

## Examining the Views of Pre-Service Primary School Mathematics Teacher on Programming Education with Gamification

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The purpose of this study is to examine the views of pre-service primary school mathematics teachers on programming education supported by gamification. For this reason, a twelve-week instructional process was designed in which gamification elements were integrated into programming education. Badges, leaderboards, and tasks were employed as gamification components. The study group consisted of 38 pre-service teachers enrolled in the Algorithm and Programming course during the spring semester of the 2022–2023 academic year. The research was conducted as a case study. Data were collected using a self-efficacy scale for block-based programming, a programming attitude scale, and an interview form. While content analysis was applied to the interview data, mean and standard deviation (SD) values were calculated for the scale items. Data analysis and storage were carried out using MS Office Excel and MAXQDA Analytics Pro 2020 software. The findings revealed that pre-service teachers demonstrated high levels of self-efficacy in block-based programming and positive attitudes toward programming. Moreover, results from the interview data indicated that gamified programming lessons enhanced students' motivation, created an enjoyable classroom environment, fostered competition and collaborative learning, and contributed to permanent learning and active participation. It was also observed that the teaching process became more engaging, and that badges awarded for completing tasks effectively motivated the pre-service teachers. In conclusion, the study emphasizes the potential of gamification to enrich programming education and make it more effective and appealing within teacher training programs.

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### Introduction

With the rapid advancement of technology, contemporary education models differ from traditional approaches, aiming to enable individuals to discover their talents, think critically, collaborate, develop socio-emotional skills, and learn through technology-supported environments. In the 21st century, there is a growing need for individuals who can conduct research instead of rote memorization, solve problems, think critically, engage in meaningful

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learning, and take responsibility in transferring knowledge. These skills represent essential learning and application competencies required for success in today's world. In this context, the choice of educational model is of great importance for equipping students with such skills.

Fidan (2016) emphasized that current teaching and learning processes are not sufficiently motivating, as knowledge is often presented to students in a direct and simplistic manner, leading to low levels of student motivation. Under such circumstances, it is unrealistic to expect students to actively participate in lessons or show increased motivation. Similarly, Kumar and Khurana (2012) pointed out that active participation and motivation of students in the teaching and learning process constitute a central problem. To overcome this challenge, students need to take an active role in the classroom.

According to Ibáñez, Di-Serio, and Delgado-Kloos (2014), game is not always a naturally occurring condition. Therefore, the use of game mechanisms can provide more enjoyable and effective outcomes, a process known as *gamification*. Gamification is an effective learning strategy employed in 21st-century education, aiming to make learning enjoyable, enhance competitiveness, increase motivation, and encourage learners to be more active and engaged through interactive games, animations, and classroom competitions. When integrated into education, gamification has been shown to increase students' motivation, interest, and participation through the mechanics and dynamics embedded in games (Üredi & Üredi, 2005). Accordingly, gamification is also used in programming courses.

Programming refers to the systematic execution of a series of commands and instructions designed to achieve a specific purpose. These instructions are constructed in computer environments through texts or blocks, referred to as programming languages. Programming is considered one of the most significant technological fields in the modern era. In programming education, gamification is typically employed to make learning more enjoyable, increase motivation, improve comprehension, and support collaborative learning. It provides a competitive environment that enhances interaction and engagement among learners. Çilengir and İzmirli (2023) found that the gamification approach increases students' motivation and achievement. Studies on programming and gamification have mainly been conducted in departments such as Computer Education and Instructional Technology (CEIT), Vocational Schools (VS), and Computer Engineering. Erol (2015), for instance, argued that the Scratch block-based programming tool can be applied across different educational levels, with its effects on motivation and achievement investigated accordingly. In contrast to similar studies, this research focuses on pre-service primary school mathematics teachers, examining the impact of gamification-supported programming education on their self-efficacy, attitudes, and perceptions.

### ***Related Studies on Gamification in Programming Education***

Gamification has recently begun to be widely applied in various fields of education, one of which is programming instruction. When the literature on gamification in programming education is examined, it is observed that studies conducted at the higher education level are relatively scarce, with most research focusing on middle and high school levels. Key studies in this area are summarized below.

Hellin et al. (2023) integrated gamification design into programming lessons to create a more engaging environment. Conducted with 215 preschool graduate students, their study

investigated how gamification tools affect student motivation and participation. Findings revealed that gamification positively influenced lesson participation.

Alsuhaymi and Alotaibi (2023) studied the teaching of HTML programming through gamification with 10th-grade students using a quasi-experimental design. Two groups were formed: the experimental group received gamified instruction, while the control group received traditional instruction. Results indicated that the experimental group demonstrated higher academic achievement and motivation.

Fidan (2016) examined the effects of gamification in Scratch-based programming instruction on participation, motivation, and achievement among 37 undergraduate students. Gamification elements such as leaderboards, badges, levels, and tasks were used. Findings showed that gamification increased student participation, motivation, and achievement while making the learning process more enjoyable.

Fiş-Erümit and Kalelioğlu (2019) conducted a study with 99 third-grade students in a private school to explore student and teacher perspectives on programming education through gamification. Focus group interviews were conducted with 30 students, and two teachers were asked open-ended questions. A five-week gamified program was implemented, and results showed that gamification made lessons more engaging for young learners, increasing both motivation and participation.

Çilengir (2019) investigated the impact of gamification on achievement and motivation in block-based programming education with sixth-grade students, using Kahoot and ClassDojo as gamification platforms. The findings revealed a significant increase in academic achievement, though no meaningful effect on motivation was observed.

Atabay and Albayrak (2020) implemented gamification to teach algorithms to preschool students through an action research study with 12 participants. Stories and gamified software were employed, and results indicated that gamification contributed positively to learning and problem analysis skills.

Özkan and Samur (2017) reviewed nine studies to investigate the impact of gamification on student motivation. Their analysis showed that common gamification elements included points, rewards, levels, and badges.

Winanti et al. (2021) examined gamification in higher education programs by comparing classes with and without gamification. Findings indicated that the gamified class outperformed the non-gamified class by 15–25 points in terms of achievement, motivation, and learning outcomes.

Ünsal Serim (2019) explored the effects of gamification in coding education on computational thinking and self-efficacy among 73 fifth- and sixth-grade students. Using a mixed-methods design, the study concluded that gamification positively influenced students' self-efficacy perceptions and computational thinking skills.

Shahzad (2023) argued that gamification is a more effective approach in learning. In a study with 122 undergraduate students developing a web-based application, the “System Usability

Scale” was applied. Results showed that 81% of students found the gamified application usable, while 79% found it easy to learn.

Sağay (2019) aimed to teach coding to younger students by increasing their interest in coding and facilitating comprehension of coding structures. The study was conducted with 106 sixth-grade students using an experimental design. Results showed that students’ attitudes toward coding and gamification were positively influenced.

Ar (2016) examined the effects of gamification on academic achievement and learning strategies among vocational high school students. Using a quasi-experimental pre-test–post-test control group design with 65 students, findings revealed that gamification enhanced the use of cognitive and metacognitive strategies, and students found learning more enjoyable, lasting, and competitive.

Meşe (2016) investigated the role of gamification elements in blended (online and face-to-face) learning environments with 63 CEIT undergraduate students using a mixed-methods design. Although no significant difference in academic achievement was found, interviews revealed that students initially participated only to earn badges but nevertheless learned the content in the process. Results indicated a positive contribution to learning outcomes, even though no significant difference was found between groups.

In summary, the literature shows that gamification in programming education generally contributes positively to student participation, motivation, and achievement, while making the learning process more engaging. However, most studies have focused on middle and high school students, with relatively fewer examples conducted in higher education contexts.

### ***Purpose of the Study***

The purpose of this study is to examine the self-efficacy, attitudes, and views of pre-service primary school mathematics teachers regarding programming education through gamification. In line with this purpose, the study seeks to answer the following research questions:

- What are the self-efficacy perceptions of pre-service teachers regarding programming?
- What are the attitudes of pre-service teachers toward programming?
- What are the views of pre-service teachers on the use of gamification in programming education?

### **Method**

The study was conducted within the framework of a mixed-methods case study design. A case study enables an in-depth exploration of a particular situation, subject, or phenomenon within its real-life context (Yin, 2003). In this research, the case consisted of pre-service teachers’ experiences with gamified programming instruction in a virtual environment. As a research strategy, the case study encompasses the logic of the design, data collection techniques, and approaches to data analysis, allowing the researcher to examine a single case in detail through multiple sources of evidence (Yıldırım & Şimşek, 2013).

At the same time, the study adopted a mixed-methods approach, which combines both quantitative and qualitative data to provide a more comprehensive understanding of the research

problem (Creswell, 2013). Quantitative data were collected through instruments designed to measure participants' attitudes and perceptions related to programming instruction, while qualitative data were gathered through semi-structured interviews to gain deeper insights into participants' experiences. Over a 12-week period, various gamification elements were implemented in the virtual programming environment. Pre-service teachers were assigned weekly tasks and activities designed to support engagement and learning. At the end of the process, interviews were conducted with eight pre-service teachers ( $n = 8$ ) from the same class to explore their views on the gamification process, the programming tool used, and their overall learning experiences. The quantitative and qualitative data were analyzed separately and then interpreted together to provide a holistic understanding of the case.

### ***Research Sample***

The study sample consisted of second-year students in the Primary School Mathematics Education Department at Kırıkkale University's Faculty of Education. A total of 38 students participated in the study: 11 male and 27 female (Table 1).

Table 1: Participants

<b>Gender</b>	<b>f</b>	<b>%</b>
Female	27	71
Male	11	29
Total	38	100

### ***Implementing Gamification in Programming Education***

The study was conducted in the Algorithms and Programming course in the Department of Elementary Mathematics Education, Faculty of Education, Kırıkkale University, during the spring semester of 2023. Scratch was used as a programming tool to help students understand algorithmic logic and write code for block-based programming. Classdojo was chosen as the gamification tool, and the course was designed around the fundamental elements of gamification. Due to the earthquake in Turkey, students attended online classes in the spring semester in all country, and students generally had access to computers or tablets. The objectives were explained to students sequentially each week and demonstrated with sample projects. After the objectives were covered, students were asked to create designs for each objective, earning badges for their designs. Gaming elements such as points and a leaderboard were integrated into the course. Students collected their scores through in-class activities and weekend assignments. A scoring table was presented to students before each lesson. Feedback was provided for each task, ensuring that students understood the importance of their work, that it had been carefully scrutinized, and that any required work was correct or incomplete. Classdojo, a social networking platform developed for educational purposes, was used. Students were assigned tasks, assigned assignments, submitted them, and graded through Classdojo. Classdojo was deemed suitable for this study because it is an educational platform that allows students to track their behavior, provide feedback, grade tasks, and assign badges. To implement the course in a gamified manner, the D6 gamification model, designed by Werbach and Hunter (2012), was used. This model consists of six steps, and while it was primarily designed for business, it can be used for various purposes (Erümit & Karakuş, 2015). The steps used in this model are shown in Figure 1.



Figure 1: 6D Gamification Design Model (Werbach & Hunter, 2012)

### Course Infrastructure

This course was designed according to the Werbach 6D gamification model (Werbach & Hunter, 2012). The design phases were as follows:

- Establish quantifiable objectives: Programming instruction using gamification in the Algorithms and Programming course.
- Outline targeted actions: Ensuring student active participation in the course, increasing motivation, and learning through fun.
- Define personas: Achievers are defined as the group of players. Achieving goals and earning rewards are the primary goals for this type of player.
- Refine the activity sequences: Two types of activities are used in the activity cycle. The first is the engagement cycle, and the second is the progression stages.
- Ensure a fun system: The gamified course features two types of fun elements. The first is casual, defined as easy fun, where the individual doesn't feel overwhelmed, while the second is competitive, human fun.
- Identifying Appropriate Tools: Appropriate dynamics and mechanics have been incorporated into the gamified course.

During the course, students were presented with a table of rules to adhere to throughout the semester, tasks to complete, activities that could earn them extra points, descriptions of weekend tasks, and badges to be earned for assigned tasks during and after class. Leaderboards were displayed at the beginning of each week to create a competitive environment. Gamification-specific activities were implemented to integrate gamification into the course. To ensure students were engaged and enthusiastic, they were not told what activities they would complete or how many badges they would receive. Feedback, scoring, in-class and weekend tasks, and badges were provided through the Classdojo program. For all assigned tasks, students

were given a specific time limit and asked to submit their completed activities within the allotted time. If they missed a submission, they would not earn a badge, and no points were deducted. Three online group activities were conducted during the semester, and these activities were included in randomly assigned groups to encourage communication and collaborative learning. A group leader was randomly selected for the online group activities, and the group leader was tasked with adding the group's activities to the Classdojo program. The assigned tasks progressed from simple to challenging, and scores varied accordingly. Instead of midterm and final exams, students were asked to create activities using the codes they learned in class. Their scores were calculated by combining 50% of the points earned on Classdojo with 50% of the activities they prepared. Students were informed at the beginning of the semester that the course would progress from simple to challenging, and the topics they would learn were explained in stages. As mentioned above, the topics covered in the 12-week course plan and their respective stages were outlined. Activities within the course were categorized as: 1) Demonstration Task, 2) Group Work, and 3) Weekend Activities.

**Demonstration Task:** Students were expected to perform the activity one-on-one on the topic covered in class, and a task description was assigned to them through Classdojo. The goal was to encourage students to learn through practice and practice. After the lecture and activity were completed by the academic, the students were given 15 minutes to complete the assigned task and turn it in. An example of a show-and-do exercise is shown in Figure 2.

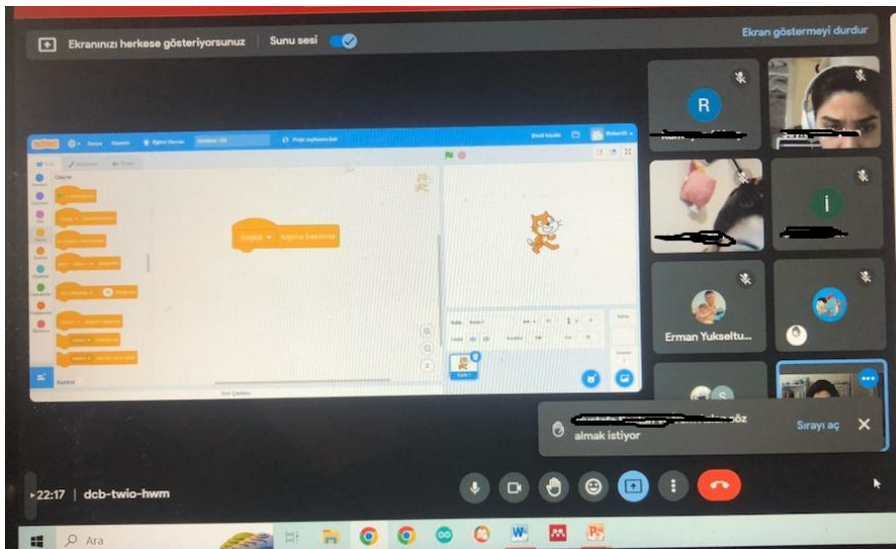


Figure 2: Demonstration Task

**Group Activities:** The purpose of the group activities was to ensure that students communicated with each other as they would in a classroom setting, to work together through cooperative learning to achieve goals, and to fulfill assigned tasks with full awareness of their responsibilities. Because the algorithms and programming course was conducted online, group activities were also provided online. Group activities were conducted three times during the semester: in weeks 4, 7, and 13, and students were expected to complete assigned tasks. A group leader was randomly selected from each group, and task assignments were made on behalf of the group leaders. Students were assigned the tasks and group leader assignments for Week 4, as shown in Figure 3.

#### 4.HAFTA ETKİNLİĞİ/2 Düzenle

10 Onaylı A 0 Doğrulama bekliyor C 0 Henüz göndermedi

Grup şimdiye kadar öğrenmiş oldukları kodları birlikte iki kuklayı eş zamanlı olarak belirlenen noktadan sona kadar yön tuşları ile hareket ettirir. (30dk.)

Mar 23

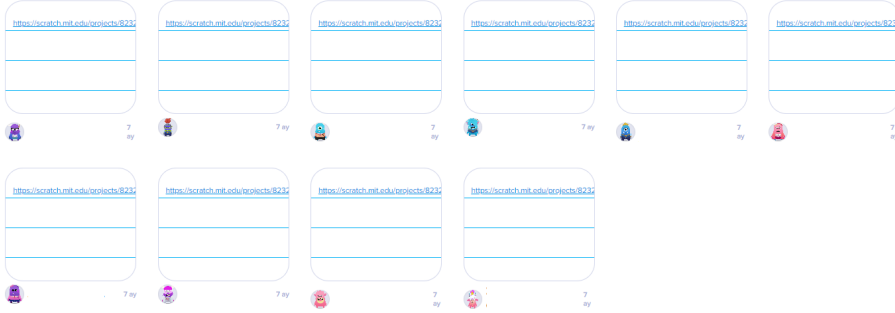


Figure 3: Appointment of Group Heads and Studies

During group work, 10 different online classrooms were created, and students created their own designs with their groupmates within these classrooms. A visual of the students' group work is shown in Figure 4.

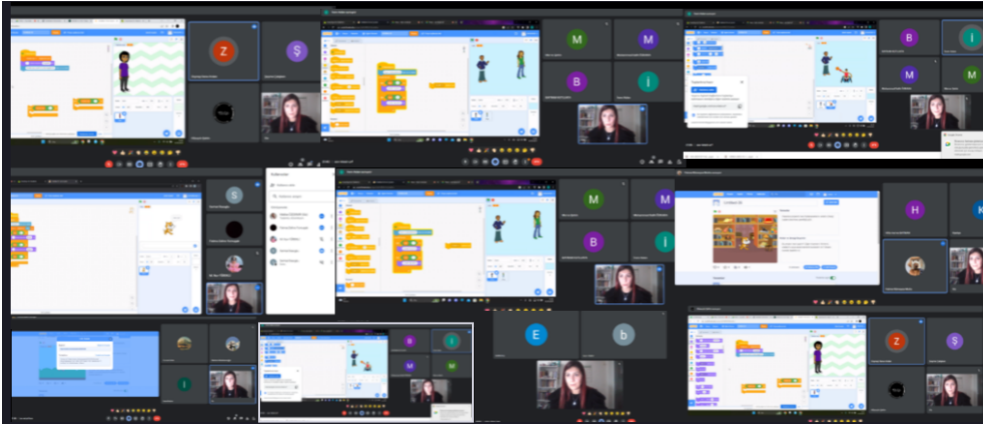


Figure 4: Group Work Activities

*Weekend Activities:* These activities consist of projects where students are assigned tasks related to the code blocks used for the week to submit on Sundays at the end of each course. Students are asked to submit these tasks on the designated day. The weekend activities are individual activities, where students are asked to develop various designs, such as game design and storytelling, using their own creativity in Scratch within specific guidelines. In the fifth week's Scratch weekend activity task (Figure 5), students are asked to create a design using characters and following the specified rules.

## 5.Hafta Sonu Görevi ✦ Düzenle

35 Onaylı 0 Doğrulama bekliyor 5 Henüz göndermedi

Hafta sonu için Sizlere resimde verilen karakterleri kullanarak, Kedinin uçmasını ve karşısına fare çıktığında fareye dokunup 1 puan almasını, binaya dokunduğunda ise -10 puan kaybetmesinin olacağı bir oyun tasarımı yapmanızı istiyorum...

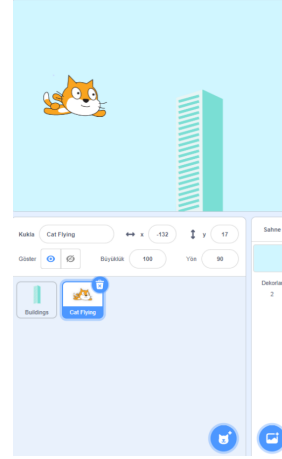


Figure 5: Weekend activity task - Visual and rules

In the given design, although the badge that was included in the badges wasn't assigned during the week, the student added different things to the activity. In addition to the specified commands, the student added "lives" to the puppet, causing it to lose points and lose lives each time it touched a building. Another striking aspect here is the harmony between the props and the puppets used.

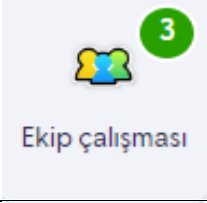
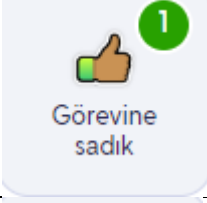
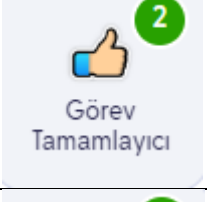
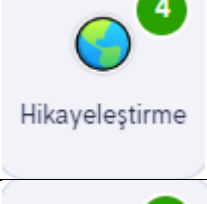

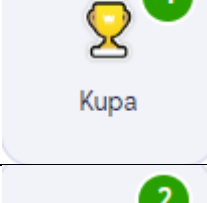
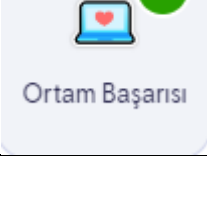
**Badges:** These are representative points students earn as rewards for completing assigned tasks. Points are awarded through the virtual classroom created in Classdojo. While badges are available on Classdojo, faculty can also create their own badges. Students can also view their earned badges. Images of the badges are provided in Figure 6.






Figure 6: Badges

Badges awarded by Classdojo include those for helping others, teamwork, faithfulness to duty, determination, participation, and hard work, while badges added by the researcher include task completion, punctual, storytelling, trophy, environment achievement, player, and overachiever. The purposes of the badges are listed in Table 2.

Table 2: Purposes of Using Badges

Badge Icon	Badge Name	Explanation	Puan
 Ekip çalışması	Teamwork Badge	Tasks are given to students as a result of group work.	3
 Görevine sadık	Faithful to Duty Badge	It is given to students who do the assigned task but cannot fully complete it.	1
 Görev Tamamlayıcı	Mission Completion Badge	It is given to students who have completed the given task completely.	2
 Hikayeleştirme	Storytelling Badge	It is given to students who successfully complete activities such as animation, story, etc.	4
 Kararlı	Decisive Badge	It is given to students who decide on the design and share it as stated.	1
 Kupa	Trophy Badge	Awarded when students contribute to a project in Teamwork.	4
 Ortam Başarısı	Media Achievement Badge	It is given to students who are successful in group work.	2

 Oyuncu	Player Badge	It is given to the student who successfully creates Game Designs.	4
 Sıkı çalışan	Hard Worker Badge	It is given to the student when the assigned task is completed.	3
 Üstüne Koyan	Extra Worker Badge	It is given to students who fulfill the assigned task and contribute to it.	5

**Leaderboards:** These are representative points students earn as rewards for completing assigned tasks. Points are awarded through the virtual classroom created in Classdojo. A picture of the leaderboard on Classdojo is shown in Figure 7.

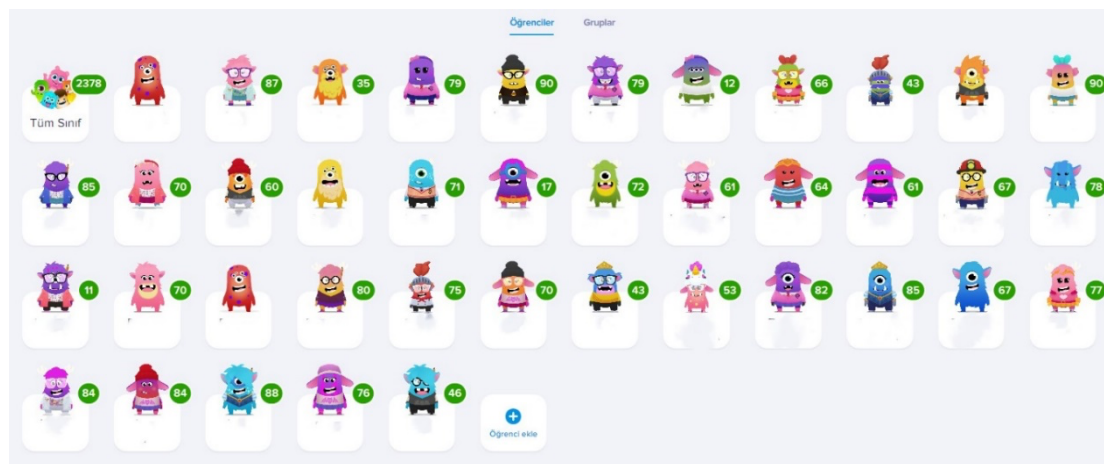


Figure 7: Scoreboard

### Data Collection Tools

**Computer Programming Attitude Scale:** In this study, the Computer Programming Attitude Scale, developed by Çetin and Özden (2015), was used to examine students' attitudes toward programming. This scale consists of 18 items on a 5-point Likert-type scale (1 = Strongly disagree, 5 = Strongly agree) measuring cognitive, affective, and behavioral attitudes. The Cronbach alpha internal consistency coefficient for the scale was 0.93, while the reliability coefficients for the sub-factors were calculated as 0.80 for the affect/desire dimension, 0.80 for the cognition dimension, and 0.90 for the behavior dimension.

**Self-Efficacy Perception Scale for Block-Based Programming:** The Self-Efficacy Perception Scale for Block-Based Programming, developed by Altun and Kasalak (2017), was used to examine pre-service teachers' self-efficacy toward programming. This scale consists of two factors: simple block-based programming tasks and complex block-based programming tasks. This 5-point Likert-type scale (1 = I don't trust at all - 5 = I completely trust) consists of 12 items. The reliability coefficient for the simple block-based programming tasks factor was found to be 0.828, and the reliability coefficient for the complex block-based programming tasks factor was 0.868.

*Interviews:* In qualitative research designs, data collection tools should be selected purposefully (Creswell, 2013). Stewart and Cash (1985) defined the interview as "a mutual and interactive communication process based on questioning and answering, conducted for a predetermined and serious purpose." (Cited in Yıldırım and Şimşek, 2013). Interviews are conversational conversations with the participant. Because the interview form is conducted through one-on-one communication with individuals and is more unrestricted and natural than other data collection tools, it is based on conversation with the participants. (Yıldırım and Şimşek, 2013). The "Pre-Service Teacher Interview Form," developed by the researcher, was used as the semi-structures interview form. The created form was reviewed by two faculty members who are field experts, and after the necessary adjustments were made based on expert opinions, the final version was presented to the participants. Interviews were conducted with eight randomly selected participants on a voluntary basis. Each interview lasted approximately 25-30 minutes and was conducted via video conference. Audio and video recordings were made with the participants' permission to minimize data loss during the interviews. The general framework of the interview questions was as follows:

- General views about the course
- General views about gamification used in education
- Opinions view the programming tool

### ***Data Analysis***

Before study, permission was obtained from the Kırıkkale University Social and Human Sciences Research and Publication Ethics Board to collect data for the study. In accordance with this permission, the researcher collected data at the end of the 12-week course period. The quantitative data in this study were collected online, while the qualitative data were collected individually via video conference. First, the quantitative data were collected online, and the obtained data was saved in a google.doc file. The data stored online was then transferred to MS Office Excel, organized, and the means for each item were calculated and presented with descriptive statistics.

The data obtained from the interviews was analyzed through content analysis in this study. One of the methods used for in-depth analysis of the resulting analyses is content analysis. It is an analysis method that utilizes inferences and coding of raw data to enable in-depth analysis according to established rules (Yıldırım & Şimşek, 2013). In this study, the audio recordings of the interviews with participants were transcribed, and the resulting texts were transferred to MAXQDA 2020 Analytics Pro to identify themes. They were analyzed in detail, broken down into smaller units based on their meaning, and coded. Based on the coded data, subthemes and themes were derived. In this context, the themes and codes obtained during the completion and interpretation phase of the findings are presented in the findings section.

## Findings

### *Pre-Service Teachers' Self-Efficacy Views Regarding Programming*

The first sub-problem of the research was determined as "What are the Self-Efficacy Views of Pre-Service Teachers Regarding Programming?" The responses to the Self-Efficacy Perception Scale for Block-Based Programming sent to the pre-service teachers and the average of the responses are given in Table 3.

Table 3: Pre-Service Teachers' Self-Efficacy Perceptions for Block-Based Programming (N=36)

Items	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		Av g	Std Sp
	f	%	f	%	f	%	f	%	f	%		
When I see a program written in Scratch, I can tell what will happen when it runs.	9	25	18	50	7	19,4	1	2,8	1	2,8	3,92	0,91
I can read and understand a program prepared by someone else.	9	25	18	50	6	16,7	2	5,6	1	2,8	3,89	0,95
Whenever I want to give a character any movement, I know where to do it in Scratch.	21	58,3	8	22,2	6	16,7	-	-	1	2,8	4,33	0,96
I can move the character in the scene at any speed I want.	20	55,6	6	16,7	8	22,2	1	2,8	1	2,8	4,19	1,06
I can constantly move the character in the scene.	22	61,1	11	30,6	2	5,6	-	-	1	2,8	4,47	0,84
In Scratch, I can change a character's appearance (e.g. costume, color, size, speech) depending on a condition (e.g. if-then).	22	61,1	9	25	4	11,1	-	-	1	2,8	4,42	0,90
In Scratch, I can change a character's movement (speed, direction, position, etc.) depending on a condition (for example: if).	18	50	12	33,3	5	13,9	-	-	1	2,8	4,28	0,91
I can create a variable to hold the point value achieved by the user in a game.	9	25	18	50	6	16,7	2	5,6	1	2,8	3,89	0,93
I can create a program where the "Point" or "Score" value increases or decreases as desired goals are achieved in a game.	22	61,1	10	27,8	3	8,3	-	-	1	2,8	3,69	0,88
When the desired results are clearly defined, I can create a game that consists of very complex and long codes (texts).	10	27,8	11	30,6	10	27,8	4	11,1	1	2,8	3,11	1,09
I can find errors in a program prepared in Scratch.	3	8,3	9	25	15	41,7	7	19,4	2	5,6	3,17	1,00
I can correct errors in a program prepared in Scratch and make it workable.	5	13,9	7	19,4	16	44,4	5	13,9	3	8,3	3,89	1,10

When the answers given to each item in the dimension of "The effects of programming education on the self-efficacy of pre-service teachers" are examined in Table 3, it is seen that being able to say what will happen when a program written in Scratch runs ( $\bar{X}=3.92$ ), being

able to understand a program prepared by someone else ( $\bar{X}=3.89$ ), knowing where to make a movement in Scratch when you want to give a puppet ( $\bar{X}=4.33$ ), being able to move the puppet at the desired speed ( $\bar{X}=4.19$ ), being able to move the puppet on the stage continuously ( $\bar{X}=4.47$ ), being able to change the appearance of the puppet depending on a condition ( $\bar{X}=4.42$ ), being able to change the movement of a puppet depending on a condition ( $\bar{X}=4.28$ ), creating a variable to keep the point value in a game ( $\bar{X}=3.89$ ), preparing a program in which the "point" and "score" values increase and decrease as the desired things are achieved in a game ( $\bar{X}=4.44$ ), being able to create ... clearly defined ( $\bar{X}=4.33$ ), being able to create a variable to keep the point value in a game ( $\bar{X}=3.89$ ), being able to create a program in which the "point" and "score" values increase and decrease as the desired things are achieved ( $\bar{X}=4.33$ ), being able to create a program in which the "point" and "score" values increase and decrease as the desired things are clearly defined ( $\bar{X}=4.33$ ), being able to create a program in which the "point" and "score" values increase and decrease as the desired things are clearly defined ( $\bar{X}=4.33$ ), being able to create a program in which the desired things are clearly defined ( $\bar{X}=4.33$ ), being able to create a program These were found to be: creating games with complex and long codes ( $\bar{X}=3.69$ ), finding errors in a program created in Scratch ( $\bar{X}=3.11$ ), and correcting errors in a program created in Scratch and making it workable ( $\bar{X}=3.17$ ). Considering these findings, the mean of item 5 ( $\bar{X}$ ) was found to be 4.47, and participants stated that they could make the character move continuously with this item. According to the results, participants defined this item as "Strongly Agree." When looking at items 11 and 12, the means ( $\bar{X}$ ) were found to be 3.11 and 3.17, respectively. When looking at the means of these items, participants defined it as "Undecided."

### Pre-Service Teachers' Attitudes Towards Programming

The second sub-problem of the research was determined as "What are the Attitudes of Pre-Service Teachers Towards Programming?" The Computer Programming Attitude Scale sent to the prospective teachers is given in Table 4.

Table 4: Pre-Service Teachers' Attitudes Towards Programming (N= 36)

Items	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		Avg $\bar{X}$	Std Sp S
	f	%	f	%	f	%	f	%	f	%		
Programming disgusts me.	-	-	-	-	6	16,7	17	47,2	13	36,1	1,81	0,71
Knowing how to program is a distinguishing feature.	13	36,1	22	61,1	-	-	1	2,8	-	-	4,31	0,62
I feel nervous when writing programs.	1	2,8	3	8,3	16	44,4	11	30,6	5	13,9	2,56	0,94
Programming does not have an important place in daily life.	-	-	-	-	3	8,3	13	36,1	20	55,6	1,53	0,65
I always strive to write better programs.	8	22,2	18	50	6	16,7	4	11,1	-	-	3,83	0,91
Writing programs is boring.	-	-	3	8,3	4	11,1	20	55,6	9	25	2,03	0,84
Programming makes human life easier.	16	44,4	17	47,2	3	8,3	-	-	-	-	4,36	0,63
If a problem arises while writing a program that I cannot solve in a	9	25	10	27,8	12	33,3	5	13,9	-	-	3,64	1,01

short time, I will not give up until the problem is solved.													
I think writing programs is unnecessary.	-	-	-	-	2	5,6	17	47,2	17	47,2	1,58	0,60	
If I have the opportunity, I will take part in a programming project.	5	13,9	15	41,7	11	30,6	5	13,9	-	-	3,56	0,90	
Programming-related activities make me nervous.	-	-	3	8,3	10	27,8	17	47,2	6	16,7	2,28	0,84	
I do research to become a good programmer.	7	19,4	15	41,7	10	27,8	4	11,1	-	-	3,69	0,92	
When I start programming, I get very bored.	-	-	1	2,8	8	22,2	17	47,2	10	27,8	2,00	0,79	
Programming improves human problem-solving skills.	10	27,8	20	55,6	5	13,9	1	2,8	-	-	4,08	0,73	
Once I start a computer program, I work harder to finish it than anything else.	2	5,6	16	44,4	12	33,3	4	11,1	2	5,6	3,33	0,96	
Even the idea of writing code is enough to make me nervous.	-	-	3	8,3	9	25	15	41,7	9	25	2,17	0,91	
I think that thanks to advances in programming, many problems that could not be solved before can be solved in our age.	8	22,2	16	44,4	9	25	3	8,3	-	-	3,81	0,88	
I follow the developments in programming.	4	11,1	7	19,4	13	30,6	11	30,6	1	2,8	3,06	1,04	

As seen in Table 4, when the responses to the “Attitude Towards Programming” scale are examined, the averages according to the items are; Programming is repulsive to me ( $\bar{X}=1.81$ ), knowing programming is a distinguishing feature ( $\bar{X}=4.31$ ), I feel nervous when writing programs (2.56), programming does not have an important place in my daily life ( $\bar{X}=1.53$ ), I always try to write better programs ( $\bar{X}=3.83$ ), writing programs is boring ( $\bar{X}=2.03$ ), programming makes people's lives easier ( $\bar{X}=4.36$ ), if I encounter a problem that I cannot solve in a short time while writing a program, I do not give up without solving the problem ( $\bar{X}=3.64$ ), I think writing programs is unnecessary ( $\bar{X}=1.58$ ), if I have the opportunity, I take part in a programming project ( $\bar{X}=3.56$ ), programming-related activities make me nervous ( $\bar{X}=2.28$ ), I do research to become a good programmer ( $\bar{X}=3.69$ ), I get very bored when I start writing programs ( $\bar{X}=2.00$ ), programming improves a person's problem-solving skills. I develop ( $\bar{X}=4.08$ ), once I start a computer program, I strive to finish it more than anything else ( $\bar{X}=3.33$ ), even the thought of writing code is enough to make me nervous ( $\bar{X}=2.17$ ), I believe that advancements in programming can solve many previously unsolved problems in our time ( $\bar{X}=3.81$ ), and I follow programming developments ( $\bar{X}=3.06$ ).

Considering these findings, the second item ( $\bar{X}=4.31$ ) had the highest mean response. Participants responded "Agree" that knowing how to program is a distinguishing characteristic. Another item was item 5 ( $\bar{X}=3.83$ ). This item indicated that participants would always strive to write better programs, and they responded "Agree." In item 7, participants believed that programming makes people's lives easier ( $\bar{X}=4.36$ ). In this context, they responded "Agree." Another item with a high score was item 8, which indicated that if a problem occurs while writing a program, they will not give up until it is resolved. The average response ( $\bar{X}$ ) to this item was 3.64, and participants marked "Agree." Another item with a high score was item 10, which indicated that they would participate in a programming project if the opportunity arose. Participants marked "Agree" with an average response ( $\bar{X}$ ) of 3.56. In item 12, the average response ( $\bar{X}$ ) for "I do research to become a good programmer" was 3.69. This item also yielded an "Agree" response to this view. The other item with a high score was item 14. Here, participants responded to the item stating that programming improves problem-solving skills with an average response ( $\bar{X}$ ) of 4.08, and they responded "Agree." Finally, the average response from participants to item 17, which indicated that they believed advances in programming could solve many previously unsolvable problems, was 3.81, with a similar response of "Agree." There were three items that participants marked "Undecided." The first was item 3, "I feel nervous when writing programs." The average response was 2.56 for "Undecided." Another undecided response was item 15, "When I start a computer program, I strive to finish it more than anything else." The average response was 3.33. Finally, the average response ( $\bar{X}$ ) for item 18, "I keep up with developments in programming," was 3.06.

Finally, participants indicated that they disagreed with some of the items. The first of these is that the average response ( $\bar{X}$ ) to item 1, "Programming is repulsive to me," was 1.81, and they answered "Disagree." The average response ( $\bar{X}$ ) to item 4, "Programming does not have an important place in daily life," was 1.53. The average response ( $\bar{X}$ ) to item 6, "Writing programs is boring," was 2.03. The average response ( $\bar{X}$ ) to item 9, "I think writing programs is unnecessary," was 2.28, and the average response ( $\bar{X}$ ) to item 13, "I get very bored when I start writing programs," was 2.00.

### ***Pre-Service Teachers' Views on the Use of Gamification Approach in Programming Education***

The third sub-problem of the research was determined as "What are the views of pre-services teachers regarding the use of gamification in programming education?" Three distinct themes emerged from the responses of the pre-service teachers. As seen in Table 5, these themes are the positive aspects of gamification, the negative aspects of gamification or difficulties in using gamification, and general views on block-based programming.

Table 5: List of Themes and Sub-Themes

Themes	Sub-Themes
<b>Positive aspects of using gamification</b>	Effective group work
	Participants' views on gamification
	Participants' views on badges
	Positive aspects of assigned tasks
<b>Difficulties in using gamification</b>	Shortcomings of the gamification tool
	Negative aspects of assigned tasks
	Negative aspects of group work
	Difficulties with badges

<b>General considerations regarding block-based programming</b>	Advantages of block-based programming Fun situations in block-based programming Needs to learn block-based programming Challenging situations in block-based programming
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### *Findings regarding the positive aspects of gamification use*

When we look at the findings regarding the positive aspects of the use of Gamification, which is the first theme in the findings of the research, we come across 4 sub-themes and codes. Table 6 shows the frequencies of each code value under 4 sub-themes.

Table 6: List of Themes and Sub-Themes

<b>Sub-Themes</b>	<b>Codes</b>	<b>f</b>
<b>The efficiency level of group work</b>	Increased interaction between individuals	8
	Productivity of group work sessions	3
	Participants learn from their peers (Peer Learning)	2
<b>Participants' opinions about gamification</b>	Feedback motivates students	8
	Motivates students	7
	Ensures lasting learning	7
	Increases competition	7
	Enjoys the gamification tool (choosing an avatar, using the gamification tool as a measurement tool)	6
	Breaks away from traditional education approaches	5
	Gamification fosters student ambition	4
	Ensures active participation in the lesson	4
	Ensures learning by doing	2
<b>Participants' opinions about badges</b>	Badges attract the attention of participants.	6
	Adequate variety of badges.	4
	Badges motivate students.	4
	Efforts are made to earn badges.	3
	Benefits of the "over-the-top badge."	2
<b>Positive aspects of the assigned tasks</b>	Tasks should be reinforcing.	5
	Tasks should be beneficial to the participant.	4
	Tasks should be assigned according to the participant's readiness level.	3
	Tasks should be productive.	2

Within the online course, the first subtheme, "The effectiveness of group work," five main opinions emerged. The first of these was that prospective teachers gained different experiences in online group work. For example, some participants expressed their thoughts as follows:

*"Everything, no matter how stressed or happy we are sometimes, gives us experience in everything in life, so I think it's positive, I think it was good to have this, it was a new experience. I've never been the Head of the Algorithm course, now that I've learned it, how do I feel? It gave me new emotions, new things happened, I got carried away, but even that was good, we laughed and had fun, I think it was positive." (Participant 1)*

*".....otherwise, online groups were a different experience for us in terms of lessons..." (Participant 2)*

As mentioned above, participants gained new experience. The second code is that the group work hours were sufficient and productive. Participants expressed some of their opinions about the group work conducted during specific weeks as follows:

*"I think the group work week was really good. Because it was like this, I experienced it myself. For example, my mood was really low, and I couldn't really influence the group for a week. Inevitably, I felt bad about myself. After all, my groupmates were working, but I wasn't. If it had been every week, I think there would have been some disruption to the work. Not everyone might have agreed, but since it was every three weeks, I think we were taking responsibility for it and moving forward..." (Participant 3)*

*"It was nice not to have three weeks. I think it was a good idea to have it every three weeks..." (Participant 4)*

Another code found when examining the participants' views was that they obtained information from their group mates. They expressed this opinion as follows:

*"I actually had the most fun in the group sessions. I enjoyed talking with the group and doing things at work, and it gave me something to learn from, so I enjoyed the group assignments." (Participant 6)*

*"...it was nice to have different ideas in the groups, like, 'Let's do this, let's do that,' and so on." (Participant 8)*

*"I mean, I got an idea of whether our other friends had learned different things outside of class, or whether they hadn't. Were they at the same level as us or better? Some of our friends, for example, had taken things further, done research, and came up with better results." (Participant 3)*

Another finding from the views of pre-service teachers was that group work increased communication among participants. They explained their views as follows:

*"...I've really seen that interaction between friends has increased through group work. Especially during this online process..." (Participant 1)*

*"Frankly, I didn't have many friends in class, but I don't have anyone I'm personally close with, but with these group activities, my individual interaction with people has increased. We talked, and I think they've helped me a lot." (Participant 2)*

*"Because the people I was in groups with weren't among my close friends... In both group activities, it was good in terms of interaction." (Participant 3)*

Considering the opinions above, participants interacted with each other through group work, allowing them to learn from their peers. Furthermore, the randomization of groups also demonstrated increased interaction.

The second subtheme, "Participants' views on gamification," was examined in the online course. As a result, the participants' responses were analyzed, and codes were generated. Participants' comments regarding the first code, "Moving beyond the traditional education approach," are as follows:

*"We don't feel like there's an exam at the end of that course. They know what they're going to cover; they feel like they're earning points in a game... I think it makes more sense. In regular classes, we'd just listen to the lecture, and we'd study the day before, and that was important for our participation. I think we needed to work on it..." (Participant 4)*

*"It was a good course for me, unlike other monotonous courses. It was different when it came to programming in games and commercials. We at least got an idea of how it's done, including how it's done, because I'd never seen anything like that before. I learned about code, plugins, how software works, and it was nice for me..." (Participant 5)*

*"We tried some things in gamification, and there were things you don't learn outside of class. We researched these things outside of class and learned how things could be done. The freedom was actually good for us because we were free to create whatever we wanted. Since we didn't impose any strict rules during the gamification process, we created a good piece of work." (Participant 7)*

When examining the above findings, it was observed that teaching the course through gamification was more fun than the traditional model, and students felt free to engage in the process with pleasure. When examining another code, "The gamification tool is fun," students expressed two distinct opinions. The first was that the gamification tool included avatar selection, while the second suggested that the gamification tool could be used as a measurement tool. All these opinions are summarized below:

*"Teacher, did you see there, there's a place called Beta. You can move your own avatar. For example, I've been following that; they've gradually established a building area... I think it would be great if that were opened as well..." (Participant 3)*

*"I think it's a good idea to have different, what do you call it, avatars there." (Participant 6)*

*"We could probably use Classdojo again in the future. As a measurement and evaluation tool, I mean, that's why I think it's so necessary, especially for teachers..." (Participant 3)*

*"Of course, teacher, we can easily upload our assignments to Classdojo, etc., and see what scores we've received... So, we could easily see if we could do anything extra, get something, or get an idea about the scoring..." (Participant 5)*

Participants found the gamification program Classdojo enjoyable, and the fact that it was an effective tool for selecting avatars and monitoring students made it an effective program for students. Half of the participants (n=4) stated that they participated more actively in this course than in other courses. Another finding was the active participation of students in the course. Participants expressed their opinions as follows.:

*"Yes, it was a different course, honestly, the most active course I've taken in my university life. Yes, it was beneficial for me." (Participant 2)*

*"I mean, I think my teacher made it active. Normally, when I look at our classes, I don't see this much participation. There wasn't this much participation in the assignments, in the classroom, etc. Even though it was online, I couldn't even imagine it would have been more if it had been face-to-face..." (Participant 4)*

Another finding of the study was that feedback motivates students. It appears that the feedback provided positively impacts students in this regard. The opinions on this matter are expressed below:

*"I've asked you questions before, professor, and I think you were helpful and enlightening. When we had questions, you got back to us directly and answered them directly, so it was good..." (Participant 2)*

*"Frankly, I expected something to be read and dismissed every time they were done, but your response is a very positive thing. It shows how important even seemingly simple things are for keeping a student engaged in the course." (Participant 1)*

*"Thanks to the feedback we received on Classdojo, we saw our shortcomings. Thanks to your feedback, there were some areas we struggled with, and some we struggled with. We could easily consult you about these issues. This benefited us..." (Participant 5)*

Some participants stated that gamification contributes to learning by doing. They explained their views as follows:

*"So, if my teacher had just taken the course, memorized the codes, and passed, I wouldn't have been able to combine them, put them together in an application or game, apply them myself, play them, use them, we would have probably just memorized them and passed. It was good that it allowed me to learn by doing." (Participant 2)*

*"We tried to learn together while listening to the lecture. We would try to do random things, but having a score every week, and having that score reflected in the midterm or final exams, made us more eager to listen to the lecture..." (Participant 5)*

The gamification of the course motivated the participants. Participants' opinions are as follows:

*"I think it's something that motivates students... I think they can compare themselves, earn points for themselves... I mean, they find something." (Participant 4)*

*"There were high scores, but then I asked myself why mine was so high. Actually, it was good for motivating us a bit. I think we were influenced by that..." (Participant 6)*

*"Frankly, he gave it to me... I don't have any absences... Even though I did it in other classes, I didn't do it in this one. I'd fall behind, I wouldn't get my grades, I needed to learn how to do weekend activities... Because of these things, I had to attend class more. I think I enjoyed my classes more..." (Participant 1)*

Another finding from the participants' opinions is that gamification instills ambition in them. They expressed their opinions on this topic as follows:

*"Every week, you'd show us the scoreboard on the screen, and it actually fuels your ambition." (Participant 3)*

*"Actually, if my score was low, I tried to get better badges. Like the "Better Off" badge or the "Punctual" badge..." (Participant 4)*

*"Well, it probably fueled my ambition because getting ahead and getting points affected us..." (Participant 7)*

*"It was so much fun, especially during the final round, because my score was a little low, I was trying to keep up with the minute summaries. I was trying to do it faster, do it right, do it properly." (Participant 1)*

Another finding was that gamification increases competition. Participants expressed that they strived harder with competition and expressed their views as follows:

*"It was really effective. I think we used to do this once a month, sorry, every three weeks, doing it for that long, you know, it goes straight, straight, straight, like that, where we suddenly make a pick point, then suddenly stabilize, and the next pick point continues higher. So, I think group work was very good. No matter how old you are, a competitive spirit with your friends can always lead to good results."* (Participant 1)

*"Frankly, it reinforced our learning through competition... It made it a little more competitive, and frankly, it was good for us too..."* (Participant 2)

*"I give examples of many of my friends. For example, Zeynep got a really high score, so it might have encouraged me to get closer to her..."* (Participant 4)

*"Having a score on this topic was good for the competition... At least because we're more motivated to learn. Actually, the competition was better; we're actually more careful when learning. I think if there had been homework last week, for example, if there had been homework the week before, we wouldn't have paid much attention."* (Participant 5)

Participants finally expressed their general opinions about gamification, stating that gamification facilitates better learning. Their opinions are as follows:

*"We can already do things without forgetting, we remember them more easily. We've learned more permanently. If you asked me questions from last year's classes right now, I might not be able to answer them as quickly. I have to think about how I would have done it, etc., for a long time. But now I've learned more permanently, and I remember them. I remember which codes were where, and what was involved in the detection process. I think I've learned more permanently..."* (Participant 4)

*"I can say that the weekly homework assignments increased our retention in our classes. Because it wasn't too challenging for us, we didn't forget the practices we did, and we did other things, like researching online and on YouTube, so it was good. The weekly assignments weren't too challenging, and the retention rate was high."* (Participant 7)

The third subtheme, "Participants' opinions on badges," was examined in the online course. Participants expressed five main opinions about badges, the first of which was "Positive aspects of the badge." Participants' opinions on this badge are listed below:

*"The other badges were good, but the one with the added bonus was especially motivating for us to work harder."* (Participant 3)

*"I was trying to get the added bonus badge again. I had more time, and I had more opportunities to mix things up compared to the coursework. Scratch is good in that respect; it's not just for class. We could add things... For example, you'd say something more general; we could turn it into a game or a story... From that perspective, I think it was good..."* (Participant 8)

When participants' opinions about badges were examined, they expressed that they made an effort to earn badges during the course. Their opinions are as follows:

*"For example, instead of getting a punctual badge, I tried harder to get a badge that was superior. And seeing that reflected in my scores, like a badge that was superior, motivated me even more. Because I worked harder, I got ahead of the class..."* (Participant 3)

*"Actually, if my scores were low, I tried to get better badges, like a badge that was superior or a badge that was punctual..." (Participant 5)*

Participants also stated that the badges caught their attention. They expressed their opinions on this matter as follows:

*"I think it's nice, but having badges and having our own avatars that we can customize, etc., was great. I liked it, sir..." (Participant 3)*

*"The badges, which emphasized punctual work, group work, and teamwork, and the sweet competition between friends to earn them, took me back to my childhood. It was fun and beautiful..." (Participant 1)*

Participants found the variety of badges available in gamification sufficient. Their opinions about the badges are as follows:

*"We had many different badges, and I thought my teacher was nice and impressive. I never got the punctual badge, but that's okay. There were times when I tried really hard, and I thought my teacher was reasonable, so it was nice." (Participant 2)*

*"I mean, it was fun anyway, it was like a game. I liked that if you do this, you'll get that badge, and so on..." (Participant 7)*

When the opinions were examined, it was observed that badges motivated participants. Participants expressed their opinions about how badges motivated them as follows:

*"I was trying to do something extra. I was trying to complete the tasks, and for example, I'd get points for putting in something I knew, and that motivated me." (Participant 1)*

*"When I was getting the badges, especially during class. I also got badges for weekend homework, and I had fun doing them. Because I was going to get the badges and the points, so that motivated me, so it was good." (Participant 2)*

*"Frankly, it creates a sense of trust in you, especially when you're committed to your duties. Even if you don't have the points, you'll complete the badge anyway..." (Participant 4)*

In the online course, the final subtheme, "Positive aspects of assigned tasks," was examined. Here, the tasks assigned during class and over the weekend were examined, and participants expressed their opinions. Their initial comments on "The usefulness of assigned tasks" were as follows:

*"I think it was even more beneficial for us, and even for me, because we were building on it during the weekend assignments. It was good, I think it was quite helpful." (Participant 1)*

*"But when you assigned me a task, I just went back to it and did it in class. At least when something happened and I asked how I was going to do it, I would go back to my past activities. I could say, 'Oh, I did it this way,' and then I could immediately adapt it to my own activity..." (Participant 3)*

*"Giving it during class would normally have been the only way we would have listened to you and seen you, but giving us a task made us try to do it right then and there." (Participant 4)*

Another opinion expressed by the participants was, "Tasks should be assigned according to the participants' level of readiness." They expressed their opinions as follows:

*"I thought it was good. You gave us assignments that were at our level and required us to add a little more to our learning, so we didn't just do rote homework (Participant 1).*

*"I always have a positive outlook on the weekly assignments. They weren't overly challenging and were within our capacity. (Participant 7)*

The final view expressed is that the tasks assigned to participants foster productivity. Participants expressed their thoughts on this view as follows:

*"We produced something ourselves. I think that was very useful, but it could have been forgotten in what you described. (Participant 1)*

*"But overall, I think it was nice to produce something and realize that something was working. I can say it was good for me, it was fun..." (Participant 4)*

### **Findings regarding the difficulties experienced in using gamification**

When examining the findings regarding the positive aspects of gamification use, the first theme in the research findings, four subthemes and codes are encountered. The findings regarding this sub-theme and the frequency of each code value are presented in Table 7.

Table 7: List of Sub-Themes and Codes

<b>Sub-Themes</b>	<b>Codes</b>	<b>f</b>
<b>Negative aspects of assigned tasks</b>	The difficulty of the task being given on the weekend	7
<b>Shortcomings of the gamification tool</b>	Not being able to see the appointments to which badges are given	2
<b>Difficulties in group work</b>	Participants' anxiety regarding the chair elections	5
	Group chair's sense of responsibility	3
	Only the group chair is active	2
<b>Difficulty in obtaining badges</b>	Participants not researching badges sufficiently	4
	They have problems obtaining the "Punctual Badge"	3

As shown in the Table, the first subtheme was "The shortcomings of the gamification tool." Participants stated that the shortcoming of the gamification tool was "Not being able to see the assignments for which badges were awarded," and expressed their opinions as follows:

*"Yes, and also, teacher, it wasn't clear which points were assigned to which, but he was doing something about it. I wondered which one I got it from, which one was problematic. Could something be done about that?" (Participant 4)*

*"So, if the badges were displayed directly on the portfolio, they could be given. Like a medal of achievement... Actually, they could be given... That could be even more motivating. For example, it would appear as a number, it would appear as a name, that kind of thing..." (Participant 5)*

The second subtheme identified from participants in the online course was "The difficulty of having the assigned task on the weekend." However, participants expressed that they found it difficult to have the assignment every week and that these tasks were time-consuming. This was stated as follows:

*"I think it was a little tiring, teacher, but it was good for our development at work, but as a student, I have to say it from a student's perspective, I felt like I had to sit down and do that thing every weekend. I had to do that task, and frankly, it was a little difficult..." (Participant 2)*

*"You know, the comfort wears off after a while. It's not like it's a challenge, but it's challenging in that sense. Otherwise, I'd try to find more difficult things, and I couldn't find them. We'd talk to our friends sometimes, but it's been harder for me to maintain consistency every week, frankly..." (Participant 3)*

*"Because our other subject areas, for example, the homework and all that, were very challenging this year. Actually, allocating extra time to algorithms was a bit of a challenge." (Participant 5)*

The third subtheme, "Difficulties in Group Work," was identified, and participants encountered some difficulties during these activities. The first of these difficulties was that only the group leader was active. The opinions are described as follows:

*"The group work was actually good, teacher, but there's one thing: the elected leader was more active within the group. I even came across a group where four people were elected and the other two didn't even speak. I did it with two people, some wrote it down once or twice, and of course, the fact that it's online also has an impact." (Participant 2)*

*"Like this: I'm trying to do it, to write down the code. For example, I'm not the leader; he does it, and it's hard to follow along. He can't quite remember where he's at, so I had a hard time there. So, I wanted to have some leadership within those groups, and I had a hard time with it." (Participant 8)*

Another shared view was that participants experienced anxiety regarding the presidential election. Participants expressed their views as follows:

*"I found it tiring that one person was the leader in group work and did everything. Because I was elected alone, it made me very nervous... I wondered what to do." (Participant 4)*

*"When I was there, I did a lot of things, and I got in trouble. I even spilled something on the table and made a noise..." (Participant 1)*

When participants' opinions were examined, it was observed that group leaders felt a sense of responsibility. They expressed their views on this situation as follows:

*"Okay, but I'm not thinking about myself because of that, but the stress my friends caused was hard. Taking responsibility was very difficult. I don't think it's easy..." (Participant 1)*

*I think it was an ideal time... Because in group work, a leader is elected. Of course, I can say that it's a bit stressful... I think the leader takes responsibility for 3-4 people, and to come up with the right thing, and it also requires extra effort... I'm sure those who have been leaders have looked at their past work to avoid making mistakes and get results faster, so I can say it's a bit stressful... I wasn't a little afraid myself..." (Participant 5)*

In the online course, the final subtheme examined difficulties in obtaining badges, and it was observed that the participant did not research the badges sufficiently. Their thoughts on this topic are as follows:

*"I thought it was fun, teacher, but sometimes I'd wonder why I got this badge because we didn't know the definition of it. I knew who was getting the badges, but I think there were a few other badges worth 2-3 points, some of which were hard-working, but I didn't fully understand them. I didn't know how to tell stories, but sometimes I'd wonder why I won or why I didn't." (Participant 4)*

*I think you're being fair about this because I couldn't keep up with the punctuality part at first; I didn't even understand it. Apparently, points were also given for being on time. That's partly why my points were low, and then, as I earned more punctuality, I was given more and more assignments." (Participant 7)*

When the opinions were examined, another comment about the badges was that they had problems obtaining the "Punctual Badge." Participants expressed their opinions as follows:

*"...Shooting directly like that in class made me nervous. There were some fast students in the class. When they did, I had to do it too for the lesson to function properly. Sometimes the codes would get mixed up, and that's where I had a bit of a hard time. That's why it made me nervous, like I had to do it right away..." (Participant 3)*

*"I mean, it's about time, teacher. I don't have a time problem and a punctual badge, either." (Participant 5)*

*"Yes, teacher, the punctuality badge... I had a hard time with the punctuality badges too. How did I struggle with this? I mean, I have to do it fast and get the right thing right at the same time, I couldn't manage it very well... I like to learn slowly and deliberately. That's why I can say I had a bit of a hard time. And since my friends are doing it so fast now, I can't learn, can I? I can't help but wonder if I'm lacking something... I can't help but wonder if there's something wrong with me... But of course, I learned, I mean, I wasn't in a rush anyway. I didn't make any extra effort to get the punctuality badge... I was basically just trying to learn, wondering how I could learn... I didn't make any extra effort to get the punctuality badge, but teacher, my score wasn't very low, it was above average overall..." (Participant 6)*

### **Findings regarding general opinions about block-based programming**

When examining the findings regarding the positive aspects of gamification use, the first theme in the research findings, four subthemes and codes are encountered. The findings regarding this sub-theme and the frequency of each code value are presented in Table 8.

Table 8: List of Sub-Themes and Codes

Sub-Themes	Codes	f
<b>Advantages of block-based programming</b>	The block-based program is sufficient for all levels.	8
	Participants can use it in their professional lives.	6
	It contributes to learning programming logic.	3
	It contributes to game creativity.	3
<b>Fun situations in block-based programming</b>	It stimulates curiosity in participants.	2
	Game design features	8
	Ease of use of the block-based program	8
	Various and diverse Add-ons/Detection tab	4
	Change of characters and scenery	2

<b>Needs to learn block-based programming</b>	Need for more sample types	5
	Lack of information boxes	2
<b>Difficult situations in block-based programming</b>	Having trouble with productivity	8
	Limitations of block-based programming	7
	Code confusion	5
	Code not working correctly	3
	Programming tool incompatibility with the phone	1

An examination of Table 8 reveals the participants' general views on block-based programming. Based on these findings, the first subtheme, the positive aspects of block-based programming, was examined, and the first finding was that block-based programming piqued the participants' curiosity. The participants' views are as follows:

*"Maybe we'll have some shortcomings in our math app development. For example, there's no such useful math app on Google Play. I could do some work in this area, and it could contribute in that respect. It was like a preliminary preparation for me, I can say it sparked my curiosity..." (Participant 3)*

*"Yes, I did have a little curiosity, to be honest, because when we solve things through tests, for example, some things remain on paper. We can't reach many people, but if they can turn it into a Google Play app, I think it could reach everyone, from the young to the old, from men to women. In that respect, it was a plus for me..." (Participant 8)*

Another finding was that the block-based program contributed to creativity in game design. Participants expressed their opinions as follows:

*"We don't see many children going out and playing with a ball anymore. We need to direct this towards more educational and learning games rather than playing harmful games... Here, we've at least made a start. Now, we know how to make games, even if it's at a basic level. I think it's beneficial in that respect..." (Participant 2)*

Participants expressed the opinion that the block-based programming tool facilitated the learning of programming logic. As a result, they stated the following:

*I think there's a big difference between starting from scratch and knowing Scratch... You know, when we start learning other programming, we'll at least know what to start with because we know the programming language..." (Participant 2)*

*"I mean, I think it's pretty good as a start... Once someone learns the programming logic, they can do it... First, for example, you have to choose how to start, whether it's pressing a button or pressing a flag, etc. I think it's generally easy to use... I think the logic of it is good... It made it easier to use." (Participant 4)*

*"I've learned about programming. I've never seen anything like it before. It was a different course than other courses. I've never seen a course like it before. At least I got an idea about how certain things happen simultaneously, how code is written, how plugins are written, and so on..." (Participant 5)*

When participants' opinions were examined, another view was that they would use block-based programming tools in their professional lives. Their opinions on this topic are as follows:

*"In terms of the curriculum I could create, for example, after explaining the topic and providing the necessary information, we could have students compete. During class, I could open the Scratch creations I've created on the computer and actively participate in the lesson. Or we could give them homework and have them revisit them at home. Using this instead of a standardized instruction would be much more beneficial for me in the future." (Participant 1)*

*"I'd probably use it. Because it also has the ability to click on the puppet... I could use it because smart boards are so common these days. You know, I could have students practice divisibility with a smart system on the board... When they get bored in class, because it's a straightforward numerical lesson, and only writing in notebooks is used, students get bored. When they can't do it, they get even more bored... That's why games can make them a little more ambitious... We'll play games, do things, do things... So I think it could be used..." (Participant 6)*

When examining the second subtheme, "fun situations in block-based programming," participants expressed their opinions on five different topics. The first of these opinions concerned the plugins/detection available in the block-based programming tool. They expressed their opinions as follows:

*"...it was nice to examine those pen add-ons and such... It was nice to draw the geometric shapes there..." (Participant 2)*

*"So, the perception parts, the perception add-ons, were a little better. Because they were a little different. I can actually say that many things are part of the perception part of the basics. Whether it's ads or gamification, we use them the most." (Participant 4)*

*After that, I really enjoyed the question-and-answer sections. Because we can use them in the future, I can say we had fun with these sections when we became teachers. They were especially interesting. I had fun using the "send me a message" and "take me a message" sections." (Participant 5)*

Another aspect that participants enjoyed was the decor and costumes. They expressed their thoughts as follows:

*"I had a lot of fun creating stories myself during the gamification phase, adjusting them one by one, adjusting the props and costumes..." (Participant 7)*

*"I had a lot of fun using add-ons, especially for things like scene transitions, in the perception phase." (Participant 8)*

All participants stated that game design in the block-based program was fun and expressed the following opinions:

*"Professor, I think I had fun with the cat chasing the mouse part. I had a lot of fun writing the code for it." (Participant 2)*

*"Honestly, I really enjoyed the maze part, collecting certain things... Then, I really enjoyed the part where we turned on the camera and picked apples. Those two parts were really good for me..." (Participant 3)*

*"The camera and all that was nice to have turned on, and it was an interesting idea to collect things from the camera... Other than that, we generally followed it through constant repetition, and if it was*

*where it wanted to be, we learned why it was there, how it happened, and how it worked." (Participant 7)*

Participants expressed some needs for learning the block-based program. These needs included the ability to do/see more examples and the lack of information boxes. They expressed their opinions as follows:

*"I think there could be more examples, teacher. I think if we saw more activities, it could take us further." (Participant 4)*

*"I mean, I think we could increase the number of projects to learn more effectively, I can say that..." (Participant 6)*

*"Teacher, I'm generally satisfied, but maybe we could have used videos occasionally during class. I think we could have looked at videos or other people's work, for example..." (Participant 3)*

When examining the challenges faced in the block-based program, which was determined as the fourth subtheme following the online course, half of the participants mentioned the limitations of the block-based program. They expressed their views as follows:

*"I mean, it can freeze a bit, I don't know if it's my own app or something I've done, but sometimes it's problematic; it won't save. I have very few problems. I even couldn't share a project... I don't know if I just opened it, but there was a save option at the beginning. I did, but I couldn't find the share option, so I had that problem again." (Participant 4)*

*"I think there are actually a lot of puppets, but I couldn't find the most basic puppets I was looking for. While there were different puppets that shouldn't be there, the most basic puppets seemed to be missing. Maybe there could be more puppets in that section." (Participant 1)*

*"But for example, I couldn't find the backgrounds. I made them online. To find exactly what I wanted, I used Canva... I designed them from there, downloaded them, and then downloaded them as characters." (Participant 3)*

One participant stated that the block-based programming tool was incompatible with the phone and that he had difficulty using it on the phone. He stated:

*"...But the thing I'm having trouble with in this area is that I can access it from a computer or tablet now, but many of my friends tried to access it from places like phones, tablets, etc., so I had to use it sometimes. In such cases, it doesn't work from the phone. So, I can't use Scratch. The screen scrolls up and down, and it's almost impossible to transfer code there..." (Participant 3)*

Another challenge is mixing up codes. Most participants said they mixed up codes, stating the following:

*"I think I'm having a bit of trouble with the "Releasing News" part of the events section. I mean, I haven't quite figured out when to put what in, so I'm having a bit of trouble with the commands and codes." (Participant 1)*

*"Because there are a lot of functions included in some of the merging, creating lists, they're a bit difficult. Some of those functions, like combining codes and combining lists, are difficult to add one by*

*one. They get more difficult as you go... Of course, it depends on what we want, but in that sense..." (Participant 2)*

*"In the "Release News" section, sometimes I couldn't figure out where to add them. Also, I couldn't figure out exactly where to add them, like "if it's like this," "if it's not like that," etc. For example, in the "create my twin" part, we were putting a few things in, and I couldn't figure them out... I was having trouble understanding..." (Participant 5)*

All participants mentioned that they struggled with productivity. They mentioned the following:

*"...I had a hard time making the games. Sometimes I had a hard time finding the story, putting it all together, etc...." (Participant 2)*

*"...but I had a little trouble putting imagination to the test, putting things together, in terms of storytelling, that's how it is..." (Participant 6)*

*"Because, Professor, I'm not very creative. I can't think of stories. That's a bit of a weakness in that aspect. I haven't been able to read books lately, I haven't had time. It's very difficult, I mean, I was having a really hard time. My friends were doing Hogwarts, they were really progressing. So I was like, 'No, I can't think of a princess, but I couldn't think of anything to write about.' I had a hard time there..." (Participant 8)*

The last difficulty in block-based programming, code not working correctly, was among the opinions expressed by the participants. They mentioned this situation as follows:

*"If some codes were moved, the added work wouldn't work as expected." (Participant 1)*

*"I saw that some codes weren't working properly. I had some problems, especially when I was doing homework for my final assignment. I was surprised, too. I was doing the same things before, but now it wasn't working. There were some problems..." (Participant 5)*

## **Discussion and Conclusion**

This section presents the conclusions regarding the findings of the research. These findings are discussed under three subheadings, along with similar findings from the literature and other relevant sources.

### ***Results and discussions regarding self-efficacy perceptions regarding block-based programming***

In this study, data were obtained using the "Self-Efficacy Scale for Block-Based Programming" developed by Altun and Kasalak (2017). This measurement tool was administered to prospective teachers at the end of the study. The findings were analyzed, and the results are presented in this section. The sample size consisted of 31 pre-service teachers from the primary mathematics teaching department. The first research question, "What are the prospective teachers' self-efficacy perceptions related to programming?", was answered. The scale consists of two sub-dimensions: simple-based programming tasks and complex-based programming tasks. When the items on this scale analyzed with the Excel program were examined, the prospective teachers' self-efficacy levels for simple programming tasks were

found to be high ( $\bar{X}=4.34$ ). The mean of the items for complex block-based programming tasks was  $\bar{X}=3.65$ . This mean suggests that their self-efficacy levels for complex-based programming tasks were also high. When the results of the self-efficacy scale were examined, three notable items were found. The mean response given by the preservice teachers to the item "I can move the character on the stage continuously," which was a simple-based programming task, was  $\bar{X}=4.47$ . According to this result, the participants had no difficulty moving the character. In the complex-based programming task, the participants responded "I can find errors in a program prepared in Scratch," with  $\bar{X}=3.11$ , and "I am undecided." They also responded "I am undecided" to the item "I can fix errors in a program prepared in Scratch and make it workable," with  $\bar{X}=3.17$ . These two results indicate that the preservice teachers are undecided about finding errors in the Scratch program. Furthermore, in this section of the research, it was concluded that the gamified programming course positively affected the preservice teachers' self-efficacy perceptions regarding block-based programming. With this result, when the literature is examined, it is seen that there are studies reporting results similar to the current research results on the positive effects of block coding practices on the level of self-efficacy for programming (Aydoğdu, 2020; Papadakis and Kalogiannakis, 2019; Yükseltürk and Altıok, 2017).

### ***Results and discussion of the Computer Programming Attitude***

In this section of the study, the "Computer Programming Attitude Scale" developed by Çetin and Özden (2015) was used. The second research question, "What are the attitudes of prospective teachers towards programming?" was addressed in the study. When the findings were examined, the items on the scale analyzed with Excel revealed that the participants had a moderately positive attitude towards programming. When the three dimensions of the programming attitude scale were considered, the affective mean ( $\bar{X}$ ) was 3.37, the cognitive mean ( $\bar{X}$ ) was 3.56, and the behavioral mean ( $\bar{X}$ ) was 3.35. In this context, the participants demonstrated a positive attitude towards the cognitive dimension. On the other hand, when the behavioral and affective means were examined, the participants indicated that they were "undecided" and had an average attitude. When the literature was examined, in the study conducted by Arslan and Akçelik (2019), no significant difference was found in terms of affective and cognitive aspects when looking at the pre-test and post-test results. The difference between the pre-test and post-test results in the behavioral sub-dimension was found to be statistically significant, and it was observed that the students' attitudes towards programming increased in a positive behavioral direction. In the study conducted by Gürer and Tokumacı (2020), which examined the attitudes of engineering faculty students towards programming according to gender, department, and number of courses, it was concluded that the students exhibited a moderate attitude at the cognitive level, while they had a highly positive attitude in terms of behavioral and affective dimensions. Erol and Kurt (2017) examined the attitudes of BOTE students towards programming and concluded that the participants' attitudes towards programming were positive. Considering the obtained results and the literature results, the reason why the participants showed only positive attitudes in the cognitive dimension may be due to the lack of a pre-test-post-test control group study.

### ***Results and discussions on the use of gamification approach in programming education***

This study examined preservice teachers' opinions on gamification-based programming education during a course enriched with gamification elements. The primary objective was to

examine the role of the gamification approach in education and training. Prior to the implementation, interviews with preservice teachers revealed that they had not received any programming training or had any courses taught using gamification. The positive aspects of gamified programming education were identified based on the responses given by the participants. The findings from the participant interviews revealed that gamification does not reflect traditional educational approaches, the course does not progress monotonously, it enables learning by doing and experiencing, it instills a sense of competition in students by motivating them, it ensures lasting learning, it motivates students to participate actively, the gamification tool is fun, the benefits of badges, their general thoughts about badges, and the positive aspects of the assigned tasks. A review of the relevant literature and research revealed that studies on gamified programming education in higher education institutions have generally been conducted in the fields of Computer Education, Computer Engineering, and Computer Programming. Şahin and Samur (2017) stated that gamification design can increase student and teacher success when used in courses where traditional education models are more frequently preferred. In this context, participants stated that they benefited from group work. A review of the literature indicates that Fidan (2016) noted that group work increased student motivation and increased student participation in activities. Fiş-Erümit and Kalelioğlu (2019) stated that group work is an important factor in ensuring active participation and motivation. Considering that it is difficult for university students to actively participate in classes, based on the literature and the opinions expressed, gamification is believed to be motivating and helps them participate by attracting attention. Another view of participants about gamification education was that gamification and the gamification tool were fun. They found gamification enjoyable due to the avatar selection and the ability to be used as a scoring tool. Kumar and Khurana (2012) stated that gamification motivates students in programming education in a fun way, and Kunduracioğlu (2018) reviewed studies on the use of gamification in education and found that students found it enjoyable. These views are similar to the results obtained in the study conducted by Oban Çakıcıoğlu and Nigar (2021). Based on the studies, it is believed that students find the gamification approach fun, and therefore, in a sense, motivates them. Gamification is an effective approach for understanding programming logic and increasing motivation (Erol, 2016). According to pre-service teachers, leaderboards are an important element that fosters competition. Hanus and Fox (2015) mentioned that competition negatively affects students. This study suggests that a sense of competition plays a significant role in both student motivation and enjoyment. To avoid losing points, pre-service teachers actively participated in the lesson and competed with each other to earn extra points on the leaderboard. Bicen and Kocakoyun (2018) mentioned in their study that gamification positively affects cooperation and competition. Additionally, Bolat, Şimşek, and Ülker (2017) mentioned the positive aspects of competition in gamified lessons. The feedback given was stated as another element that ensures students' activity and participation in the lesson. This result is consistent with the study conducted by Yıldırım (2018), in which a unit of social studies course was taught as a gamified lesson with middle school students. It is thought that badges were considered as a feedback element (Werbach & Hunter, 2012). When the researcher's findings were examined, the participants stated that the badges were motivating, useful, and made the participants happy. This inference is similar to the study conducted by Ünsal Serim (2019), where students stated that they were happy when they received badges, medals, or titles. Yıldırım et al. (2014) examined students' opinions about digital badges and found that badges increased students' motivation, provided competition, and increased their interest in the course.

Pre-service teachers expressed their opinions about the challenges they experienced with gamification, as well as its positive aspects. Based on the findings, the shortcomings of the gamification tool, the negative aspects of the assigned tasks, the negative aspects of group work, and the difficulties encountered with badges were identified as difficulties in using gamification. The fact that students cannot see which tasks the gamification tool assigns badges to can be considered a disadvantage of this tool. Therefore, the tool chosen during the design process is crucial. Participants also noted difficulties obtaining badges, and it was observed that participants who fell behind in the competitive environment expressed negative opinions about gamification in these situations. Furthermore, studies by Yıldırım and Demir (2016) and Hebebcı and Usta (2018) have indicated that competition in gamification can have some negative consequences.

In this study examining the views of pre-service teachers on programming education through gamification, participants expressed some opinions about the block-based programming tool used in the gamified course. Participants noted that the block-based programming tool increased their curiosity, ease of use, contributed to game design, fostered creativity, encouraged them to use it in their professional lives, and facilitated the learning of programming logic. Çatlak, Tedal and Baz (2015) stated in their study that Scratch, above all, stands out for its visual appeal, making it easier for novice learners to learn programming. Meerbaum-Salant et al. (2013) and Scaffidi and Chambers (2012) noted that the Scratch tool's colorful interface encouraged students to design games. The results of the study are similar to those reported in the literature.

## **Recommendations**

Based on the results of the study, the following recommendations for future studies are provided:

### ***Recommendations for Teachers/Teacher Candidates***

- Gamification can be used in lessons where students have difficulty understanding and become bored during the process.
- Gamification can be used in their professional lives for collaborative learning, active participation, increased creativity, learning by doing and experiencing, contributing to motivation, ensuring lasting learning, and increasing motivation.
- Instead of presenting the necessary learning outcomes through traditional education, students should be presented with games.
- Students should feel included in the process and take responsibility, resulting in a positive attitude towards the lesson.
- Since working with students individually can be challenging in a large class, group work can encourage students to work collaboratively and increase their motivation.

### ***Recommendations for Researchers***

- This research used the D6 gamification design model developed by Werbach and Hunter (2012). A different gamification design could be used in future studies.
- The research used a case study design. In a future study, quantitative findings from a programming education course using a gamification approach could be obtained and discussed by creating an experimental-control group.

- In this research, badges, achievements, leaderboards, points, avatars, teams, and content creation were used as gamification components. Different components could be used for future gamification approaches.
- A different gamification tool could be used instead of "Classdojo," which was used as the gamification tool.
- "Scratch," which was used as a block-based programming tool, was used. Future studies could be conducted with a different programming tool.
- In group studies, the group leader position could be determined based on the leaderboard.
- Studies could be conducted using different programming languages to examine the impact of gamification.
- Finally, although the findings of the study are significant, it should be noted that they cannot be generalized. This is due to the relatively small sample size of the study and the fact that it was conducted in an undergraduate course at a single university. Furthermore, it can be applied to different disciplines, and the results can be discussed quantitatively.
- Limitations

This study has certain limitations that should be acknowledged. First, the research was conducted with 38 pre-service teachers from a single university. Although case studies typically involve small and context-specific groups, this limited sample size reduces the generalizability of the findings to broader populations.

Second, the interviews were carried out with 8 students from the same class in which gamification was implemented. As a result, the homogeneity of the participants may have constrained the diversity of perspectives and introduced a potential bias in the qualitative data. Future research could include participants from different classes or institutions to provide a more varied range of views and experiences.

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