Coding Education in a Flipped Classroom

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Abstract - **The main purpose of this research is to determine the influence of the flipped classroom model on digital game development and student views on the model. 9th grade students attending Bilişim Teknolojiler II at secondary level participated in the study. The research is an experimental research, designed according to the pretest-posttest research model with experimental and control groups. In the experimental group, the lectures were carried out according to the flipped classroom model while the control group was taught with the traditional methods in the laboratory environment. As a result of the research, the success of the digital game development and the opinions of the students were favored by the experimental group students who were educated with the flipped classroom model. The results obtained in the last part of the study and suggestions for the results are discussed.**

Keywords - **Flipped classroom, coding, digital game development, Scratch.**

1. Introduction

Nowadays, the development and progress of technology creates important changes in respect to both social and different fields. This change and innovation effects the education and training process too. It is known that several needs of either individuals or organizations and institutions are provided by computers and smartphones in the 21st century [1].

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Technology was included in the education sector after affecting social life and living standards in such an important way. Roblyer and Edwards (2000) assert that the use of technology in education contributed to the motivation of students, provided an effective use of time for the teachers who are teaching in the classroom, and assisted the students in gathering necessary information and abilities. Activities that apply to multiple sense organs in education environments are thought to provide a quality education. These types of activities are known to provide easy and permanent learning [2,3]. The use of technology in education is one of the most important requirements of our day [4,5].

Nowadays, researchers and course teachers do much research in order to affect the students' learning positively and provide an active learning environment [6,7]. This new research and new approach, which is called the flipped classroom, provides an active learning environment for the students and teachers [8]. This education model, which is known as a flipped classroom or transformed classroom, is a special type of blended education [9,10]. The flipped classroom model allows students to perform the course by taking support from information technologies. Performed studies and the flipped classroom model have become a popular interclass implementation and education model in these days [11].

According to Mull [12], the flipped classroom model is defined as a model where students have the possibility to add new information by watching videos before the lesson, listening to podcasts, and researching articles about the subject.

In another definition, students in the flipped classroom model study with the materials given by their teacher and prepare questions about the points they did not understand [13,14,15]. In the flipped classroom model, students are prepared with the course teaching videos, which they watch at home, and are included in the activities such as problem solving, finding the answers with prepared questions, and brainstorming with group study [16].

The most important advantage of the flipped classroom model is encouraging teamwork and interclass discussions in respect of learners [13,17].

In many researches it has been mentioned that technology theory increased student motivation [18,19,20]. Technology has been made an inseparable part of human life by the personal computer. The most important reasons for integration of personal computers to human life in a short time are the use of computers in health, tourism, media, education and several other sectors; also, they are becoming cheaper as well as smaller [21].

By integration of computer to every field of life, the software sector gains more importance day by day [21]. However, software courses are underestimated [22,23]. In previous studies, it is seen that students have a negative attitude towards programming and computer programming is considered boring by students [24]. Besides, when the body of literature is scanned, several researches exist about the difficulties of computer programming and its teaching [25].

It is seen that the above-mentioned difficulties have many reasons in body of literature. When the body of literature was scanned, the most common programming languages were Visual Basic, C++, C#, and Java. These are considered difficult to learn by students [29,27]. Accordingly, in order to prevent this situation and ingratiate the programming, there are some computer programs for beginners and children in developed countries [23]. Small Basic and Scratch programs are an example. If secondary school students are targeted, the most important characteristics of programming language should be language support, easy usage, and simple interface so Scratch software could be accepted as the suitable program, which provides these features [23]. Programs, which are developed at the same time, open sourced code loaded in to Scratch list and they could be assessed by the other users, changed and developed [23]. Students can make their own designs by Scratch and execute creative solutions for the problems they faced in real life [23].

2. Related Research

2.1. Flipped Classroom

Kakosimos [26] tested the flipped classroom model in his study. Instruction on a chemical engineering liquid operations module was achieved in application. In a qualitative evaluation, it was determined that there was an improvement in students' perception through flipped classroom model. In addition, a general improvement was observed in the control group.

Velegol, Zappe and Mahoney [27] reviewed the literature on the flipped classroom method used for engineering students. Recommendations were provided in that study about interaction, performance evaluation, video duration, time spent in the class, and lecture organization based on the flipped classroom model.

Lee, Beatty, Feng, Hoffman and McDermott [28] applied the flipped classroom model to first year students of librarianship. They taught the lessons based on the collaborative learning process. The traditional method and flipped classroom model were compared in application. In order to evaluate the effectiveness of the two methods, students took exams at the end of the application. Results revealed a significant difference between traditional method and flipped classroom model in favor of the students who took lectures based on flipped classroom model.

Kim and colleagues [13] conducted a study with 115 students and compared student-centered classroom and flipped classroom models. A significant difference was observed in favor of students in the flipped classroom.

2.2. Visual Programming for Digital Game Development

Genc and Karakus [29] used Scratch design program, which is a graphical programming language, to promote students' active participation in the design process in "Designing Computer Games in Education" and improve their mathematical and computational skills. Students were asked to share their opinions about game concept in the game design process and their experiences of Scratch use through blogs. A total number of 109 second-year students from the department of Computer Education and Instructional Technology participated in the study. Qualitative data was collected from the surveys in the blogs of the researchers and quantitative data was collected from student blog softwares. The results of the study revealed that students have positive opinions about Scratch, learning with design leads to permanent learning, and that the blog-supported instruction method was internalized by the students.

Liang [30] conducted a semi-experimental study to create awareness about secondary education students' cognitive effects and examine their creative thinking and problem-solving performances related to Scratch-based programming based on peer evaluation. There was both a control group and an

experimental group for the application. The Scratch-based programming approach and a peer evaluation system were applied to participants for 10 weeks. Results showed that Scratch-based programming improved students' achievement, attitudes, and meta-cognitive awareness skills.

3. Purpose

The main purpose of this study is to determine the effects of Flipped Classroom model on developing a game in a secondary education. The following questions aimed at finding answers.

1. Is there a significant difference between the students receiving education in the flipped classrooms model, and the control group students with regards to success in the field of game coding?

2. What are the opinions of the empirical group students about the flipped classroom education model method?

4. Method

Research model

Qualitative and quantitative methods are used together in this research. In the quantitative dimension of the research, pre-test post-test, Rubrick gradual pointing key, and the success test were used. In the qualitative dimension of research, data was obtained through semi structured interview forms.

Forming working group

The working group of this research consists of 9th grade students who receive education in Lapta Yavuzlar High School adhered to General Secondary education Administration located in North Cyprus National Education Ministry. It has been assessed whether there is a significant difference or not between two groups based on first-term Computer course success of the students who participated in the research. Due to the fact that first term computer course success grades of both groups will affect the research, an independent t-test has been implemented and difference was observed. Lastly, student numbers in schools were observed in order to organize the empirical group and control group; odd numbers have been included in the empirical group, even numbers have been included in the control group. According to this, the experimental group included 28 students and the control group included 24 students.

Table 1: Computer course success grades of experimental and control group

	N	Average	SS	df	T	p
Experimental	28	77.964	12.685			
				50	-.069	.945
Control	24	78.208	12.819			

As seen in Table 1., there is no significant difference for the first term computer success grades of both groups of students (p>.05). Depending on the first term computer success grades of students, it has been determined that both groups are suitable for experimental study and there is no significant difference between the computer course success grades, which is necessary for Digital game developing.

Data collection tools and implementation

The success test was used in order to determine the success of students towards game development. **The Rubrick Graded Pointing** scale was generated in order to point the game software, which was developed in Scratch software by experts, and it has been used in order to assess the student projects.

Preparing education environment and application

The Wordpress content management system, which is free and an open sourced code system, was chosen in the research. Due to the limitation on video sizes that could be uploaded to the Wordpress content management system, course videos have been uploaded to www.youtube.com by establishing a private channel, named Flipped Classroom-scratch Education, and the content of the videos have been linked to course site.

Figure 1: Main page view of course materials where course materials exist for the Flipped classroom education method

The main page view of course materials where course materials exist for the Flipped classroom education method is shown in Figure 1. On the main page, the students are told how to reach the lesson about the flipped classroom education method. Course videos and other materials exist on the menu, named course videos. Each course video has been added to the online environment weekly.

Implementation

The difference between the experimental group and control group during the implementation has been maintained according to experimental group's flipped classroom education model.

Subjects in the experimental group and control group were taught: introduction to algorithm, introduction to main programming, code blocks of scratch programming, variations, and game developing mechanics (scoring, life decrement, passing a level). Coding education and digital game development have been studied during their education, which was realized for 8 weeks. Scratch software was used for software education, which has Turkish Language support and has an easy interface for software beginners.

A discussion group has been established and a chat environment has been formed in order to provide interaction between the students on a one-to-one basis except in the environment where the videos and materials are shared. Implementation of subjects in class environment has been carried out with the experimental group students' activities, such as collaborative activities and brainstorming. Lecture videos of students in the experimental group were prepared with the Camtasia studio group, since they included asking questions and adding surveys. Therefore, it was determined which students come ready to the lecture. In order to check whether the students of the experimental group follow their lessons at home or not, according to the flipped classroom education model, the students were asked to use the same method that they studied at home before the start of application. In the first week, the students were told that the courses are interrelated to each other and they will not understand the final game design if they miss one of the courses. Students were asked to answer questions about the lecture via e-mail before the lecture and names of the students who answered and those did not answer were reported to the teachers. Therefore, students are motivated to watch the lecture videos before coming to the class based on the flipped classroom model. The lectures of the experimental group were conducted in a laboratory environment at 3-hour

information technologies course found in a weekly schedule.

Also, it has been announced to the students that the best 3 games will be chosen by a jury, which will be organized by the department of Computer Education and Instructional Technologies. These 3 best games' owners will be awarded with a success certificate at the beginning of education for both groups, in order to attract the interest of students.

The 8-week lecture of students in the control group was only conducted in a laboratory environment based on the traditional model. Lecture topics of students in the control group included the same topics as the ones in the experimental group. At the end of the application, students in the control group were asked to form groups with a minimum 2 and a maximum of 4 people and develop a digital game, based on the digital game development topics taught during 8 weeks of education.

After the implementation, the programming abilities of students in the experimental and the control groups were measured by a graded pointing scale for success test and by scoring the developed games. During the calculation of programming abilities of students, the success test was graded over 40 % and the graded pointing scale, which was developed for the project's assessment was measured over 60%. Dimensions found in rubric scoring key developed by the researcher are Originality, Attractiveness, Needs, Fulfilment, and Study. In the Originality dimension, whether the digital games were prepared by the students, whether they got help from any website, and whether the game belongs to them or not were scored. In the Attractiveness dimension, font, background of the game, characters, and graphics were scored. All needs (character, story, supporting characters, voices, and game rules) identified for the game were scored in the Needs dimension. In the Fulfilment dimension, whether there was an incorrect code in the game was scored. In the last dimension, which is Study, spelling and grammar mistakes, incorrect codes and whether the game works without any problems or not were scored.

At the end of the application, the researcher prepared an achievement test, used to measure students' achievement. The test was administered to 52 students. The reliability of the test was calculated with cronbach alpha, Kr20 and Kr21. According to this, the cronbach alpha reliability coefficient was calculated as .893, the Kr20 value was calculated as 0.90 and the Kr21 value was calculated as 0.75. The reliability and validity of the questions in the test were calculated with p: item difficulty and d:

distinctiveness. Based on this, 5 questions were removed from the test, which included 25 questions. Subsequently, a multiple choice achievement test with 20 questions was administered to the experimental group. The test was scored over 100 and every question scored 5 points. According to this, 20 questions were included in the achievement test. Experts have assessed the digital games, which were developed by students in project developing application, and graded pointing ranks of students have been calculated. Applied success tests and project points were calculated over 100 and programing success grades of students have been found.
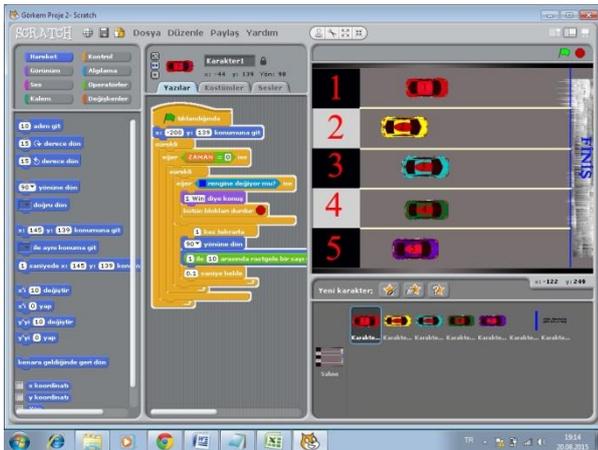

Figure 2: Digital game developed by a student with Scratch software in experimental group

At the end of the application, pre-test and post-tests were applied to the groups and included the same questions. Improvement among the students in both the control and experimental groups before and after the application was examined based on the dimensions. Therefore, the same scale was used in pretest and posttest.

5. Results

The test aiming to determine the digital game success of students was used in order to see whether there is a significant difference between the data which was collected from the Rubrik form and independent t-test.

The average success grades of students in the experimental group and the control group is shown in Table 2.

Table 2: Success grades of students in the experimental and the control group

	Group	N	Average	SS
Success	Experimental	28	86.96	6.55
	Control	24	67.29	13.74

After the end of these assessments, the average success grades of students in the flipped classroom education model was determined as 86.96 and the average success grade of students within the traditionally-taught students was determined as 67.29.

Table 3: success grades of students

	F	Sig.	t	Df	Sig. (2 tailed)
Success grades	25.576	.000	6.742	50	.000

According to the findings obtained from the analyses, it has been determined that there is a significant difference in favor of the experimental group. Therefore, the digital game developing success of the flipped classroom model has been affected positively.

Most of the students indicated that this application increased their confidence towards the course and discovered new working systems. Some of the students mentioned that learning in crowded and noisy classrooms was difficult but they could study the course in their rooms quietly by means of this method and understood the course in a shorter time. In table 4. are presented the frequencies of students towards the advantages, which were provided by the flipped classroom education model.

Table 4: Frequencies of students towards the advantages which were provided by flipped classroom education model

Views of experiment group students (n=28)	f
My confidence towards the course increased	28
I have discovered new working systems by means of the flipped classroom education model	28
I was able to listen to the course, which was difficult to hear in a crowded and noisy environment, in my room, quietly	12
I could learn the course in a shorter time	11

As seen above, the 28 students who participated the research in the flipped classroom education model experiment group mentioned "my confidence towards the course increased"; 28 students said, "I have discovered new working systems by means of the flipped classroom education model"; 12 students said, "I was able to listen to the course, which was difficult to hear in a crowded and noisy environment, in my room quietly"; and 11 students said "I could learn the course in a shorter time".

Students remarked that different applications in the classroom helped them produce more practical solutions towards their studies; they learned the courses enjoyably, moving away from the boring course environments and they could understand the lessons easily due to what they followed at home. Some of the students indicated that they were scared due to the difference of this new application and they didn't know how to work but they stopped being scared when the teachers told them how to study the courses at home and how to follow the courses. Also, some students mentioned that solving the problems, which they did not understand in the classroom, increased their self-confidence and allowed them to learn the courses in their learning speed.

Students indicated that they would log on while the Internet speed was slow during the video watching. Most of the students stated that they did not face any problem during watching the videos due to the fact that the videos could be watched in low qualities. Some of the students mentioned that they didn't know how to study at first but they solved this problem in time. Some of the students mentioned that their Internet quotas ran out while watching the videos at home because they had 3G mobile connections. One of the students remarked that he studied at home when nobody else was at home because there was only one computer and this made it difficult to study. In table 6. are presented the frequencies of students related the difficulties they had during the application process.

Table 5: View frequencies of students related to the difficulties they had during the application process

Views of experiment group students (n=28)	f
I did not face difficulties during the application process	28
There were disruptions due to slow internet speed	3
I didn't know how to study because this was a new method	8
I didn't have available time due to having one computer at home	1

As seen above, 28 students who attended the research in the flipped classroom education model experiment group mentioned, "I did not face difficulties during the application process"; 3 students said, "There were disruptions due to the internet speed was slow"; 8 students said, "I didn't use to know how to study because this was a new method"; and 1 student said, "I didn't use to have available time due to having one computer at home".

6. Discussion and Conclusion

Results aimed to assess the effects of digital game development education on the success

When the successes of the experiment and control group students are compared, it has been determined that the success rate of the experimental group students in flipped classroom education, was higher than the control students learning in a traditional method.

Based on the results of research, generally, the flipped classroom education model in education, training organizations, and usage in other courses is recommended.

It has been observed that the application of the flipped classroom education method increased the motivation of students. Programmers should develop a model related the integration of the flipped classroom education model by collaborating with the academics working in education technologies.

Activities, which will create awareness of the flipped classroom education model applications, should be carried out in order to generally implement the flipped classroom education model for all teachers.

Realizing the course teachers' applications of the flipped classroom education model effectively and being open for innovations will increase the students' motivations and successes. Also, it could be encouraged that teachers should use the course materials in other courses too.

This research is limited to 9th grade students and information technologies courses. It will be beneficial for a body of literature to reveal similar researches in different sample levels and different courses.

Accordingly, the flipped classroom education model, affected the success in positive side. Similarly to these results, [10] reached the result that the problems of students in English and Math courses decreased in the flipped classroom method and the interest and motivations of students increased towards the course. Results indicated that students'

achievement increased. In addition, students taught with the flipped classroom method in the experimental group had higher levels of achievement when compared to students in the control group. Kong [9] also taught 107 students with the flipped classroom model through tablet computers for 13 weeks. It was revealed that information, literacy, and critical-thinking skills of the students were improved. Therefore, the results of this study showing that the flipped classroom model, improves information, literacy and critical-thinking skills of students are consistent with the findings in the literature as well.

In addition, it is shown that students have positive views about environments in which the flipped classroom learning method is applied; they feel happy about the lectures taught with the flipped classroom learning method and they prefer the flipped classroom model. [8] compared the flipped classroom learning model and a traditional education method and determined that students who participated in the application reported negative views about the flipped classroom method.

Based on the results of the present study, it is recommended that the flipped classroom model should be more prevalent in educational institutions and used in other lectures as well.

Curriculum developers should develop a model that integrates the flipped classroom model to lectures and work collaboratively with academics to use this model in other lectures as well. Activities should be organized for teachers to learn more about the flipped classroom model and increase awareness to use this model in lectures. There should be essential educational platforms and materials in classrooms in order to apply the flipped classroom model at schools.

This study was conducted with 9th grade students in information technologies course. Similar studies might be conducted with different groups in different lectures.

Coding lectures should be included in secondary education information technologies curriculum of countries' Ministry of Education and said coding lecture might benefit from the Scratch program.

Researchers might conduct studies on robot programming and application development by using the Scratch program. Researchers might conduct studies in order to increase the popularity of programming instruction among young learners.

Individuals, who use technology effectively, might be raised by diversifying practices for computer programming and software development in order to create a productive society rather than a society consuming technology.

Robots, such as Arduino ve Lego Education, might be integrated into the Scratch program and coding education might be provided by robotic learning as part of software learning.

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