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# One mobile application for the development of programming skills of secondary school students

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**Abstract**

The aim of this study is to develop a mobile application for the Scratch programming language in order to develop programming skills of the students from secondary schools. The mobile application has been developed to solve two problems related to teaching Scratch programming language. The first problem related to educational aspects of the Scratch programming commonly used in secondary schools. The second problem is that Scratch does not have mobile applications for its learning.
The structure of the application is described. The results of using the application in the learning process have been analyzed. Analyse shows that there is a significant difference between the problem solving skills of the students who have used this application in the learning process and the skills of the students who have not used it.

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## 1. Introduction

One of the important issues in education is the improvement of problem solving skills of students (Nelson,J., (2009; Papadopoulos Y. and Tegos,S., 2012; Gülbahar, 2014). The study of programming languages in secondary schools plays an important role in the development of problem solving skills. So as programming education enhances students' high level skills in problem solving, critical thinking, logical thinking, and creative thinking (Siegle, 2009, Calder, 2010, Fessakis, Gouli and Mavroudi, 2013). In this sense, students who take the programming education at the required level and understand the programming logic can also succeed in other courses.

Various languages are used in programming education in secondary schools. Among of these languages Scratch is one of the most common. Scratch programming facilitates higher order thinking such as problem solving skills. Scratch offers a number of opportunities for students to create their algorithms and coding skills at a certain level.

Although Scratch is a powerful tool for studying programing in schools, there are some shortcomings in Scratch applications when students want to improve their language skills outside the school environment.

In particular, there is a need for a software extension that analyses students' errors during programming, suggests solutions, directs students to solutions, and provides correct coding recommendations.

On the other hand, considering the attention of students to mobile applications, widening of Scratch learning to mobile environment can give a new impetus to the programming learning.

This submittion describes the study to solve the above-mentioned problems related to Scratch learning.

## 2. Research purpose

The main objective of this study is to improve the effectiveness of Scratch learning by moving the learning process into a mobile environment with adaptive opportunities. To achieve the above mentioned purpose, the research problem divides into the following subproblems:

Developing a software that allows to learn Scratch language in mobile environment

Developing a software add-on that enables to lead students to correct coding during code creating process;

Investigate whether there is an effective difference between the academic performance of students who use and who do not use the mobile application in the Scratch of learning process.

## 3. Literature Review

Scratch is a programming language developed by MIT Media Lab to teach programming for children. Scratch offers an easier and more enjoyable environment for students. It also encourages users in advanced code writing. There are studies analyzing the impact of SCratch learning in the development of problem-solving skills of students. (Kobsiripat, 2014) studied the creativity of students using Scratch. Author observed that Scratch positively influence the creativity of the students. Scratch using help students to develop their collobarotion skills, logical thinking, and algorithmic thinking (Taylor, Harlow and Forret, 2010). (Gülbahar and Kalelioğlu,2014; Shin and Park,2014) have investigated the influence of Scratch programming on problem solving skills of students. The results of these studies show that Scratch programming contributes positively to students' problem solving skills.

(Nam, Kim and Lee,2010) have studied the influence of scratch programming to programming achievement and problem solving skills of students. Sixteen students from the 6th grade participated in the study. The students were divided into experimental and control groups. The students in the experimental group were taught Scratch programming language. The students in the control group taught programming course were taught with classical methods. The results indicated that the students in the experimental group had a positive change in their programming and problem solving skills.

Using Scratch programming language in foreign language education was studied by (Sanjanaashree, Anand Kumar and Soman,2014). The authors detected that the Scratch programming language could help in providing foreign language education such as English and Tamil.

(Wang, Huang and Hwang,2014) have investigated students' problem solving skills, their attitudes toward learning and their motivation by conducting a project-based study integrated with Scratch. A total of 91 students

from middle schools participated in the research. Experimental results have led to significant advances in the success of the proposed learning approach.

(Chen and Chung,2008) have developed a mobile learning system for English cources. Experimental results show that the proposed system positively affects the language learning performance of students in teaching English vocabulary.

(Fernández-López et al.,2013) developed a mobile learning software aimed at improving the academic skills of special education students. The results show that the proposed has a positive effect on improving the basic skills of students with special needs.

(Turgut,2015) has developed a mobile software using the ADDIE design model. The software has been developed for pre-school students. Students can create their own stories in mobile software by adding pictures, recording sound and drawing. The software is evaluated by making semi-structured interviews with children and their families. It was stated that the software is suitable for the social, psychological and cognitive aspects of pre - school students.

(Dehmenoglu,2015) has developed the "Code Everywhere" mobile learning application for the course of “introduction to programming” to support of “face to face” education. The author examined the differences between the students who use this application and the students who do not use it. 62 persons attended to the research from the 10th grade in the vocational high school. The control group received the programming lessons as face-to-face in their schools. The experiment group used mobile learning software. As a result of the research, it was stated that students who use mobile learning had a meaningful effect on their academic achievement and that they were more successful than students who only studied face to face.

(Hill,2016) has developed a mobile application that will enable students to develop their knowledge and skills in educational area. The students used the application for 2 months. As a result of the research, students' academic achievement, attitudes and opinions about mobile learning applications were examined. The results of the study show that the academic performance and attitudes of the students varied positively. The students expressed a positive opinion on the mobile learning applications.

## 4. Research design

The study was carried out using the ADDIE design model (Fig. 1.). In the analysis phase of the model, the shortcomings in Scratch programming learning process have been analyzed. At the same time, the study group was determined. In the design stage, the logical and visual design of the mobile learning application wsa developed. The instruction modules for Scratch learning have been determined and developed. In the the development phase coding of the application is done. In the application phase the developed mobile application was tested by the 7th grade students. A total of 94 students are in the 6th grade students who participate in the implementation process. There are 41 students in the experimental group and 53 students in the control group.

The students in the experimental group are learning programming from their smartphones using the Scratch programming language mobile learning application. At the same time they also receive programming training in the classroom.

Students in the control group receive programming training only from the course teacher. In addition, both groups received programming training by the same teacher. Pre-and post-practice programming skill success test was applied to the students in both groups. The implementation process lasted for a total of 5 weeks.

During the evaluation phase programming skills of the students were tested. For this purpose the test developed by the authors has been used. To analyze the data the Sampe T-Test was used. .To mesurement of effetiviness of the proposed application the programming skills achievement test was developed. This test was used as quantitative data collection tools.

## 5. The scructure of the Mobile Learning Application

The Mobile Learning Application consists of 6 functional modules.

**User Login Module**

The purpose of the module is to record and tracking the activities of the students.

**Help Module**

The help module consists of 2 blocks. The information related to the Scratch software is saved in the first block. The other block is a guideline for the mobile learning application. The module allows easy use of the application without any external support.

**Student Profile Module**

This module processes and saves the statistics about of students' activities. All the activities data are kept in the database. When the student is entered to the system, he/she is informed about his/her programming skill level, and progress on the activities

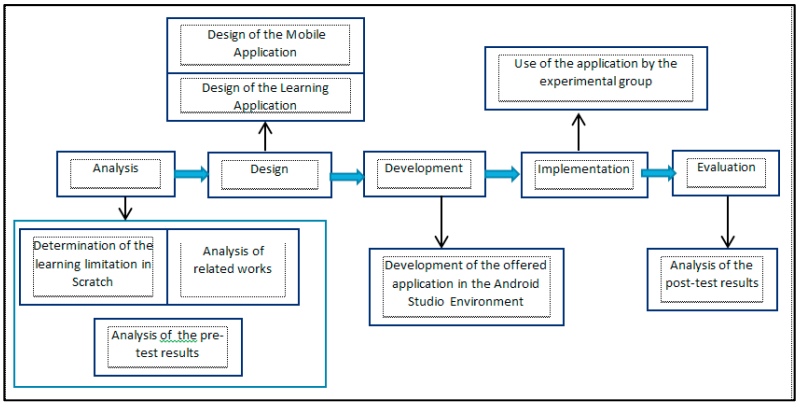


Fig.1. ADDIE Model for Scratch Mobile Application Develeopment

**Lessons Module**

Lessons to be taught divided into 8 blocks. These blocks contain totally 112 lesson units The student can choose the lesson unit appropriate to their knowledge level and learning style.

**Test Module**

Test module has been developed so that students can evaluate their programming knowledge themselves. The component has easy, medium and difficult level tests (Fig. 2).There are 10 questions in each level. After the test questions are answered, feedback on the test results is given. The feedback includes information such as the number of correct and incorrect answers, the succes level of the student. Feedbacks provide information on the number of the correct and incorrect answers, performance levels, as well as recommendations on how to improve knowledge on test questions. A record of feedback is kept for each student. Students can access these records when they enter the module.

**Activities Module**

In this module, students are asked to use their Scrath programming skills to perform certain activities with specific goals (Fig.3). There are a total of 20 Scratch programming activities in the module. Events are listed from easy to difficult. This provides step-by-step learning of programming logic. In every activity, students have to reach a certain goal by using programming skills. Tips for reaching the goal are offered to students.

Drag-and-drop is used to perform activities. If the activity is performed correctly, students can go to next activities. In the case of the wrong activities, students are informed about the mistakes they have made, and what they need to perform the activity correctly.

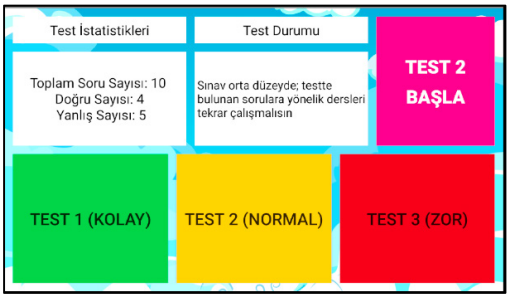


Fig.2. The screen view of the test module


Fig.3. The main screen of the Activities Module

## 6. Results

To evaluate programming skills pretest and posttest were applied to the students.

**Pre-test findings on programming skills of the students**

The appropriateness of the normal distribution of the groups was confirmed by the Shapiro test before the students tested their programming skills in the experimental and control groups. According to the test result, the data are normal distribution in both groups because the data is higher than the 0.05 significant level [p = 0,825> 0,05]. The descriptive statistics and normal distribution test results of the groups are shown in Table 1.

Table 1. Descriptive Statistics and Shapiro-Wilk Normal Distribution Test Results

| Group | N | X | Ss | Min | Max | Shapiro-Wilk |
|---|---|---|---|---|---|---|
| Experimental | 41 | 13,51 | 3,35 | 6 | 22 | ,825 |
| Control | 53 | 12,36 | 3,09 | 6 | 19 | ,288 |

Since the data are normally distributed the Sample t-Test was used as a parametric test technique to examine the difference between the programming skills of the groups. Results of independent sample t-test are shown in Table 2.

Table 2. Pre-test Sample t-Test Results

| Group | N | X | Ss | Sd | t | p |
|---|---|---|---|---|---|---|
| Experimental | 41 | 13,51 | 3,35 | 92 | 1,729 | ,87 |
| Control | 53 | 12,36 | 3,09 | | | |

From table 2 we could see that there was no significant difference between pre-test programming skill scores of the students in the control group and the experimental group (p> 0.05). The reason for this is that the initial programming skill scores of the students in the study group are similar. At the same time, the homogeneity of the

variances of the groups was analyzed using the Levene Test. As a result of the analysis, no significant difference was observed between the groups [F = 0,121, p = 0,73> 0,05].

**Post-test findings on programming skills of the students**

The appropriateness of the normal distribution of the groups was confirmed by the Shapiro test before the students post-tested their programming skills in the experimental and control groups.. According to the post-test result, the data are normal distribution in both groups because the data is higher than the 0.05 significance level [p = 0,208> 0,05]. Descriptive statistics and normal distribution test results of the post-test programming skills of the groups are shown in Table 3.

Table 3. Descriptive Statistics and Shapiro-Wilk Normal Distribution Test Results

| Group | N | X | Ss | Min | Max | Shapiro-Wilk |
|---|---|---|---|---|---|---|
| **Experimental** | 41 | 20,00 | 2,40 | 15 | 24 | ,208 |
| **Control** | 53 | 18,68 | 3,30 | 9 | 24 | ,096 |

The post t-test results on the groups are shown in Table 4.

Table 4. Independent Sample t-Test Results

| Group | N | X | Ss | Sd | t | p |
|---|---|---|---|---|---|---|
| Experimental | 41 | 20,00 | 2,40 | 92 | 2,157 | ,034 |
| Control | 53 | 18,68 | 3,30 | | | |

From table 4., it showed that there is a significant difference between the pre-test programming skill scores of the students in the experimental group and the control group (p <0.05). It was observed that the experimental group had more increase in the programming skill (X = 20.00) than the control group (X = 18.68) [p = 0,034 <0,05]. However, when both pre-test and post-test scores are examined in both groups, the programming skill scores of both the experimental group and the control group are increased.

## 7. Conclusion

In this study one mobile learning application for Scratch programming learning is discussed. The application was developed to support the programming education in the secondary schools. The influence of this application on the development of programming skills of students has been studied. The test results show that there is significant difference between the post-test results of students who use mobile learning and those who do not.

Therefore, an application that guide students to encode in the mobile environment can positively contribute to development of programming skills of students

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