' attitudes towards mathematics course and created a positive classroom climate.

EBA and experimental-based instruction given to the students of the experimental-2 group increased (about 6.0 points) the students' mean attitude scores towards the science course compare to the pre-test. The reasons for this may be that students learned by using EBA and experimental activities the subjects in the unit well, found the opportunity to learn their missing knowledge from these activities and learned by making and experiencing the concepts. The EBA application offered to the students with the help of technology and the experimental activities providing the opportunity to learn by doing affected positively their attitudes towards science course. In the literature, the results of some studies (Kırılmazkaya, Kececi & Zengin, 2015; Yazici & Kurt, 2018) investigating the effect of the EBA and experimental-based instruction on science attitude support the results of this research.

While experiment activities were made in teaching the subjects to the Experimental-2 group, the students were divided into groups and learned the subjects of unit by cooperating. Arslan (2016) stated in his study that when laboratory processes are supported with a collaborative method, it affects students' attitude towards science course positively. The groups realized the learning process by producing ideas among themselves and helping each other during the experimental stages. Aydin & Biyikli (2017) stated that correcting the missing knowledge and the problems of the process in the laboratory environment with the support of their group friends is important for learning. The EBA and experimental-based instruction was more

effective for science attitude in the experimental-2 group than experimental-1 group. The EBA and experimental are method in which continuous activities are held and students participate in these activities. School facilities, student profile and time are important factors in conducting these activities.

According to the results obtained from SSIF applied to six students from the Experimental-2 group, the students stated that they saw EBA as a process containing educational videos, games, pictures and activities. In their studies by taking the views of middle school students about EBA, they concluded that EBA is a useful site with photos and videos (Timur, Yilmaz & Isseven, 2017). They stated that although EBA is a useful site, its content is insufficient and needs to be improved (Altin & Kalelioglu, 2015). It was stated that EBA is weak in terms of content, videos are short, and technical problems are sometime encountered due to internet infrastructure (Birisci & Uzun, 2014; Tuysuz & Cumen, 2016). Another result of the qualitative dimension of the research is that EBA is not very effective alone, but more effective when combined with experimental activities. In EBA activities, students stated that the knowledge they learn is not as permanent as the knowledge learned in experimental because they usually learn by listening. In the literature, the result of a study (Kalemkus, 2016) was stated that the majority of the students gave the answers “neutral” and “disagree” about the content in EBA being appropriate to the curriculum, increasing motivation, insufficient content, plain and suitable for the student level. The result of study (Ceylan, 2019) was stated that some schools lack interactive boards and EBA is not used enough. Another important result obtained from the research was that the use of EBA and experimental activities together in teaching the subjects of ECU changed positively the attitude towards the science course of the students in experimental-2 group. Most of the students in the Experimental-2 group who applied the SSIF stated that they learned the subjects better by doing and found the experiments very enjoyable. Experimental activities are very important in science education and have a big role in students’ meaningful learning. In a smilar study, it was concluded that more experimental activities should be included in the science course and that the experimental activities used in science courses made the lesson more fun and fluent (Kurt, 2017).

According to the findings of the students in the Experiment-2 group in the SSIF, the students stated that the knowledge they learned via EBA and experimental-based instruction was more permanent than EBA-based instruction because they made and observed the experiments themselves. In the literature, the results of some studies (Bagcı & Simsek, 1999; Tobin, 1986) support the results of this research.

As observed in this study, the EBA and experimental-based instructions increased the science attitude of students in experimental-2 group and made a positive contribution to their knowledge on the ECU. Therefore, it is important to use defensible activities such as the EBA and experimental. To help students learn science lessons better, teachers can consider using the activities such as the EBA and experimental for science attitude as pointed by this study.

4.1. Suggestions

In this study, the EBA and experimental-based instruction were observed to have a positive effect on students’ attitude towards science course and views on these activities in ECU. As the amount of research increases, an idea can be formed concerning the common impact of the EBA and experimental activities. The application took three weeks. A limited number of activities were sometimes held. Therefore, studies using EBA and experimental-based instruction may be of longer duration. There are many studies showing that the EBA and experimental are effective in science teaching. In this context, science teachers should be encouraged with in-service teacher trainings to use the EBA and experimental in-class. The students in the experimental-2 group stated that there were technical problems in the use of

EBA from SSIF. These problems can be detected and prevented by the teacher. The students in the experimental-2 group stated that some of the tools and equipment they used during the experimental didn't work and they experienced time difficulties. The teacher can avoid the trouble of time by testing the materials to be used before starting the experimental.

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Appendix 1

Table 19. *Course plan for control group*

Week	Subject	Method/Technique	ECUW

1st week	*Connecting in series bulbs,* *Connecting in parallel bulbs*	Lecture Questin-answer Demonstration experimental	Activity-1
2nd week	*Brightness connecting in series bulbs,* *Brightness connecting in parallel bulbs,* *Electrical current*	Lecture Questin-answer Discussion Demonstration experiment	Activity-2 Activity-3
3rd week	*Relationship between electrical energy and current,* *Relationship between voltage and current*	Lecture Questin-answer Demonstration experiment	Activity-4 Activity-5

Appendix 2

Table 20. *Course plan for experimental-1 group*

Week	Subject	Activity	ECUW
1st week	*Connecting in series bulbs,* *Connecting in parallel bulbs*	EBA-1: Electrical circuits EBA-2: Series connected bulbs EBA-3: Parallel connected bulbs	Activity-1
2nd week	*Brightness connecting in series bulbs,* *Brightness connecting in parallel bulbs,* *Electrical current*	EBA-4: Batteries and Electrical current EBA-5: Brightness ve resistance	Activity-2 Activity-3
3rd week	*Relationship between electrical energy and current,* *Relationship between voltage and current*	EBA-6: Current and ammeter EBA-7: Voltage EBA-8: Voltmeter EBA-9: Relationship between voltage and current	Activity-4 Activity-5

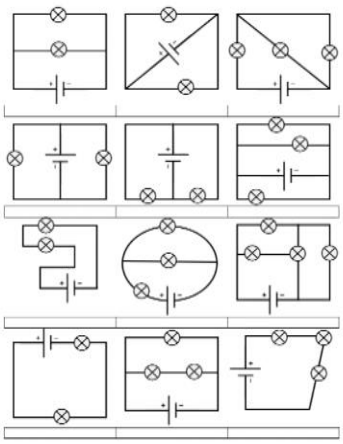
Appendix 3

Tablo 21. *Course plan for experimental-2 group*

Week	Subject	Activity	ECUEA	ECUW
1st week	*Connecting in series bulbs, Connecting in parallel bulbs*	EBA-1: Electrical circuits EBA-2: Series connected bulbs EBA-3: Parallel connected bulbs	Experimental-1	Activity-1
2nd week	*Brightness connecting in series bulbs, Brightness connecting in parallel bulbs, Electrical current*	EBA-4: Batteries and Electrical current EBA-5: Brightness ve resistance	Experimental-2 Experimental-3 Experimental-4	Activity-2 Activity-3
3rd week	*Relationship between electrical energy and current, Relationship between voltage and current*	EBA-6: Current and ammeter EBA-7: Voltage EBA-8: Voltmeter EBA-9: Relationship between voltage and current	Experimental-5	Activity-4 Activity-5

Appendix 4 (Samples of Worksheets)

Write below the connection methods of the bulbs in the following circuits.



Appendix 5 (Sample of Experimental Activities)

Experimental-1
The name of the experimental: Electrical current
Materials used in the experimental: A glass of water, spoon
The aim of the experimental: Learning the current passing through the electrical circuit.

Experimental procedure:
1. 8-10 people, make a circle so that your shoulders touch each other and each of you take a spoon in your hand.
2. Put a glass of water between you anywhere on the ring.
3. Let one of your close friends take water into the glass and pour this water into the other friend's spoon. In this way, ensure that the water reaches the glass again.

The result of the experimental:
1. How did you get the water you took from the glass to return to the glass?
2. Have there been situations where you could not transfer the water?
3. What does the water used in the activity represent?

Let's general:
1. What is the electrical current?
2. What conditions are required for current to occur in an electrical circuit?

Let's associate it with everyday life
1. How does a light bulb give off light in a simple electrical circuit?

Let's evaluate ourselves:
1. What are the things you learned best in this activity?
2. What concept do you learn best?
3. What are the things that do not interest you in this activity?