



# Opinions on a Digital Game Designed for the Topic of Pressure through the Kodu Game Lab

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## Abstract

Gaming is a phenomenon that is very common today and is activated by individuals of all ages. In this study, it was aimed to contribute to learning the acquisitions in the "pressure/physical phenomena" unit in the middle school science curriculum in a computer environment and to enable students to participate more actively in the lesson. This study is aimed to support Generation Z students to learn at their own pace outside the school environment and to develop their scientific process skills, engineering, and design skills. The research was conducted with the phenomenology method. The applicability of the computer game designed with Kodu Game Lab was evaluated by conducting semi-structured interviews with three science teachers and 12 students who played the game. According to the results of the research, it was concluded that the designed digital game is a feasible activity in teaching the subject of Pressure.

**Keywords:** Digital Game, Kodu Game Lab, Pressure, Science Teaching, Students, Science Teachers

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## INTRODUCTION

Science is undoubtedly the course that will offer the best solutions to the problems that students face in daily life. The general aim of the science course is to provide students with critical thinking skills, lifelong learning skills, scientific process skills, engineering, and design skills (MoNE, 2018; NRC, 2000). In the contemporary understanding of education, the teacher aims to provide a high level of benefit from the environment and methods in which learning will take place. The methods in which students actively participate in the lessons positively affect students' success and motivation in the lessons (Sezer & Tokcan, 2003). The education process is changing from a teacher-centered approach to a student-centered approach. Instead of memorization-based methods in the education process, activities in which students actively

participate in the process should be included. The use of educational games in the educational process provides the opportunity for active participation of students by attracting their attention and interest (Kaya & Elgün, 2015). According to Piaget (1954), the game is a harmony, if the individual can actively connect the pieces of information in a meaningful way as a whole by interacting; he can internalize that information more easily. There are multiple theories about games. This study is an educational game designed based on Piaget's Cognitive Game Theory. Cognitive Game Theory covers mental processes. In this theory, the game is based on the mental development of the individual. The mental development of the individual and the game are intertwined; mental development cannot be handled separately from the game (Karamustafaoğlu & Uyar, 2019).

With the advancement of today's technologies, Generation Z individuals who are intertwined with internet environments have emerged. This generation, whose motor skills are the most developed among the generations, can deal with different subjects at the same time and accordingly develop their skills in different subjects. This generation enjoys activities that allow for creativity and has a very strong memory. This generation does not like memorization and wants to learn through games and fun methods (Büyükuslu, 2017).

Today, it is seen that different computer software is used in educational platforms to make education more effective (Emrahoğlu & Öz, 2008; Taşçı & Soran, 2008; Zengin, Kırılmazkaya & Keçeci, 2011). In the global development process, the ability of societies to increase their competitiveness to a higher level can be associated with their potential in terms of technological production. In this context, raising individuals with strong technological productivity from an early age plays an important role in social goals. Corral et al. (2014) tried a game-based approach to object-oriented programming education. Today, more than 90% of Norwegian children play digital games in their free time (Medietilsynet, 2014). This generation is often referred to as "digital natives", i.e. children and younger generations who have grown up with digital technologies as part of their daily lives (Prensky, 2001).

Digital games have become part of the cultural and social reality in today's Western world and have greatly shaped the lives of those who have open access to them, especially children and young individuals. In recent years, digital games have been recognized as tools and resources that facilitate teaching. This means that games are increasingly being applied in educational situations and in various educational contexts, which again requires teachers to understand not only both the potential and the limits of digital game-based learning, but also the basic logic of coding, which is the foundation of all digital media as well as many things in our daily lives. The application of games in more and more educational situations and in various educational contexts will increase with teachers' understanding of the potential, limits, and basic coding logic of digital game-based learning, which in turn will enhance Generation Z's learning experiences with digital games. In 2013, three University Colleges in Norway started a collaboration project by creating a new university college course entitled *Spillbasert læring*. The aim was to prepare teachers at different levels of the education system to use digital games as learning tools in various forms (Nygård et al., 2015).

When the literature was reviewed, it was seen that the subject of pressure was taught with experiment, POE and argumentation studies, but there was no teaching of the subject with any digital game (Kodu lab). In this study, it was tried to teach the 8th grade "Pressure" subject "variables affecting solid pressure, variables affecting liquid pressure and gases apply pressure in a similar way to liquids" to students through an educational digital game designed and teacher and student opinions were consulted about the effect and applicability of the game. In this

regard, what are the opinions of science teachers and students about the educational digital game developed with educational games? An answer to the problem was sought.

## **METHODOLOGY**

The study was conducted with a phenomenological design, one of the qualitative research methods. The key concept in the phenomenological design is experiencing. In the phenomenological design, data collection is usually done through interviews with people who have experience. Here, the number of interviews varies depending on the way the people experiencing the phenomenon handle and experience the phenomenon in its entirety (Özmen & Karamustafaoğlu, 2019).

### **Study Group**

The participants of the study were twelve 8<sup>th</sup> grade students studying in a public middle school in a district in central Anatolia and three science teachers teaching at this level. In the selection of the participants, the convenience sampling method, one of the purposive sampling methods, was preferred. Two of the teachers were female, the male one has a master's degree.

### **Data Collection Tool**

In the study, a semi-structured interview form, which is one of the qualitative data collection methods, was utilized. Semi-structured interview forms are a tool in which the researcher prepares questions about the subject in advance and directs them to the participant during the interview process. The researcher tries to obtain in-depth information by asking probing questions to the participant when necessary. The interview form was presented to the participants after the necessary arrangements were made after receiving the opinions of two faculty members who are experts in their fields.

### **Data Analysis**

Content analysis was used to analyze the data collected in the study. The aim of content analysis is to reach relationships that can explain the data, to bring together similar data and to organize them in a way that the reader can understand (Creswell & Creswell, 2018). The findings from the interviews conducted in the study are summarized and direct quotations from the teachers' opinions are presented. The interviewed teachers were coded as T1, T2 and T3, and the students were coded as S1, S2, S3, ....

### **The Developed Game and Implementation Process**

**Name of the Game:** Solid, Liquid, Gas Planets

**The place where the game is implemented:** Kodu Game Lab Platform

**Number of students:** Single or multiple student groups

**Equipment:** All access devices with open internet access to Kodu Game Lab platform

## Rules of the Game

1. The game consists of 3 stages. In the 1<sup>st</sup> stage there are planets in which events in solid pressure are evaluated, in the 2<sup>nd</sup> stage there are planets in liquid pressure and in the 3<sup>rd</sup> stage there are planets in which events in gas pressure are evaluated.
2. Each pressure planet has its own rules.
3. Rules of the solid pressure planet:
  - Mars collects points by smashing the rocks on the surface of the planet Mars with the help of a drill and laser.
  - 10 drills are allowed, and the laser is unlimited.
  - The game on planet Mars is timed and lasts 240 seconds.
  - When the time is over, the game ends and there is no transition to the other planet.
  - You can switch after completing the level.
4. Rules on the liquid pressure planet:
  - There are 3 islands on the liquid planet. These are the island where the game starts, the island with the factory and the island with the hut.
  - Rocks from the sea are taken to the factory.
  - In the factory the rocks are turned into precious metals.
  - These rocks, which turn into precious metals in the factory, are taken to the hut and points are collected.
  - While collecting rocks, fish and octopuses in the sea reduce the health of our traveler character.
  - When 50 points are collected in the game, you move on to the next planet.
5. Gas game rules
  - The game character zeppelin moves with the W-A-S-D keys or directional keys.
  - There are 9 clouds in the game, 5 of these clouds are collected as points while 3 clouds are empty and 1 cloud explodes the airship.
  - Each of the clouds to be collected as points is worth 1 point each.
  - The player will not be able to switch to the next section without earning 5 points.
  - Game time is 120 seconds.
  - Within 120 seconds, if the section is not completed, the transition to the next section will not be provided.
  - Each full cloud is worth 1 point.

## Solid Gameplay

The traveler, the game character, is moved by the player with the direction keys. The player collects points from the ores in the rocks in the section and presses the 'A' key for the code character to send a signal to understand which rocks have ores in them. When the signal reaches the rocks, the 'B' key is pressed to extract ore from the rocks and points are obtained from the ore in the rock. The game is played in 240 seconds. In the game, the code character has drill and laser features to extract ore from rocks. While the drill feature is limited to 9, the laser feature is not limited. For this reason, when the drill feature runs out, he cannot extract ore from every rock. There are different grounds on the surface of Mars. On these floors, the player tries to fulfill the tasks by realizing the relationship between the progress speed of the Kodu character

and the pressure in the game. The game ends when the game time is over. When the Kodu character's drill feature runs out, the game is restricted because the player's capabilities in the game are limited.



Figure 1: Solid pressure planet

### *Liquid Gameplay*

The traveler character in the game is controlled by the player with the W-A-S-D or directional keys. These keys are used for the traveler to move in the direction he needs. There are 4 octopuses and 10 fish in the game, these characters try to destroy the traveler by reducing his health. When caught by these creatures, the life of the traveler decreases. The traveler can fill his life from the life stone by going to the life island in the game to increase his life again. There is a factory in the game and a sales hut where the stones processed in the factory are sold and turned into points. There are a total of 10 stones in the game to be taken to the factory, 4 of these stones are in the octopus' zone and 6 of these stones are in the fish zone. Each of the tiles in the octopus' zone has a point value of 10 and each of the tiles in the fish zone has a point value of 3. The player who reaches a total of 50 points is considered successful. The player overcomes the octopus and fish obstacles and struggles to earn points by processing the stones in the factory and converting them into points on the point island. The player does this by directing the traveler character.

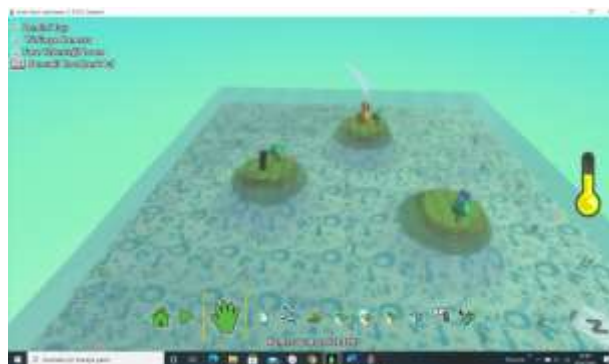


Figure 2: Solid pressure planet

## Gas Gameplay

The zeppelin, the game character, is moved by the player with the W-A-S-D or direction keys and collects points by collecting the clouds in the section. While 5 of the 9 clouds in the section are collected as points, 3 clouds are empty, and the remaining cloud explodes the game character airship. Game duration is 120 seconds. During this time, the player must collect 5 points by finding 5 clouds full of points. The player who cannot collect enough points in the given time will not be able to pass to the next section. The player is responsible for collecting clouds by moving the airship left, right, up and down with the specified keys. The player who successfully completes this part is entitled to move on to the next part.



Figure 3: Gas pressure planet

## RESULTS

In this section, the data obtained from the interviews, teachers' answers to the questions "What are your opinions about the educational game and the digital game developed?", students' answers to the questions "What did the game you played teach? Do you think the game contributed to learning the subject of 'Pressure'?", "Is the lesson more effective with the digital game?", "Are there any parts of the game that you do not understand or have difficulty with?", "Did you have fun playing the game?" are presented respectively. While the common aspects of the answers are given in the foreground, one-to-one quotations are given from some of the answers.

### Teachers' Opinions

Teachers emphasized that educational games add mobility and motivation to teaching and that digital games are an important teaching alternative, especially in today's technologically advanced world.

*T1: Gamification method with Web2.0 tools definitely contributes. The subject of pressure is one of the subjects that is difficult to understand and found boring by students. This game will increase children's motivation and interest in the lesson.*

*T2: Since we are in the age of technology, our students are very interested in digital games and applications. Therefore, instead of games that do not improve themselves and waste their time, I think games with lesson content will be useful.*

## Student Opinions

All the students stated that learning the subject of pressure by playing digital games was very effective and fun, that solids travel more slowly on soft ground, that the pressure of liquids increases as the depth increases, and that learning with games was both more effective and enjoyable.

*S2: When I was watching my friend in the liquid pressure game, I did not understand why the rocks next to the octopuses had more points than the rocks next to the fish. But when I played, I realized that the rocks there had more points because they were deeper.*

*S3: It is very good with games if we had games in other lessons.*

*S5: It would be nice if there were games for every subject, I could play them at home.*

*S6: In the solid planet, when the code character fell into the pit, it was difficult to get out, I didn't understand that part.*

*S8: I would have had more fun if the game lasted longer.*

*S9: Yes, I had a lot of fun. In fact, after school, my friends and I will go to our house to play.*



Figure 4: Some visuals from the digital gameplay

## DISCUSSION

In this digital game designed with Kodu game lab, it is seen in this study that these students, who constitute the current Generation Z, not only love the science course, but also enjoy playing the

8th grade pressure subject on the computer and comprehend the subject much better. Today, a teaching approach that takes individual differences into account, aims to make the student active in the lesson, makes the learning environment enjoyable and offers different opportunities to the student in this direction is becoming widespread. For this reason, the game technique, which is a technique that makes learning effective, has an important place in education. It is thought that the learning environment where various developmental areas of students are supported and student characteristics are taken into consideration will positively affect student success (Bernardini et al., 2014).

Digital games appear as alternative learning environments for Generation Z individuals. Digital games played over the internet have become widespread to facilitate learning and make it more fun. In this process, while it becomes difficult to control students in the internet environment, another result is that the game designed with code game lab keeps students away from awareness that will negatively affect their developmental processes. It is possible to find similar results in studies on educational digital games and educational software with the spread of digitalization in education in the 21st century (Aguilera & Mendiz, 2003; Dondlinger, 2007; Griffiths, 2002; Pallesen et al., 2015; Ulicsak, 2010).

Digital games encourage a wide range of cognitive skills, strategic and analytical thinking, decision-making, and may also improve problem-solving skills, which are reported to be acquired in this game (Akcaoglu, 2013; Akcaoglu & Koehler, 2014; Spires, 2015). In addition, spatial thinking can be significantly improved through active play, and this skill can be associated with engineering thinking skills. Furthermore, due to the brain oscillations that occur more often in more complex games related to navigation and spatial learning, users' learning and recall abilities become persistent and promote academic, social and computer literacy abilities (Mitchell & Savill-Smith, 2004).

## CONCLUSION

The language of the Kodu game lab program is simple and completely object-oriented. The programs consist of pages that are divided into rules and into conditions and actions. Conditions are evaluated simultaneously. The Kodu program is designed specifically for game development and provides custom baselines derived from game scenarios. The codes are expressed in physical terms, using concepts such as sight, hearing, and time to control character behavior. In line with the results obtained from all these components, digital games can be designed and developed with code on many topics other than pressure in science courses. This research has shown that science subjects supported by digital games can be learned more easily by students and will facilitate the work of teachers. In the regard of the results, necessary suggestions were presented to educators in the form of the designed game titled 'Solid, Liquid, Gas Planets' should be used in teaching the subject of pressure, Kodu game lab application should be utilized in teaching by designing digital games in science subjects, in-service training should be given to teachers about Kodu game lab, students should be supported with flipped education for more efficient learning with digital games.

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