

## INFLUENCE OF ACTIVE LEARNING ON UNDERGRADUATE STUDENTS' ACHIEVEMENTS IN AND ATTITUDES TOWARDS SIMPLE ELECTRIC CIRCUITS IN PHYSICS

Şükran AKPINAR<sup>a</sup>  
Mehmet Emin KORKUSUZ<sup>b</sup>

<sup>a</sup> sukranakpinar88@gmail.com, Balıkesir University, Balıkesir, Turkey; ORCID: 0000-0002-3256-6098

<sup>b</sup> korkusuz@balikesir.edu.tr, Balıkesir University Balıkesir, Turkey; ORCID: 0000-0003-4945-6845

Doi: 10.31681/jetol.518281

Suggested citation: Akpınar, Ş. & Korkusuz, M.E. (2019), Influence of active learning on undergraduate Students' achievements in and attitudes towards simple electric circuits in physics, *Journal of Educational Technology & Online Learning*, 2(1), 16-33.

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### Article Info

Received : 26.01.2019

Revised : 28.01.2019

Accepted : 28.01.2019

Research Article

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### Abstract

This study examined the influence of active learning method on students' achievements in and attitudes towards simple electric circuits within the scope of the course of physics. The active learning method allows students to structure the information themselves by doing and experiencing. The study was carried out with 28 students from the department of Computer Education and Instructional Technologies of a state university in a period of five weeks including the process of data collection within the scope of the physics lesson unit of Simple Electric Circuits. In the application process of nine course hours in three weeks, the lesson unit of Simple Electric Circuits was taught to the students with the help of simulation-like activities that they developed based on their own coding using the programming environment of Scratch to solve the given problems. In the study, as the data collection tool, the “Attitude Scale for the Lesson Unit of Simple Electric Circuits” developed by Erdal TAŞLIDERE and Ali ERYILMAZ, the Simple Electric Circuits Achievement Test developed by the researcher of this study and a semi-structured interview form again developed by the researcher were used. For the analysis of the quantitative data collected in the study, the paired-samples t-test, one of parametric test techniques, was used. As for the analysis of the qualitative data, descriptive analysis was applied. The findings obtained in the study demonstrated that the active learning environment established using the programming environment of Scratch had significant influence on the students' achievements in the lesson unit of Simple Electric Circuits. In addition, according to the results, no significant difference was found between the attitude scale pretest and posttest mean scores. Lastly, the semi-structured interviews held with the students revealed that the active learning method carried out for the learners supported permanent learning thanks to the visual contents included, concretized and made learning entertaining and that teaching with the help of this method should be made common.

**Keywords:** Active learning, learning by doing and experiencing, self-learning, Scratch programming environment

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## 1. INTRODUCTION

Recent rapid and fundamental changes in the field of information and technology have influence on education system as well. It is important to prepare students for life with new skills and competencies in the 21st century. Instead of traditional learning methods, which cause students to become passive in learning, the method of learning by doing, experiencing, which requires students to become active, and which supports the changes in students not only in cognitive and affective domains but also in the psychomotor domain, is now more prominent (Şen, 2001).

In one dissertation conducted by Aşıroğlu (2014) with 39 elementary school 5th grade students, the researcher examined the influence of activities based on active learning within the scope of the course of Science and Technology on their achievements and problem solving skills. In the study, which involved use of methods such active learning methods as problem solving, case study, educational games, project-based learning and creative drama, it was found that the experimental group, which the active learning approach was applied to, had significantly higher mean scores in the problem solving skills and achievement posttests when compared to the control group. In another study carried out with 64 8th grade students in a period of 10 weeks, Aydede and Kesercioğlu (2012) examined the participants' self-learning skills. In the study, the researchers reported that the applications based on active learning were positively influential on the students' self-learning skills. Another study investigated the effects of a learning environment enriched with active learning techniques on 121 5th grade students' academic achievements in and attitudes towards the course of Science and Technology (Türksoy and Taşlıdere, 2016). The analysis of the results obtained in the study revealed that the teaching method enriched with active learning techniques had significantly positive influence on the students' academic achievement in and attitudes towards the lesson unit of Electric in Our Lives.

The 21st century skills of problem solving, critical thinking, productivity, creativity and learning to learn are also among the target skills of the active learning theory (Kotluk and Kocakaya, 2015). Parallel to this, the curricula should be developed in a way to have students acquire these skills, and the methods and techniques to be used should serve this purpose. In line with this purpose, computational thinking is an effective approach which tries to develop individuals' problem skills by combining their critical thinking and creativity skills.

Current developing technologies not only influence all aspects of life but also cause great differences in the field of education. Coding, which has now become quite common parallel to the technological developments, provide those in the field of education with the opportunity to develop new instructional methods. It is thought that abstract concepts hard to understand can be taught more easily thanks to teaching with the help of programming. Concretization of abstract concepts helps students learn these concepts more easily and meaningfully (Akpınar, 2006). Studies carried out in the field of science teaching, which includes a considerable number of abstract concepts, demonstrate that physics subjects are considered by students to be abstract, complex and hard to understand and that many students thus suffer from failure in physics subjects and lack of motivation (Turgut, Karaman, Sönmez, Dilber, Şimşek and Altun, 2006; Bülbül, 2010). Technology-aided education, or computer programming, is fairly useful for

concretizing abstract science concepts as well as for presenting rich activities by ensuring students' active participation in learning (Akpınar, 2006).

Computer programming reminds of a difficult system involving complicated codes. However, if students make a scheme of the steps of a problem and obtain the related algorithm structure, then they will find the solution more easily. Tools like Scratch and Alice are used for various reasons such as concretizing the abstract algorithm process, allowing instant testing and providing the user with the opportunity to make corrections (Erol, 2015).

When compared to Alice using 3-dimension models, Scratch, which involves 2-dimension visuals easier to form and organize, has approximately 30 million users. Scratch, designed to encourage various types of projects, provides motivation and opportunities to learn from others (Maloney, Resnick, Rusk, Silverman and Eastmond, 2010). Genç and Karakuş (2011) conducted a study to determine the experiences and views of 109 students regarding the use of Scratch within the scope of the course of 'Designing Computer Games in Education'. According to the results, 73% of the participants found it easier to learn basic programming structures via Scratch than via other programming languages. In addition, the results of the student also revealed that use of Scratch in the course of programming, which the students found hard to learn and had low levels of academic achievement in, led to positive changes in the students' attitudes towards programming. Saygıner and Tüzün (2017), in their study, pointed out that abstract and complex concepts related to the programming language caused the students to have difficulty understanding the structure of programming. As a solution to this, the researchers suggested block-based visual programming environments like Scratch and reported that block-based visual programming had contributed positively to learning programming.

Ferrer-Mico, Prats-Fernández and Redo-Sanchez (2012), in their study, examined the influence of Scratch programming on students' self-learning skills. The study was carried out with two different groups of participants. The participants in one group were at starter level in Scratch programming, and those in the other were at advanced level. The results of the study did not reveal any significant difference between the two groups in terms of their self-learning skills. However, the results demonstrated that the interactions encouraged learning.

In another study, Ouahbi, Kaddari, Darhmaoui, Elachqar and Lahmine (2015) aimed to teach basic programming concepts to the students using the Scratch software. The study was carried out with three groups of randomly selected 60 high school students. The students in the first group were taught programming with Scratch by creating simple games. The students in the other two groups were taught programming using traditional methods based on Pascal programming language. In the study, for the purpose of determining the students' levels in programming, their gaming habits, their motivations and their interests in programming, two questionnaires were distributed to the participants before and after the experimental process. The results of the analysis of the students' responses to the questionnaires demonstrated that use of Scratch for teaching programming motivated the students and increased their interest in learning programming. Also, the researchers suggested that creating games and stories could increase students' creativity to learn the fundamentals of programming.

In one other study, Erol (2015) aimed to examine the influence of teaching programming with Scratch on the students' motivation and achievement in programming. The study was conducted with two different groups of participants with 26 students in each. In the first seven-week

process, for the purpose of teaching basic programming structures, the students in the experimental group carried out game-design activities using Scratch, while those in the control group carried out problem solving activities using flow charts. In the second seven-week process of the study, the students in both groups were taught C# programming language, which is a real programming language for real-world tasks. The results of the analysis of the data collected with the data collection tools revealed that throughout the application process, there was an increase in the motivations of the students learning programming with Scratch and that there was a decrease in the motivations of the students in the control group. When the participants' achievements in programming were examined, it was seen that an increase in the achievements of both groups of students and that there was a significant difference in favour of the experimental group students learning with Scratch. At the end of the study, the experimental group students reported that it was easier and more entertaining to learn programming with Scratch, while those in the control group who learned programming using flow charts thought that the problem solving process was difficult and boring.

Kalelioğlu and Gülbahar (2014) carried out a study with 49 elementary school 5th grade students to examine the influence of Scratch programming on their problem solving skills. The results of the analysis revealed that Scratch did not cause any significant difference in the participants' problem solving skills. The results also demonstrated that the students found Scratch easy to use and that it helped the students enjoy programming.

Considering the results of all those studies mentioned above, it could be stated that Scratch is an effective visual programming language environment and that it helps students enjoy programming by making difficult and abstract aspects of programming easier, concrete and entertaining for them. In addition, use of Scratch could be said to contribute positively to students' attitudes, motivations and programming skills. Thanks to its user-friendly interface, Scratch allows designing games and thus makes learning entertaining. Also, as it concretizes the problem solving process, Scratch learning environment could be used as an effective tool in teaching science subjects including abstract concepts. Lastly, Scratch could help students avoid demonstrating negative attitudes to physics caused especially by abstract, complex and hard-to-understand physics subjects, and it could increase their motivation and thus their achievement in physics.

The present study is considered to be important since it allowed the students to produce simulations on their own to solve the given problems using the Scratch block-based programming environment. Thus, the students were provided with the opportunity to create their own learning environments. In this respect, an active learning environment was created for teaching the lesson subject of "Simple Electric Circuits". As required by this learning environment, the students were expected to achieve their own learning thanks to the coding in Scratch programming environment. The present study examined the influence of the active learning method on the students' academic achievements in and attitudes towards the physics lesson unit of simple electric circuits.

### **1.1 Research Problem and Sub-Problems**

- 1) Does the active learning activity regarding the lesson unit of simple electric circuits in the undergraduate course of Physics on the students' academic achievements?

- a. Is there a significant difference between the students' pretest and posttest achievement scores?
  - b. Do the achievement levels of the students carrying out the active learning activity differ significantly with respect to their gender?
- 2) What is the influence of the active learning activity regarding the undergraduate physics lesson unit of simple electric circuits on the students' attitudes towards the subject of simple electric circuits?
  - a. Is there a significant difference between the students' pre-application attitudes and their post-application attitudes towards physics?
  - b. Is there a significant difference between the students' pre-application and post-application attitudes towards physics with respect to their gender?
- 3) What are the students' views about the active learning activity carried out in relation to the undergraduate physics lesson unit of simple electric circuits?

## **2. METHODOLOGY**

### **2.1. Research Model**

The study was carried out with students from the department of Computer Education and Instructional Technologies (CEIT) within the scope of the course of Physics. The study aimed to determine the influence of Simple Electric Circuits applications designed by the participants themselves using the Scratch programming environment on their attitudes towards and achievements in the lesson unit of simple electric circuits. In the study, the qualitative and quantitative research methods were used together. The mixed method research design, which involves elements of both qualitative and quantitative approaches, basically assumes that a combination of qualitative and quantitative approaches helps understand a research problem better when compared to a single approach (Creswell, 2014).

In the study, involving both quantitative and qualitative aspects, the single-group weak experimental design with pretest and posttest, one of quantitative research approaches, was used. Experimental research designs aim to reveal the influence of the differences created by the researcher on the dependent variable for the purpose of testing the cause-effect relationship between the variables (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz and Demirel, 2014). As for the method called weak experimental design, the influence of the experimental process is tested on a single group using the same measurement tools (Büyüköztürk et.al., 2014).

### **2.2. Study Group**

The research universe included students taking the undergraduate course of physics in the department of Computer Education and Instructional Technologies (CEIT). The research sample was made up of 24 CEIT 2nd grade students at Necatibey Education Faculty of Balıkesir University. Among the participants in the study, 16 of them were female (57,1%), and 12 of them were male (42,9%).

### 2.3. Data Collection Tools

In the study, Simple Electric Circuit (SEC) Attitude Scale developed by Taşlıdere and Eryılmaz (2012) was used to measure the students' attitudes towards the physics lesson unit of simple electric circuits. The SEC Attitude Scale was five-point Likert-type scale made up of 24 items rated as “I Completely Agree”, “I Agree”, “I am Neutral”, “I Disagree” and “I Completely Disagree”. The overall reliability coefficient of the scale was calculated as 0,93, and the reliability coefficients for the sub-dimensions were found to range between 0,81 and 0,91.

In order to measure the participants' levels of achievement in the physics lesson unit of simple electric circuits, the “Simple Electric Circuits Achievement Test” developed by the research was applied as pretest and posttest. This “Simple Electric Circuits Achievement Test” included 17 questions, and for the purpose of determining the content validity of these questions and their appropriateness to the students' levels or class grades, three field experts were asked for their views. In line with the experts' suggestions, the necessary corrections were done. In addition, this achievement test was piloted with 47 3rd grade students from the Department of Physics Education at Necatibey Education Faculty. As a result of the analysis conducted using SPSS, the Cronbach alpha reliability coefficient of the test was calculated as .566. The main reason why the test was found moderately reliable was that the students involved in the pilot application were taught the lesson unit of Simple Electric Circuits one year earlier. It could also be stated that the students participating in the pilot application might have forgotten what they had learned about the lesson unit of simple electric circuits. Therefore, for the test reliability, mostly the expert views were taken into account.

In the present study, for the purpose of determining the students' views both about their own learning and about the active learning application, a semi-structured interview form made up of five questions was prepared. In relation to these five questions found in the interview form, detailed sub-questions were prepared. Also, field experts were asked for their views, and in line with their suggestions, the necessary corrections were done in the form. As a result, a total of 30 questions were obtained. Before the interviews, the students were informed about the interview purpose and about how long the interviews would take. Among all the students taking part in the active learning applications, 16 volunteers were asked for their views about the process. The interviews held with the participants were audio-recorded, and prior to the interviews, the participants were asked for their consents. Also, the researcher took notes during the interviews.

### 2.4 Application Process

In the study, the purpose was to determine the influence of Simple Electric Circuits applications developed by the participants themselves using the Scratch programming environment on their attitudes towards and achievements in this subject. The study was carried out with students from the department of Computer Education and Instructional Technologies (CEIT) within the scope of the course of Physics in a total of nine course hours in three weeks.

In the three-week research process, an application was developed by the students regarding the subject of SEC in Scratch programming environment. In this three-week process, instead of asking the students to solve the given problems using the pen-and-paper method, they were taught the subject of SEC with the help of the simulations developed by the students themselves

via their own codings in Scratch programming environment. The students did not use the current ready-made simulations regarding the subject of SEC. Instead, they carried out their experiments on the simulations they developed themselves. In this way, they actually prepared their own learning materials themselves. In these applications, the situations they encountered in their real lives were selected as the problem cases (Battery connections of remote controllers, battery connections of watches and so on). The participants were in contact both with their peers and with their teachers throughout the process. In addition, at the end of the lessons, the summarization technique, in which the students briefly described what they had learned, was used. The purpose of using this technique was to provide the students with the opportunity to review the subject and the lesson content.

When the codings developed by the students within the scope of SEC using the Scratch programming environment were examined, it was seen that the students formed different structures for the same problems.

In the application, which involved calculation of the potential difference of a circuit with  $R_1=25,5$  and  $R_2=32,3$ , there were differences between the solutions put forward by three students.



Figure 2.1: Student-1's calculation of the potential difference.



Figure 2.2: Student-18's calculation of the potential difference.



Figure 2.3: Student-20's calculation of the potential difference.

When the codings done by the students regarding the problems in Scratch environment were examined, it was seen that the numbers of sprites and costumes increased from the first

application developed to the last one and that the difficulty of the coding structure increased from the first application to the last one.

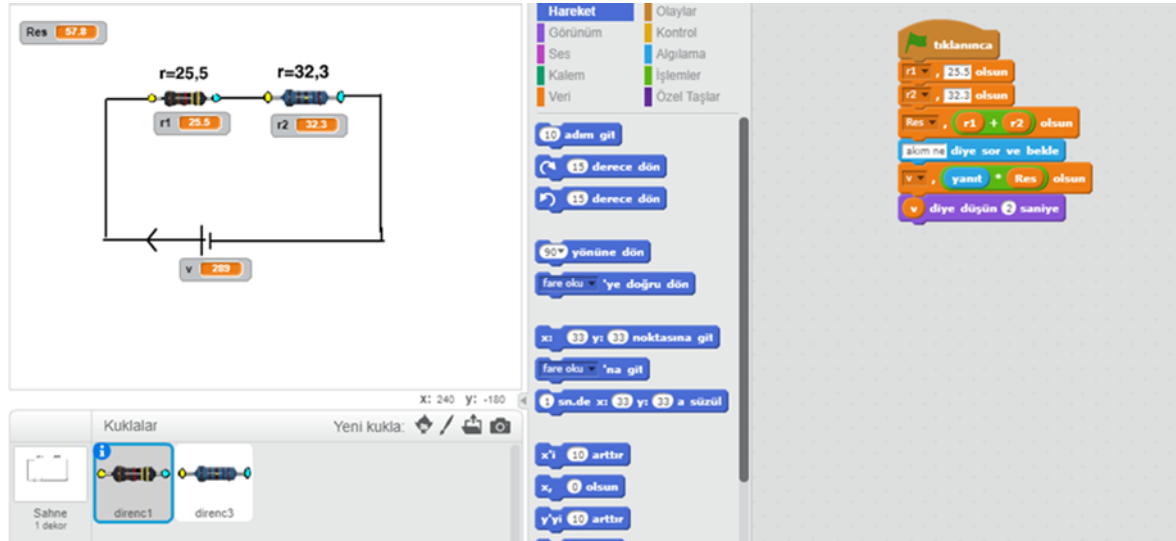


Figure 2.4: The first application shared by Student-18.

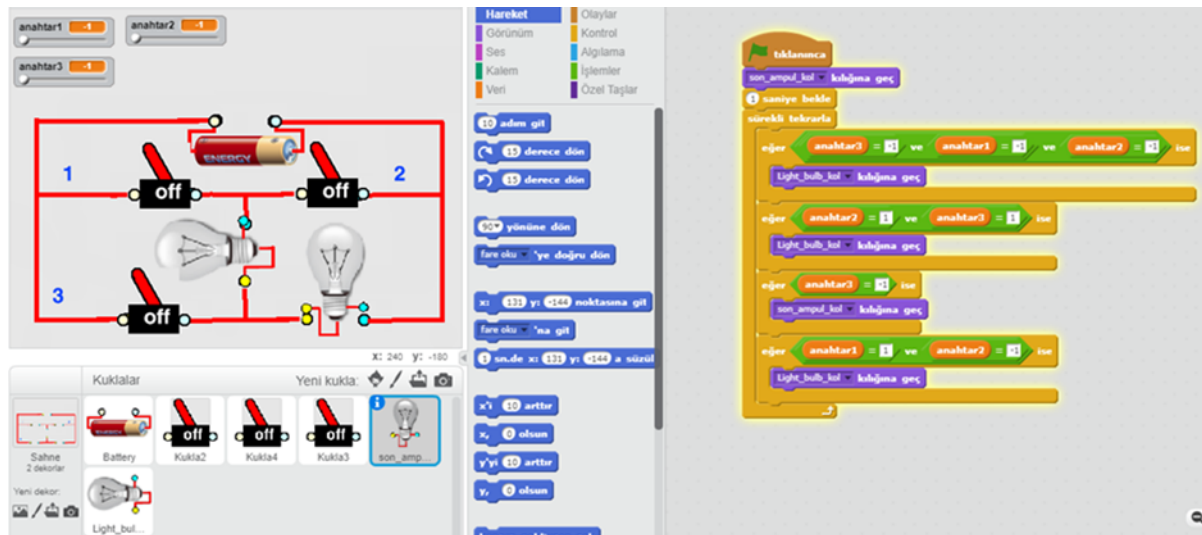


Figure 2.5: The last application shared by Student-18.

## 2.5 Data Analysis

In the study, the students' responses to the data collection tools were computerized. In this way, healthier and more correct results were obtained, and the results were analysed using SPSS 17.0.

In this study, normality was examined using the coefficient of skewness, histogram, normal Q-Q plot and Shapiro-Wilks test. The data obtained by examining the influence of the teaching method on the students' academic achievements demonstrated a normal distribution. Therefore, paired-samples t-test, one of parametric test techniques, was used to examine the difference between the SEC achievement scale pretest and posttest scores within the scope of the course of physics taught with the active learning method using the Scratch programming environment. In addition, the data collected via the examination of the influence of this teaching method on the students' attitudes towards SEC demonstrated a normal distribution; therefore, paired-



samples t-test, one of parametric test techniques, was used to examine the difference between the SEC attitude scale pretest and posttest scores within the scope of the course of physics taught with the active learning method using the Scratch programming environment. The paired-samples t-test can be used in survey studies or in experimental studies, in which two relational measurements or scores are obtained via the repeated measures of the same participants or from paired research samples (Büyüköztürk, 2016).

The qualitative data were obtained via the semi-structured interviews held with 16 randomly selected students. For the analysis of the participants' responses to the semi-structured interview questions, descriptive analysis was applied.

### 3. FINDINGS and DISCUSSIONS

#### 3.1 Effects of the Development of an Application in Scratch Programming Environment on the Undergraduate Students' Academic Achievements in the Physics Lesson Unit of Simple Electric Circuits

Among the purposes of the present study was examining the influence of the students' development of an application regarding SEC in Scratch programming environment on their academic achievements within the scope of the course of physics. In line with this purpose, the SEC achievement test was applied to the students as pretest and posttest. The students' responses were divided into four groups: "correct=1,00", "operational mistake=2,00", "wrong=3,00" and "No answer=4,00". The sum of the scores for their responses to each question was calculated. As a result, the students with low scores were considered to be more successful than those with high scores. For instance, a student giving correct answers to all the questions was considered to be the most successful student with a total of 22 points receiving 1 point for each question (correct=1,00).

*Tablo 1: SEC achievement scale Shapiro-Wilk normality test results.*

Measurement (SEC Achievement)	Kolmogorov- Smirnov			Shapiro-Wilk		
	Statistics	df	p	Statistics	df	p
Pretest	,092	28	,200	,977	28	,769
Posttest	,091	28	,200	,966	28	,480

In the study, as the pretest p-value ( $\alpha=.769$ ) and the posttest p-value ( $\alpha=.480$ ) calculated for the SEC Achievement Scale were higher than  $\alpha=.05$ , it was concluded that at this level of significance, the scores did not deviate excessively from the normal distribution and that the distribution was normal. As the data demonstrated a normal distribution, t-test, one of parametric test techniques, was used to examine the difference between the SEC achievement scale pretest and posttest scores within the scope of the course of physics taught with the active learning method using the Scratch programming environment.

*Tablo 2: t-test results regarding the SEC pretest and posttest mean scores.*

Measurement (SEC)	N	X	Sd	df	t	p
Pretest	28	67,68	8,22	27	4,48	.000
Posttest	28	59,68	9,53			

The results revealed a significant increase in the students' academic achievements thanks to the applications they themselves developed using the Scratch programming environment within the scope of the course of physics ( $p=.000<.05$ ). It was found that there was no significant difference between the students' scores in the SEC achievement scale before the active learning activity carried out using the Scratch programming environment ( $p=.28>.05$ ). In addition, it could be stated that following the activity, there was no significant difference between the students' scores in the SEC achievement scale with respect to the variable of gender ( $p=.87>.05$ ).

*Tablo.3: t-test results regarding the SEC pretest and posttest mean scores with respect to gender.*

Measurement (SEC)	Gender	N	X	Sd	sd	T	p
Pretest	Female	16	69,31	5,29	14,89	1,12	0,28
	Male	12	65,50	10,89			
Posttest	Female	16	59,94	8,57	26	0,16	0,87
	Male	12	59,33	11,08			

### **3.2 Effects of the Development of an Application in Scratch Programming Environment on the Undergraduate Students' Attitudes towards the Physics Lesson Unit of Simple Electric Circuits**

The study also aimed to examine the effects of examining the influence of the students' development of an application in Scratch programming environment on their attitudes towards SEC within the scope of the course of physics. In line with this purpose, the SEC attitude scale was given to the students as pretest and posttest. In order to determine whether the measurements demonstrated a normal distribution or not, Shapiro-Wilk test was applied. It was found that the SEC Attitude Scale pretest ( $p=.224>.05$ ) and posttest ( $p=.624>.05$ ) scores demonstrated a normal distribution.

*Tablo.4: SEC Attitude Scale Shapiro-Wilk normality test results.*

Measurement (SEC Attitude)	N	X	Sd	Shapiro-Wilk		
				Statistics	df	p
Pretest	28	3,57	0,47	,952	28	,224
Posttest	28	3,48	0,47	,972	28	,624

As the data demonstrated a normal distribution, t-test, one of parametric tests, was applied to examine the difference between the SEC attitude scale pretest and posttest scores within the scope of the course of physics taught with the active learning method using the Scratch programming environment.

*Tablo 5: t-test results regarding the SEC attitude pretest and posttest scores.*

Measurement (SEC Attitude)	N	X	S	df	t	p
Pretest	28	3,57	0,47	27	,830	,414
Posttest	28	3,48	0,47			

No significant difference was found between the students' SEC attitudes following the applications developed by the students themselves using the Scratch programming environment within the scope of the course of physics ( $p=.414>.05$ ).

*Tablo 6: t-test results regarding the SEC attitude pretest and posttest scores with respect to gender.*

Measurement (SEC Attitude)	Gender	N	X	S	df	t	p
Pretest	Female	16	3,49	,37	26	-1,05	0,30
	Male	12	3,67	,57			
Posttest	Female	16	3,30	,42	26	-2,52	0,02
	Male	12	3,72	,43			

In the study, no significant difference was found between the students' scores in the SEC attitude scale with respect to their gender before the active learning activity carried out using the Scratch programming environment ( $p=.30>.05$ ). In addition, it could be stated that following the activity, there was a significant difference between the students' scores in the

SEC attitude scale with respect to the variable of gender ( $p=.02<.05$ ). When the mean scores obtained via the SEC attitude scale following the activity were examined, it was seen that the male students had a mean score of 3.72 and that the female participants had a mean score of 3.30. In other words, the male students had a higher levels of SEC attitudes after the activity when compared to the female students.

### **3.3 Students' Views about an Activity for Learning by Doing and Experiencing Regarding the Physics Lesson Unit of Simple Electric Circuits**

The third research purpose was to determine the students' views about an activity for learning by doing and living regarding the lesson unit of simple electric circuits within the scope of the undergraduate course of physics. In order to reveal the students' views about this physics lesson taught with the active learning method using the Scratch programming environment, a semi-structured interview form developed by the researcher was used at the end of the application process. The interview form made up of five questions and related sub-questions was applied to 16 students selected among the participants on voluntary basis. For the analysis of the participants' responses to the questions in the semi-structured interview form, descriptive analysis was conducted. During the analysis of the data, the responses of each student were examined, and the similar views of the students were combined. Thanks to this, the students' common views were determined.

During the interviews, the students reported that the applications felicitated their understanding the lesson unit of simple electric circuit and that use of visuals to concretize the subject led to effective and permanent learning. Also, the students pointed out that there were important differences between active learning and the traditional method of learning. Among the students interviewed, Student-1's views were as follows:

"I don't like this course at all. Usually, I used to fail to understand what the teacher taught us, but with the help of these applications, we learn concretely. In this way, we can remember the subjects better."

Another student coded as Student-9 stated that:

"I think the method of active learning is better because I believe students will learn better with the help of visuals. I mean we learn by concretizing an abstract subject. In this way, it could be more permanent. For example, when the teacher shows an application, we do it. This is very important in learning. This method is better for me than the traditional method."

During the interviews held after the applications, the students reported that the process was entertaining and that the applications increased their interest in the lessons. One of the students, Student-16, said:

"The computer-aided educational applications are more entertaining than the traditional method. I already like spending time on computer; thus, I have found this method more enjoyable. In the traditional method, I sometimes get bored, but when use the computer, I entertain more thanks to the visuals while doing the applications myself."

## **4. CONCLUSION and SUGGESTIONS**

In literature related to the active learning method, there are several studies which revealed that teaching courses with the help of the active learning method increased the learners' academic achievement and which reported learners' positive views about this model (Aydede and Matyar, 2009; Akşid and Şahin, 2011; Büyükbayraktar Ersoy, 2015). Similar to the results obtained in these studies, the present study demonstrated that the active learning method allowed learners to structure their own knowledge (Büyükbayraktar Ersoy, 2015). In addition, Aşıroğlu (2014)

the students taught using activities based on active learning had high levels of problem solving skills than those who did not use these activities.

Different from the studies carried out using the active learning method in related literature, the Scratch programming environment was used to prepare an active learning environment in the present study. In literature, there are several studies examining the effects of the Scratch programming environment on learners' levels of programming, their gaming habits, motivations, achievements in programming, achievements in other fields, interests in lessons, problem solving skills and on their self-learning skills.

According to the data obtained via the semi-structured interviews held individually with the students, it was found that the applications carried out using the Scratch programming environment within the scope of the course of Physics contributed to the students' programming skills. Erol (2015), who examined the influence of teaching programming with the help of Scratch on students' motivations and achievements in programming, pointed out that the students' experiences in the process of designing games using Scratch contributed to their achievements in programming in the process of learning the C# programming language, which is said to include abstract concepts. In addition, Ouahbi and colleagues (2015), who aimed to teach students basic programming concepts using the software of Scratch, found that use of Scratch for teaching programming motivated the students and increased their desire to maintain their studies.

In the present study, the learners' problem solving skills were not determined experimentally, but it was revealed that the learners developed algorithms appropriate to the problems related to simple electric circuits which they were likely to encounter in their real lives. Similarly, there are various studies in related literature which examined the influence of Scratch programming on learners' problem solving skills. Vatansever (2018), who examined the influence of teaching programming with Scratch on students' problem solving skills and evaluated their views about this process, suggested designing games to teach programming with Scratch as an alternative method for training students with problem solving skills. On the other hand, Kalelioğlu and Gülbahar (2014), in their study, investigated the influence of Scratch programming on students' problem solving skills and concluded that the Scratch environment did not cause any significant difference in the students' problem solving skills.

Based on the results presented in the section of findings, it could be stated that this active learning study integrated with the use of the Scratch programming environment, one of block-based visual programming languages, supported the findings regarding the active learning method reported in related literature that lessons taught with the active learning method increased students' academic achievements.

When the SEC achievement test results were examined, it was seen that there was a statistically significant difference between the pretest and posttest results ( $p=.000<.05$ ). The students' SEC pretest achievement mean score was  $X=67,68$ , their posttest achievement mean score was  $X=59,68$ . The students' responses were divided into four categories as follows: "correct=1,00", "operational mistake=2,00", "wrong=3,00" and "No answer=4,00". While calculating the students' scores, the sum of the scores for their responses to each question was calculated. Based on this calculation, the students with the lowest score were considered to be more successful than those with high scores. For example, a student giving correct answers to all the questions was considered to be the most successful student with a total of 22 points receiving 1

point for each question (correct=1,00). This shows that the active learning environment created by using the Scratch programming environment had considerable influence on increasing the students' SEC achievements. This result provides an answer to the first research question directed in the present study: "Is there a significant difference between the students' academic achievements before and after the active learning activity regarding the Physics lesson unit of simple electric circuits?"

When the students' scores in the SEC achievement scale before the active learning activity carried out using the Scratch programming environment were examined, it was seen that there was no significant difference between the results with respect to the variable of gender ( $p=.28>.05$ ). In addition, when the scores obtained via the SEC achievement scale following the activity were examined, no significant difference was found between the results with respect to the variable of gender ( $p=.87>.05$ ). This result provides an answer to another research question directed in the study: "Do the achievement levels of the students carrying out the active learning activity within the scope of the Physics lesson unit of simple electric circuits differ significantly with respect to their gender?"

In the study, no significant difference was found between the students' pretest and posttest scores in the SEC attitude scale regarding the course of Physics in which they carried out their own applications using the Scratch programming environment ( $p=.414>.05$ ). This result provides an answer to the research question of "Is there a significant difference between the students' attitudes towards the lesson unit of simple electric circuits before and after the active learning activity carried out within the scope of the undergraduate course of Physics?"

In the present study, which investigated the influence of active learning on undergraduate students' attitudes towards the physics lesson unit of simple electric circuits, semi-structured interviews were held with the students. During these interviews, the learners reported that teaching lessons with this method was more interesting and entertaining and that they participated more in lessons. In related literature, a similar result was reported by Kalelioğlu and Gülbahar (2014), who examined the influence of Scratch programming on elementary school 5th grade students' problem solving skills and found that the students considered Scratch programming environment to be easy and that thanks to this environment, the students began to enjoy programming.

Based on the results of the analyses and interviews, it could be stated that physics lessons taught using the Scratch programming environment became more entertaining and permanent when compared to the traditional method of teaching. In addition, associating CEIT students' field courses with other disciplines could allow students to produce more creative ideas regarding the probable situations they would face in their future professional lives.

### **Suggestions for Practice**

- In order to help understand courses like Physics, which include a number of abstract concepts, activities like designing games by using Scratch, Alice or other similar visualizers could be carried out.
- For the purpose of increasing students' achievements and motivations by helping them understand abstract concepts more easily, learner-centred learning environments could be designed for the course of Physics.

- This active learning activity carried out in Scratch programming environment could be carried out with more students under similar conditions. Students at the same class grades but at different schools could be taught lessons using this method.
- While teaching courses which include a number of abstract concepts, learning environments which allow learners to learn in cooperation with each other and which encourage them to conduct research could be designed to increase their achievements and motivations.
- In order to help students understand the abstract concepts easily within the scope of the course of Physics, game design activities could be carried out in physics lessons using Scratch or other similar visualizers for different age groups ranging from elementary school level to university level.

### Suggestions for future Studies

- Future studies could use different visualizers instead of Scratch within the framework of an active learning activity that students carry out by designing their own applications while learning SEC within the scope of the course of physics,
- For the purpose of investigating the influence of active learning activity carried out with Scratch on learners' motivations and achievements in the physics lesson unit of simple electric circuits, similar studies could be conducted with students from different education levels including secondary school students, high school students and university students.
- The activity could be carried out again with a higher number of participants.
- The influence of the Scratch coding activities using while teaching the physics lesson unit of simple electric circuits on learners' motivations and achievements in other programming courses could be investigated.

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## Aktif Öğrenmenin Lisans Öğrencilerinin Fizikte Basit Elektrik Devreleri Konusundaki Başarı ve Tutumlarına Etkisi

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### Özet

Bu çalışmada yaparak yaşayarak öğrencinin bilgiyi kendisinin yapılandırmasını sağlayan aktif öğrenme yönteminin fizik dersi basit elektrik devreleri konusundaki başarı ve tutumuna etkisi incelenmektedir. Araştırma bir devlet üniversitesinin Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümünde öğrenim gören 28 öğrenci ile Fizik dersi Basit Elektrik Devreleri konusu kapsamında testlerin toplanma süreci dâhil olmak üzere 5 haftalık süre boyunca yürütülmüştür. 3 hafta toplam 9 saat uygulama sürecinde Basit Elektrik Devreleri konusu, öğrencilere verilen problemlerin çözümü için Scratch programlama ortamında kendi kodlamalarıyla geliştirdikleri simülasyon benzeri etkinlikler aracılığıyla öğretilmeye çalışılmıştır. Çalışmada veri toplama aracı olarak Erdal TAŞLIDERE ve Ali ERYILMAZ tarafından geliştirilen "Basit Elektrik Devreleri Konusuna Yönelik Tutum Ölçeği", araştırmacının geliştirdiği Basit Elektrik Devreleri Başarı Testi ve yarı yapılandırılmış görüşme formu ile veriler toplanmıştır. Araştırmada elde edilen nicel verilerin analizinde parametrik test tekniklerinden ilişkili t-testi, nitel verilerin analizinde betimsel analiz kullanılmıştır. Çalışmada elde edilen bulgular neticesinde Scratch programlama ortamı kullanılarak gerçekleştirilen aktif öğrenme ortamının, öğrencilerin Basit Elektrik Devreleri başarılarını artırmada önemli etkiye sahip olduğu, tutum ölçeği ön test ve son test puanları arasında anlamlı bir farklılık olmadığı görülmüştür. Yarı yapılandırılmış görüşmelerde öğrenenlerle gerçekleştirilen aktif öğrenme yönteminin görsel içerikler barındırarak kalıcı öğrenmeyi desteklediği, öğrenmeyi somutlaştırdığı, eğlenceli hale getirdiği ve bu yöntemle ders işlenmesinin yaygınlaştırılması gerektiği sonuçlarına ulaşılmıştır.

**Anahtar kelimeler:** Aktif öğrenme, Scratch programlama dili, kendi kendine öğrenme, yaparak yaşayarak öğrenme

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## About the Author(s)

### Şükran AKPINAR



Şükran Akpınar has got bachelor's degree (BS) from Gazi University, Department of Computer and Instructional Technologies Teacher Education in 2011. Also she has got a bachelor's degree (BS) from Dumlupınar University, Department of Computer Engineering in 2015. She has been continuing her academic life as a graduate student in Balıkesir University, Department of Computer and Instructional Technologies Teacher Education while she is working as a Computer and Instructional Technology Teacher in Ministry of National Education. Her interest areas are robot software, coding and studies on usage of technological tools for education.

Mailing Address: Bandırma Halk Eğitimi Merkezi Paşakent Mah. Mehmetçik Cad. No166 10 nolu Sağlık Ocağı Yanı Bandırma/Balıkesir

Mobile: +90 541 742 3663

E-mail: [sukranakpinar88@gmail.com](mailto:sukranakpinar88@gmail.com)

### Mehmet Emin KORKUSUZ



Mehmet Emin KORKUSUZ is Assistant Professor at Necatibey Faculty of Education, Balıkesir University. Dr. KORKUSUZ received M.S degree in Physics Education Department at Balıkesir University. He gained his Ph. D. in Educational Computer Games at July, 2012. His academic interest areas are educational games, programming language education, educational material design.

Mailing Address: Balıkesir University, 10100, Balıkesir, Turkey

Phone: +90 266 241 27 62-150

E-mail: [korkusuz@balikesir.edu.tr](mailto:korkusuz@balikesir.edu.tr)

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