Students' Perceptions on Learning Programming with CodinGame

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This survey study examines students' perceptions on learning programming with CodinGame. Participants included 71 students at Department of Computer Programming Isparta University of Applied Sciences in Turkey. Both quantitative and qualitative research methods were used. In order to collect quantitative data, the questionnaire method was used, and open-ended questions were applied to reach qualitative data that data was subjected to content analysis. According to the research results, it has been determined that the participants described CodinGame as an educational code learning platform and can be used in computer programming courses. CodinGame platform provides challenge to write correct code and solve the problem, so it helps users to improve coding skills. Also, students emphasized that the platforms as CodinGame is too important to increase learning motivation in computer programming in the pandemic process for studying in distance education away from face-to-face training.

Keywords: Programming, student perceptions, CodinGame, pandemic process, coding skills.

INTRODUCTION

Programming is the most important skill in the age of technology and programming teaching has some difficulties. Robins et al. (2003) stated that programming learning is difficult, due to the needs such as learning the information specific to this structure, developing new strategies about this information and having the ability to write programs in practice. Computer programming requires abstract thinking, most students have difficulties in applying this to programming learning (Berge et al., 2003), and also instructional strategies and tools are important for programming as being a cognitively challenging subject (bt Rahim et al., 2018). According to Tan et al. (2009) the compulsory subject in the field of information technology has been a challenge that has provided a better solution as digital game-based learning to teach and learn computer programming subjects. It is thought that digital game-based learning will contribute to students in distance education especially during the pandemic process.

In Turkey, Covid-19 Pandemic was announced on March 10, 2020 by The Republic of Turkey Ministry of Health. Within the scope of coronavirus measures,

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universities decided to apply the distance education model in the Spring Semester of 2019-2020 Academic Year. Isparta University of Applied Sciences has started distance education with asynchronous course documents on March 23, 2020. And synchronous courses started on March 30, 2020, to continue their education with a distance education model during the pandemic process (Yılmaz İnce, Kabul & Diler, 2020a).

Digital game-based learning environments provide just-in time support and situated learning experiences, so they have the potential to make learning more meaningful (Prensky, 2001; Gee, 2005; Shaffer et al. 2005). The contributions of digital game-based learning to education have been proven in the literature (Priyaadharshini et al., 2020; Demirkiran and Hocanın, 2021). However, it is important to use the game in coding education and to reflect student views in distance education during the pandemic.

PURPOSE AND RESEARCH QUESTIONS OF THE STUDY

In the distance education applied during the pandemic process, it is thought that students' coding learning can be provided by digital game-based learning, the study purposed to describe student experiences. In this study, the opinions of students about using CodinGame in coding education were examined. It was investigated what the opinions of the participants about the features with the questionnaire used in accordance with the research. This study is considered to be a detailed example for the use of CodinGame in the game programming course. The research questions of this study are listed below;
1. What are the opinions of participants about CodinGame platform features?
2. Is CodinGame useful for Computer Programming learning?
3. What are the difficulties that participants have with the CodinGame platform?
4. What are the participants' general opinion about the CodinGame environment?

There are studies about educational benefits of CodinGame, but the importance this research is using CodinGame in distance education during the pandemic period and reflecting students' views.

LITERATURE REVIEW

Educational games contribute positively to students' motivation towards the lesson (Tüzün, Barab, & Thomas, 2019), academic success (Toraman, Çelik & Çakmak, 2018), cognition level and learning outcomes (Lamb et al., 2018) is determined. Educational computer games used in many disciplines are also used in computer programming teaching. Kazimoglu et al. (2012) designed educational digital game to teach introductory computer programming, the participants enjoyed playing the game and the game can enhance the problem-solving abilities of students according to participants.

Mathew et al. (2019) introduced a game to enhance problem solving skills of programmers, according to the results the game helped most of the students in understanding the programming concepts, structures and problem-solving strategies. Rose et al. (2020) described the design of a novel educational block-based programming game, to introduce and reinforce procedural abstraction, and according to research it is recommended for improving the evaluations of educational games using learning trajectories and restrictive success conditions to introduce complex content.

An and Cao (2017) indicated that the game design experience had a positive influence on the teachers' attitudes, self-efficacy, and perceptions regarding the use of digital games in the classroom. In the 2019-2020 academic year, there was a compulsory transition from traditional education to distance education due to the pandemic, and researchers have investigated distance education in the pandemic process (Serhan, 2020; Yılmaz İnce, Kabul & Diler, 2020b). Digitization in education

during the pandemic process has led to frequent discussions and recommendations of game-based teaching (Sutton and Jorge, 2020; Blume, 2020; Gupta et al., 2020).

Wehden et al. (2021) researched how omnidirectional virtual reality treadmills influence the gaming experience, to measure flow feature used the game experience questionnaire. Wang and Yao (2020) examined the influence of telepresence and user control on the effectiveness of embedded billboard ads in a VR racing game by using the same questionnaire. In this research, CodinGame all features were evaluated by the participants using the game experience questionnaire.

Butt (2016) researched students' perceptions of game-based learning using CodinGame; and according to the findings the students found CodinGame enjoyable and in some cases preferable to conventional approaches. Besides code learning, CodinGame is aiming at companies recruiting people with specific computer programming skills, that offers a number of tests for evaluation of the computer programming skills of each candidate (Ivanova, 2016). Fraser (2017) CodinGame can be used as platform for gamification of software testing. Rosado (2019) emphasized the goal of the CodinGame platform is not only to provide a funny way to learn, practice, and improve programming skills but also to help participants and employers to contact each other for consideration.

METHODOLOGY

CODINGAME PLATFORM

CodinGame is a web-based educational game platform that supports programming languages and focus on the gamification of coding. Users solve short programming puzzles by writing a program to graphical user interface that presents learners a traditional code editor. CodinGame developers' aim to let programmers keep on improving their coding skills by solving the World's most challenging problems and learn new concepts.
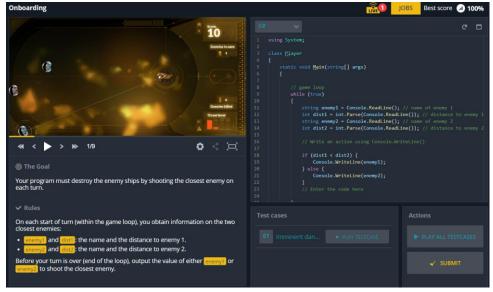

Figure 1. CodinGame platform

CodinGame consists of four parts: game visual, goal, coding and test cases for each game (see Figure 1). The game visual is the scene where the game takes place, and it stages the game according to the codes written by the user. The goal section contains the story of the game, the purpose of the game and instructions about coding. In the coding part, it enables to write programs in the coding language chosen by the user and includes the starting codes of the game. In the test cases section, it is the part where the

written codes are tested. CodinGame Platform offers users the opportunity to encode, test and re-encode.

There are studies on the use of CodinGame for programming education with gamification (Fraser, 2017), parallel programming (Buzek & Kruliš, 2018) and assessment environment (Paiva & Leal, 2018) themes. In the light of the literature reviews, considering that CodinGame is an instructional platform, the benefits of computer programming students are considered.

PARTICIPANTS AND SETTINGS

This study was conducted at Isparta University of Applied Sciences during the academic 2019-2020. All of the participants were second-year associate degree program in computer programming. All participants were second year students who had completed "Introduction to Algorithm and Programming", "Visual Programming" and "Game Programming" courses a term ago. Each participant completed ten different challenges in three-week period in the CodinGame. Volunteering and availability principles were taken as basis in determining the participants. A total of 71 participants, 42 of whom were male and 29 were female. The age of the participants is between 19 and 25 with an average of 20.2.

This study was carried out to reflect the students' perceptions on learning programming with CodinGame using the survey method. Both quantitative and qualitative research methods were used. In order to collect quantitative data, the questionnaire method was used, open-ended questions were applied to reach qualitative data.

PROCEDURES

The CodinGame environment was introduced to the students in the online course and they were given 2 weeks to play the 10 games they wanted. During the 2-week period, once a week, the students shared their CodinGame experiences in the online course. It was determined that students chose the "Onboarding" the most, as being tutorial game of the CodinGame Platform. The Onboarding goal is explained as "Your program must destroy the enemy ships by shooting the closest enemy on each turn". Onboarding is A game where you get rid of enemies by shooting from a spaceship, to win the game, "if/else" encoding enables shooting at the nearest enemy. It has been determined that most of the students have reached the 5th level on the CodinGame Platform. At the end of the 2 weeks, the students explained the games they played in the online lesson and gave information about their experiences. At the end of the course, the students were given a questionnaire and open-ended questions via an online questionnaire.

MEASUREMENTS AND DATA ANALYSIS

Questionnaires consist of three section as demographic questions, game experience core module with likert scale 33 items and 3 open-ended questions for this research. Gender and age variables were asked in the demographic questions section (see Appendix). Game experience core module questionnaire measures features as competence, sensory and imaginative immersion, flow, tension/annoyance, challenge, negative affect, and positive affect of the game platform, that are created by grouping the questions to each subtopic by IJsselsteijn, de Kort and Poels (2013).

In section two, the information obtained from the questionnaires applied to students was coded to the computer. The questionnaire distributed with an online web form in the course and student information system of the Isparta University of Applied Sciences. The response rate was 88%. SPSS statistics program was used to analyze the obtained data. The collected data were transformed into tables, and presented with arithmetic mean analysis results.

The data from open ended question answers were analyzed using the content analysis method in section three of questionnaire. The data are encoded taking word

frequencies into consideration. After coding by the researcher, the same record is re-coded by another field expert. After calculating concordance and differences between the two encodings, the percentage of intercoder reliability was determined to be 95%. The research findings are described in codes and frequencies. In addition, the statements used by some of the participants are presented.

RESULTS

RESULTS FOR OPINIONS OF PARTICIPANTS ABOUT CODINGAME PLATFORM FEATURES

The game experience questionnaire consists of 33 items and seven components. Component scores are computed as the average value of its items, challenge ($\bar{x}$=2.68) is the highest and flow ($\bar{x}$=1.97) is the lowest component according to questionnaire results (Table 1). Participants defined the CodinGame environment as a challenge in terms of game subjects and problems in open-ended questions, but they did not like the flow because the games have different stories and are independent games. Positive ($\bar{x}$=2.65) and negative ($\bar{x}$=2.54) affect averages are close to each other, it has been determined that there are those who find the CodinGame environment positive as well as negative ones.

Table 1. *Components of the Experience Questionnaires*

Components	Items	$\bar{x}$
competence	2, 10, 15, 17, and 21	2.25
sensory and imaginative immersion	3, 12, 18, 19, 27, and 30	2.53
flow	5, 13, 25, 28, and 31	1.97
tension/annoyance	22, 24, and 29	2.39
challenge	11, 23, 26, 32, and 33	2.68
negative affect	7, 8, 9, and 16	2.54
positive affect	1, 4, 6, 14, and 20	2.65

Open-ended questions were asked to reflect students' opinions about CodinGame in depth. "Is CodinGame useful for Computer Programming learning?", "What are the difficulties you have with the CodinGame platform?" and "What is your general opinion about the CodinGame environment?" questions are asked to participants in online web form.

RESULTS FOR USEFULLNESS OF CODINGAME COMPUTER PROGRAMMING LEARNING

Participants answered the question "Is CodinGame useful for Computer Programming learning?" as 58% yes; and some of them that answered as no this item made explanation as:

P21: CodinGame environment is not suitable for those who never know how to code.

P36: It took me too long to understand the purpose of the game.

P48: When I tested the codes, the software I wrote gave an error although it was correct.

P64: ….games have information about coding levels, but games must have a written mathematical difficulty level.

RESULTS FOR DIFFICULTIES İN CODINGAME PLATFORM

The participants listed as the difficulties they faced on the CodinGame platform; difficulty of understanding the game story (20%), game problem difficulty (15%), having few hints to solve problem (10%), having different independent stories (7%).

P70: I had trouble understanding the game story and the problem

P32: …games in the environment are classified according to software subjects but not by difficulty

P18: There should be more hints in the environment

P12: The games in CodinGame have different independent stories

RESULTS FOR GENERAL OPINION ABOUT THE CODINGAME ENVIRONMENT

When the answers of the participants about CodinGame are examined; coding practice in different languages (35%), motivation during Covid-19 pandemic process (21%), educational environment (17%), makes learning fun (8%), and job opportunity (3%).

P14: CodinGame covers many different software languages, it is a nice environment to practice in different languages

P7: I am happy to introduce a different educational game environment in distance education during the Covid-19 pandemic process

P56: It teaches you to code faster and more effectively as it pushes you to code against time in online games

P12: I liked CodinGame because of being simple and fun environment

P69: CodinGame provides job opportunity, I see the link labeled as get a job

According to the answers given to open-ended questions, although students have critical thoughts about the CodinGame platform, they see it as an educational environment for computer programming. The CodinGame environment is convenient, fun and educational for writing codes in different software languages according to the participants.

DISCUSSION AND CONCLUSION

In this study, the students' perceptions on learning programming with CodinGame has been researched. CodinGame is described as enjoyable learning material (Butt, 2016; Rosado, 2019), evaluation instrument (Ivanova, 2016), gamification tool (Fraser, 2017), communication tool with employers (Rosado, 2019). Relevant research in the literature advocates that CodinGame is a suitable platform for learning, it is the same according to the opinions of the participants in this study.

In this research, participants described CodinGame as an educational code learning platform and can be used in computer programming courses. CodinGame platform provides challenge to write correct code and solve the problem, so it helps users to improve coding skills. Also, students emphasized that the platforms as CodinGame is too important to increase learning motivation in computer programming in the pandemic process for studying in distance education away from face-to-face training. Considering student views and academic research, it is suggested that CodinGame can be used as a learning material in the computer programming course. CodinGame records the actions users take on the platform, and gamification of the course can be achieved with these records and scores. CodinGame can be used for communication with companies and individuals in the software field.

The limitation of this research is CodinGame player and trainer are not in the classroom because of being in the pandemic midterm and in distance education, if there was such a possibility, the instructor would have information about the participants' instant reactions to the game.

Suggested topics for future research could be: (a) if the participants are in the same environment with the instructor while playing the CodinGame game, instant emotion changes can be watched, and (b) other educational games developed about coding education can also be made available to participants and a comparison research can be done

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APPENDIX

QUESTIONNAIRE

Dear Students,

This research is carried out to find out your perceptions on learning programming with CodinGame. Answering the questions sincerely is very important in terms of obtaining reliable information as a result of the research. Your answers will be kept strictly confidential and will only be used for scientific research. If you would like information about the study, you can contact us. Thank you for your contribution.

Section 1: Demographic Questions
Gender:

Age:

Section 2: Game Experience Questionnaire – Core Module

Please indicate how you felt while playing the game for each of the items, on the following scale:

not at all	slightly	moderately	fairly	extremely
1	2	3	4	5
< >	< >	< >	< >	< >

1. I felt content
2. I felt skillful
3. I was interested in the game's story
4. I thought it was fun
5. I was fully occupied with the game
6. I felt happy
7. It gave me a bad mood
8. I thought about other things
9. I found it tiresome
10. I felt competent
11. I thought it was hard
12. It was aesthetically pleasing
13. I forgot everything around me
14. I felt good
15. I was good at it
16. I felt bored
17. I felt successful
18. I felt imaginative
19. I felt that I could explore things
20. I enjoyed it
21. I was fast at reaching the game's targets
22. I felt annoyed
23. I felt pressured
24. I felt irritable
25. I lost track of time
26. I felt challenged
27. I found it impressive
28. I was deeply concentrated in the game
29. I felt frustrated
30. It felt like a rich experience
31. I lost connection with the outside world
32. I felt time pressure
33. I had to put a lot of effort into it

Section 3: Open-ended questions

1. Is CodinGame useful for Computer Programming learning?

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2. What are the difficulties you have with the CodinGame platform?

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3. What is your general opinion about the CodinGame environment?

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