Biology Teacher Candidates' Views on The Educational Game Design Process[*]

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Abstract: The aim of this investigation is to explore the perspectives of prospective biology teachers on educational game design, lesson plan development, and the game design phase. The participants utilized the "Game Design Key Model" (GDKM) to create their games. This study employs a qualitative research approach, specifically a case study design. The sample comprises 14 prospective biology teachers enrolled in a faculty of education in the Marmara region during the academic year 2022-2023. Prior to game creation, participants received training on educational game design and planning. Subsequently, they were tasked with developing educational games and corresponding lesson plans in accordance with the GDKM framework. The researchers assessed the game designs using rubric. Semi-structured interviews were conducted to gather participants' perspectives on educational games, the GDKM game design model, and lesson planning, followed by content analysis. Through peer evaluation, prospective teachers identified "Biyopoly" as the most suitable game for GDKM, while experts favored "X-O". The interviews revealed participants' positive attitudes towards incorporating educational games into biology education. Participants expressed enjoyment in the educational game design process and demonstrated the ability to develop games aligned with biology topics and learning objectives.
Keywords: games in education, game design, key model in game design.

Eğitsel Oyun Tasarım Sürecinde Biyoloji Öğretmen Adaylarının Sürece Yönelik Görüşleri

Öz: Çalışmanın temel amacı, biyoloji öğretmen adaylarının eğitsel oyun tasarlama, oyuna ait ders planı oluşturma ve oyun tasarım sürecine dair görüşlerini incelemektir. Katılımcılardan, eğitsel oyunlarını "Oyun Tasarımı Anahtar Modeli" (OTAM) adlı bir eğitsel oyun tasarım modeli kullanarak hazırlamaları talep edilmiştir. Araştırmada nitel araştırma yöntemi; durum çalışması kullanılmıştır. Örneklem, Marmara bölgesinde bir eğitim fakültesinde 2022-2023 eğitim-öğretim yılında eğitim alan 14 biyoloji öğretmen adayından oluşmaktadır. Katılımcılara öncelikle eğitsel oyun tasarımı ve derse aktarım sürecinde planlama konularında eğitim verilmiştir. Ardından, OTAM'a göre eğitici oyunlar ve ders planları oluşturmaları istenmiştir. Öğretmen adaylarınca hazırlanan tasarımlar, araştırmacılarca hazırlanan rubrik ile değerlendirilmiştir. Katılımcıların eğitsel oyunlar, oyun tasarımı ve ders planlarıyla ilgili görüşleri yarı yapılandırılmış görüşmelerle alınmıştır. Veriler içerik analizine tabi tutulmuştur. Çalışmada, öğretmen adaylarının akran değerlendirmesi sonucunda, OTAM'a en uygun oyunun "Biyopoli" olduğu; uzman görüşüne göre ise "X-O" oyununun modele en uygun olduğu sonucuna varılmıştır. Öğretmen adaylarıyla yapılan görüşmeler sonucunda, eğitsel oyunların biyoloji eğitiminde kullanılmasına yönelik olumlu düşüncelerinin olduğu belirtilmiştir. Adaylar, göreve başladıklarında sınıflarında eğitsel oyunları kullanmak istediklerini ifade etmişlerdir. Eğitsel oyun tasarımını eğlenceli bulan adaylar, oyun mekaniklerini ve elementlerini doğru bir şekilde tespit etmişlerdir ve ayrıca biyoloji konu ve kazanımlara uygun oyunlar hazırlayabilmişlerdir.
Anahtar Kelimeler: eğitimde oyun, oyun tasarımı, oyun tasarımı anahtar modeli

Introduction

Today, individuals are expected to have problem-solving skills, think analytically, adapt to a collaborative work environment, and use technology effectively, in short, have 21st-century skills (Karamustafaoğlu & Kılıç, 2020). The way individuals can acquire these skills is through education. The constructivist approach became the main philosophy of our education system in 2002. Changes in our education system and curricula have affected teaching planning, teaching methods and techniques, the evaluation process, in short, every step of teaching. For teachers to teach based on the constructivist approach, they need teaching, methods and techniques that they can apply inside and outside the classroom (Saraç & Bayrak, 2017). Especially in science teaching; Since researches, activities, and experimental studies are at the forefront, the 5E teaching model is the most useful learning circle model, preferred in the constructivist approach (Saraç & Bayrak, 2017). 5E lesson plans are used to make plans suitable for this model. 5E lesson plan; It consists of Engage, Explore, Explain, Elaborate, and Evaluate steps. Teachers are responsible for planning learning environments suitable for students and enriching them with various activities. In the course preparation process, teachers plan by considering criteria such as the structure of the subject, student level, and teaching methods. Teachers are expected to gain competence in their own fields and make qualified lesson plans with different teaching methods and techniques suitable for the age and needs of students (Önen, et al., 2012). One of the methods and techniques by which future teachers can plan their lessons by using their field knowledge is educational games.

To be able to understand and explain the world in which a person lives; knowledge, observation, experience, and research need (Samur & Cömert, 2022). Games are one of the most natural, funniest, and oldest educational technologies, and are always on the agenda (Crawford, 1984). According to Burgun (2015), the game is the whole in which the individual progresses according to their own choices, experiences the entertainment or competition environment, and interacts with the elements of the system. In the literature, games are classified into different types such as action, simulation, card games, board games, children's games, and educational games (Korkusuz & Karamete, 2013; Samur & Cömert, 2022). Educational games, which are a type of games, can be used by educators to evaluate target achievements, in-class activities, or teaching outputs (Samur & Cömert, 2022). Educational games can be defined as activities where concepts can be embodied with the link between theoretical learning and practice, keeping individuals in a learning environment with an element of entertainment as well as active learning (Ghosh, 2022; Karamustafaoğlu & Kılıç, 2020). Spore and Quest Atlantis are good examples of educational games. In learning environments designed based on games, games based on physical activity, educational board games and digital games come to the fore.

When an educational game and design process is examined, it can be seen that there are many components, some of them are the learning outcomes, suitability for the student level, being remarkable, entertaining, and instructive (Samur & Cömert, 2022). Considering the educational game and design process components mentioned, it is stated in the literature that educators have difficulties in designing educational games (Ghosh, 2022). For teachers and pre-service teachers who have not stepped into the profession yet, to design educational games as a method they can use in their classrooms, and to have knowledge and experience in the application of educational games inside and outside the classroom; They need to know game design processes, decide how to design a game with the relevant acquisition and prepare a lesson plan.

When the literature is examined, it is seen that there are different models related to educational game design. Some of them are EFM model, FIDGE model, Game object model, Octalysis Model, Game design documents Gamification Design Framework, and Game Design Key Model (Korkusuz & Karamete, 2013; Özkan, 2018; Roungas, 2016; Şenocak & Bozkurt, 2020). Game designers should choose their models by considering the features of the game they want to prepare. The selection of the appropriate game design model is very important in designing games that are properly structured and serve the purpose of the educational curriculum. Thus, obstacles in educational game design can be removed and the desired game can be obtained (Ghosh, 2022).

The Game Design Key Model (GDKM) is a game design model developed by Özkan (2018), drawing upon the principles of the ADDIE (Analysis, Design, Development, Implementation, Evaluation) instructional design model. ADDIE, which encompasses analysis, design, development, implementation, and evaluation, is a comprehensible and easily implementable instructional design model. The steps of the GDKM derived from this design framework are outlined in Table 1.

Table 1.
Stages of GDKM (Samur & Cömert, 2022)

Steps	Game
1.Analysis	Needs Analysis
	Audience Analysis
	Determining Game Design Purpose
	Educational Goal Analysis
	Situation-Context Analysis
	Determination of Game Technology
	Determining the Game Type
2.Desing	Determination of Game Elements and Mechanics
3.Development	Development of the game's physical prototype
	Development of Game Product/ Model/ Digital Prototype
	Pilot Application of Game Product/Model/ Digital Prototype
	Development of a Lesson Plan for Educational Games
	Pilot Implementation of Lesson Plan
4. Implementation	Implementation of Game Product/ Model/ Digital Prototype
	Implementation of Lesson Plan for Educational Games
5. Evaluation	Evaluation of Game Design and Process
	Evaluation of Instructional Design and Process

Regarding the GDKM educational game design model prepared by Samur and Özkan (2022), an educational game design starts with an analysis. As can be seen in Table 1, the analysis includes a wide research and analysis process, because an educational game that we can define as good should be in a structure that is suitable for the target audience and can meet the educational goals. In addition, why the game was designed, whether the game will be designed digitally or physically, and what type of game it should be determined first.

The second step in GDKM is the design step. After determining the aim, target audience, type, technology, and educational goal of the game, a design should be made on this main skeleton. During the design process, the mechanics and elements of the game are determined. Game elements and mechanics are indispensable when designing educational games (Özkan, 2018). Elements and mechanics must be considered separately and combined for a successful game design process (Alagöz Hamzaj, 2022). Game elements: It can be defined as all the elements in the game that make the game difficult, orderly, and fun. Game mechanics, on the other hand, are all the verbs, actions, and actions in the game based on repetitive, animated, fun, uncertain results, defined skills (Samur & Özkan, 2022). Game mechanics: It is luck, competition, cooperation with the activities, behaviors, and control mechanisms in the game. Approaching, jumping, drawing, pulling, picking up, collecting, saving, etc. while actions are the mechanics of games; reward, level, rules, etc. can be given as an example of game elements. After the analysis and design stages of the game, the development stage of the game comes as seen in Table 2. At this stage, a prototype should be prepared and developed in accordance with the game technology and a pilot application should be made. In addition, the lesson plan of the developed game should be prepared, and the lesson plan should be finalized by making a pilot application. The plan should clearly state at what stage, for what purpose, and how the game will be used.

The next GDKM step is the implementation. It is the combine lesson plan and the game in the classroom as a result of the pilot applications. After these applications, evaluation processes such as self-assessment, player evaluation, and expert evaluation should be done for both the game design process and the educational design process. In this way, educational games can play a role in contributing to learning effectively. Science is a field that has abstract concepts from everyday life, especially in terms of the subject and scope of biology education. Difficult, complex, and abstract concepts in the field cause various difficulties in learning science subjects; For this reason, it is necessary to make science subjects understandable and integrate them with daily life (Yıldırım & Can, 2017).

Educational game studies are constantly increasing around the world, but there are still unexplored areas of study regarding the use of games in education (Ghosh,2022). When the field related to educational games is examined, some studies examine the processes and views of teacher candidates on educational game design. (Önen, et.al, 2012; Uluay & Doğan, 2016; Kapucu & Çağlak, 2018; Keleş, et.al, 2016; Akcanca & Sömen, 2018; Özkan, 2018; Usta & Güntepe, 2019; Karamustafaoğlu & Aksoy, 2020; Akgül & Kılıç, 2020). As there are studies in the field (Akcanca & Sömen, 2018; Kapucu & Çağlak, 2018; Ghosh, 2022) that concluded that pre-service teachers have difficulties in associating with learning outcomes and finding games in the process of designing educational games, it is seen that the games they prepare are qualified and educational (Akcanca & Sömen, 2018; Kapucu & Çağlak, 2018), there are also studies (Akgül & Kılıç, 2020; Uluay & Doğan, 2016) that findings that there are some difficulties and conveniences in the digital game design process and that a fun and effective learning environment is created with games in the process. When the studies conducted abroad in the literature review are examined, it is seen that educational games are effective in teaching biology concepts (Gutierrez, 2014); different educational game design and development approaches used in education support concept teaching (Amory & Seagram, 2003); it is used as a tool for students to gain interactive information about the subject and gains in the curriculum (Deus & Lopez, 2013); the study, which examines the opinions of secondary school teachers who do not prefer to use digital games frequently in teaching, after using digital games in classroom environments, it is examined that their perceptions about the increase in students' interests, cognitive learning, and motivation are examined. (Huizenga, et.al, 2017); when the views of pre-service teachers on digital educational games are examined, educational games in accordance with the curriculum content support education (Sardone & Devlin-Scherer, 2009); it was concluded that pre-service teachers would use digital educational games in their classrooms. (Sardone & Devlin-Scherer, 2010) researches are included.

Uluay and Doğan (2016), in the study prepared, they examined the digital game design competencies of science teacher candidates and their views on digital games with a different design model, MAGDAIRE. Quantitative and qualitative research methods were used in the study. Proficiency test and interview form were applied as data collection tools. A course was designed for the experimental group within the framework of MAGDAIRE and the results were compared with the control group who did not take the course. As a result, it was concluded that the proficiency scores of the experimental group were significantly higher and their views on digital game-based learning were more positive than the control group.

Keleş and his frends (2016), in their study, obtained a design framework on the use of gamification in education; undergraduate, graduate, and doctoral students stated that gamification in lessons is a fun method that increases motivation and commitment to the lesson.

In her study, Gürpınar (2017), made a presentation about educational games to 40 pre-service science teachers, then asked them for lesson plans with educational game content and evaluated these plans. As a result of the study, it was concluded that most of the candidates were sufficient in preparing educational games and lesson plans.

Kapucu and Çağlak (2018), in their study on pre-service science teachers' educational game design skills, they measured pre-service science teachers' game design skills with an evaluation rubric. Candidates' views on the design process were collected through an interview form. As a result of the study, it was concluded that the candidates designed good, applicable educational games, but they could design games at a medium level in terms of instruction and content skills. Candidates stated that educational games have a positive effect on the learning process and increase permanence by making the lesson fun.

Study by Özkan (2018) "An educational game design model proposal: Game design key," identified the need for an educational game model and proposed a step-by-step model to assist in game design. The research was conducted as a design and development study, with data analysis conducted through document analysis. Additionally, participants' opinions were gathered using semi-structured interview forms, and the model was refined based on expert feedback and revisions. During the interviews, participants highlighted that determining game mechanics posed the greatest challenge, and they expressed that the model was simple, understandable, plain, easy, and practical for game design. Furthermore, it was noted that with this developed model, educators could individually design their own games.

Based on semi-structured interviews with mathematics teacher candidates regarding the process of designing educational digital games, Üstün (2020) concluded that the use of games in educational settings enhances students' interest and motivation. Research indicates that integrating educational games into lessons positively impacts student achievement and motivation. It is crucial for teachers who intend to incorporate educational games into their lessons to engage in game experiences, develop educational games, and plan their lessons accordingly.

Experiencing the educational game design and lesson planning process during their teacher training enhances the quality of education once teachers enter the profession, offering students diverse learning experiences that foster lasting learning. Thus, this study was designed to enable biology teacher candidates to engage in the process of educational

game design and planning and to gather their perspectives on the process. In this study, after briefing pre-service teachers on the educational game design process, they were tasked with creating a game and lesson plan in accordance with the Game Design Key Model (GDKM). Subsequently, the prepared games and plans were evaluated based on the model.

Purpose and problem of the research

When the biology course content is examined, the abstract nature of some subjects and concepts makes it difficult to learn. In teaching difficult subjects in the field, teachers should guide the learning process by using effective teaching methods as well as field knowledge. Creating environments where teacher candidates can develop their professional competencies in education faculties; will help the candidates to carry out the teaching process in a more planned and programmed way by using modern teaching techniques when they start the profession.

In this context, the objective of the study is to assess the educational games and lesson plans created by pre-service biology teachers using the Game Design Key Model (GDKM), and to elucidate their perspectives on both the educational game design process and the 5E lesson plans they developed within this framework. The research problem statement is framed as follows: "What are the opinions of biology teacher candidates regarding the educational games they designed using the Game Design Key Model (GDKM), and the lesson plans they formulated throughout this process?"

The sub-problems of the study are;

1. How are the results of the expert, peer, and self-evaluation of the educational games designed by the biology teacher candidates according to the GDKM Game design template?

2. At what stage did the biology teacher candidates include the educational game in the lesson plan they prepared?

3. What are the views of biology teacher candidates on the educational game design process?

4. What are the pre-service biology teachers' thoughts on the process of creating 5E lesson plans with educational games?

Method

The study utilized a case study approach, a qualitative research method characterized by its in-depth exploration of a specific subject. Qualitative research aims to delve deeply into a particular topic, offering a comprehensive understanding beyond mere quantitative measurements. Researchers in qualitative studies pose varied and detailed questions to uncover insights beyond simple assessments of quantity or quality. Case studies, within the realm of qualitative research, involve the thorough examination of events or phenomena that researchers cannot manipulate, focusing on "how" and "why" questions (Yıldırım & Şimşek, 2021). In this study, a case study was chosen to gain an in-depth understanding of biology teacher candidates' processes in educational game design and lesson planning, as well as to analyze participants' experiences, perspectives, and behaviors in detail (Creswell, 2013). The case study provides an ideal framework for understanding the individual experiences of biology teacher candidates, such as the challenges they encountered, the strategies they developed, and their evaluations while designing games in accordance with the GDKM. The study group consists of 14 biology teacher candidates studying at Balıkesir University Necatibey Faculty of Education in the 2022-2023 academic year. In the study, 5 groups of teacher candidates were formed and asked to prepare their educational games and lesson plans. Interviews were conducted with a randomly selected teacher candidate from each group.

The data of this study was collected from volunteer teacher candidates. Ethics approval for the study was obtained from Balıkesir University's Social and Humanities Ethics Committee (approval number 2023/01, letter reference E-19928322-302.08.01-235117, dated 06.03.2023).

Research process

The study was designed for biology teacher candidates to prepare educational games and prepare a lesson plan for these games. Therefore, before starting the study, the participants were informed about the purpose and process of the study; A voluntary participation consent form was obtained. In our study, the primary reason for choosing the 5E model lies in its compatibility with the constructivist approach and its effectiveness in teaching abstract and complex topics, such as those found in biology (Saraç & Bayrak, 2017). The 5E model enhances student engagement in active learning processes, allowing them to construct their own knowledge and connect abstract concepts to tangible contexts. The model's structured phases—Engage, Explore, Explain, Elaborate, and Evaluate—offer a systematic framework that facilitates understanding in science education. Furthermore, educational games can be easily integrated into various phases of this model, particularly during the Evaluate phase, serving as both a supportive and enjoyable tool for the learning process (Ertuğrul & Karamustafaoğlu, 2021). Then, the training plan in Table 2 was applied to the preparation of the educational game and 5E lesson plan.

Table 2.
Educational Game Design and 5E Lesson Plan Curriculum Education Process

Group	Process	Time
Biology Teacher Candidates	Informing teacher candidates about the research process and obtaining voluntary participation consent forms	1 Lesson Time.
	Educational Game and Preparation Process What is a game? What is an educational game? How is the game prepared? What are the game elements and mechanics? What are game design models? "Introducing the "Game Design Key Model (GDKM)"	2 Lesson Time.
	Lesson Plan Preparation Introduction of the 5E teaching model Introduction of 5E lesson plan stages Examining sample 5E lesson plans	1 Lesson Time.
	Introducing the "Educational Game Design Evaluation" rubric	1 Lesson Time.

After the training given in Table 2, teacher candidates were divided into 5 groups. The groups were asked to design an educational game in accordance with the GDKM template and to prepare a 5E lesson plan suitable for their game. Pre-service teachers were given 2 weeks for these preparations. Educational games prepared at the end of this period were evaluated with the "Game Design Key Model Evaluation Rubric" The evaluation process was carried out in the form of peer evaluation, self-evaluation, and expert evaluation. At the end of the training and design process, 5 teacher candidates; Opinions were received about the educational game and the 5E learning model, and the research process.

Data collection tools

The educational games prepared by the candidates were evaluated with the "Game Design Key Model (GDKM) evaluation rubric" (Appendix 1). Among the tools used for evaluation, rubrics are frequently used in schools; in addition, self-assessment and peer-assessment applications have an important place in educational research (Güneş & Kılıç, 2016). Rubrics are documents in which the criteria determined in any field are listed and their qualitative definition is made (Andrade & Du, 2005; Goodrich, 1997). There are two types of rubrics in the field: holistic and analytical (Cohen, 1994). In the study, an analytical rubric was prepared for individuals to examine the components of game design models separately and for teacher candidates to recognize game design models and notice their deficiencies. In addition, analytical rubrics provide the advantage of providing both intra-rater and inter-rater reliability for self-assessments, peer-assessments and expert assessments used in this study (Knoch, 2009; Kumaş, 2024). For this study, a rubric was prepared by the researchers according to the game design key model (GDKM). While preparing the rubric, OTAM and other game evaluation rubrics in the field were examined first. Rubric criteria were determined by selecting criteria compatible with OTAM's stages rubric questions. The prepared rubric was evaluated by three experts, one in biology education and two in the field of games and was used in the study after the necessary corrections were made.

The rubric consists of 15 main criteria and 17 sub-criteria. Each criterion was scored as "No (1 point); Partially (2 points); "Yes (3 points)". The highest score that can be obtained from the rubric is 96, which indicates that the educational game meets all the criteria; the lowest score is 32. If the score obtained from the rubric is higher than the average, the game design prepared is suitable for the model; being low indicates that the prepared design has aspects that do not match the model.

Another data collection method employed in the study is the semi-structured interview, which was designed by the researchers. This interview format includes questions crafted to gather the perspectives of the participants on educational game design, lesson plan preparation, and the overall research process, considering the research problem and sub-problems. The semi-structured interview form was examined by two biology education experts and a playground expert and was used in the study after the necessary corrections.

Analysis of data

The educational games prepared by the biology teacher candidates were written in the game key model template and the template was scored with the "OTAM evaluation rubric". In the evaluation of the games prepared, three different evaluations were made: expert evaluation, peer evaluation, and self-evaluation. During the evaluation process, pre-service teachers were asked to evaluate their educational games, and their self-evaluation scores were calculated; In the peer assessment, pre-service teachers were asked to evaluate other games, and the average score was calculated. In the expert evaluation, game templates were evaluated by three experts, and average scores were calculated. Thus, the suitability of the prepared games was also checked by different evaluators, and the most suitable game for OTAM was determined.

Finally, a pre-service teacher from each group who was involved in the educational game design and lesson planning process was selected and interviews were conducted. These interviews were recorded with the permission of the teacher candidates. The content analysis method was used in the analysis of the semi-structured interview form. As a result of the analyses, the pre-service teachers were coded as S1, S2, S3, S4, and S5 and their views were included in the study.

Results

In the study, pre-service biology teachers designed an educational game according to the game design key model after the educational game and 5E lesson plan training and prepared lesson plans for the games they prepared. In the study, 14 pre-service teachers were divided into groups and designed five games. These educational games are: "Who Am I", "Bio taboo", "Biology Bingo", "Biopoly" and "X-O". In Table 3, short explanations that introduce these educational games are given.

Table 3.

Presentation of the prepared educational games

Name of the Game	Brief introduction of the game
Who am I	It is a card game about the classification of living things. The player tries to guess the creature on the selected card using yes-no questions as soon as possible. It's a group game.
Biotaboo	It was developed as a "Taboo"-like game. It is a board game that can help to learn the concepts related to organelles, and mitosis-meiosis without using forbidden words.
Biology Bingo	It is a board game adapted with the logic of the classic "bingo" game, prepared to repeat the 11th-grade human physiology unit. It includes questions and answers on the subject.
Biopoli	It is designed as a board game similar to "Monopoly". It is a box game designed for 11th and 12th grade students to learn the functioning of systems and concepts about the subject.
X-O	It is an educational game prepared by combining the question-and-answer activity with the known X-O game to repeat what was learned at the end of the 11th-grade human physiology unit.

The educational games prepared by the pre-service teachers were first evaluated with the "GDKM Evaluation Rubric" and the data were analyzed. Then, interviews were held with a randomly selected teacher candidate from each group on educational game design, lesson plan preparation, and research process.

Findings related to the "GDKM" assessment rubric

While evaluating the educational games prepared by the pre-service teachers, the OTAM evaluation rubric scores prepared by the researchers were considered. The highest score that can be obtained from the rubric is 96, and the lowest score is 32. In the evaluations using rubrics, participants were first asked to evaluate themselves, then the groups evaluated each other, and finally, experts assessed the educational game. In the analysis of this data, the mean scores of peer assessment, self-assessment, and expert assessment were calculated for targeting. The GDKM assessment rubric scores of the evaluators are shown in Table 4.

Table 4.

GDKM assessment rubric evaluator scores

Evaluate	Who Am I (Group 1)	Bio taboo game (Group 2)	Biology bingo game (Group 3)	Biopoli game (Group 4)	X-O (Group 5)
Self-assessment	89	68	94	89	77
Peer Review	72	73	80	91	81
Expert Evaluation	71	69	66	73	75

When the findings in Table 4 are examined, the GDKM assessment rubric self-assessment scores are "Who Am I" 89; 68 for "bio taboo"; 94 for "Biology Bingo"; It is 89 points for "Biopoly" and 77 points for "X-O" game. The highest score that can be obtained from the assessment rubric is 96. Accordingly, the game with the highest self-assessment score among the groups preparing educational games is "Biology Bingo".

The groups evaluated the educational games prepared by each other according to the GDKM evaluation rubric, and thus, the averages of peer evaluation scores were found in Table 4. Pre-service teachers found the "Biopoli" game of group 4 suitable for GDKM with 91 points. Group 1's game "Who Am I" was the least suitable educational game for OTAM, with 72 points according to peer evaluation averages.

5 groups that prepared educational games were evaluated by 3 experts. The average score as a result of the expert evaluation; was 71 in Group 1; 69 in Group 2; 66 in Group 3; 73 in Group 4 and 75 in Group 5. According to expert evaluation, it is the "X-O" game with 75 points most suitable for GDKM. Considering the GDKM evaluation rubric criteria, the game with the lowest expert evaluation score is "Biology Bingo".

When the self-evaluation scores in Table 4 are examined, all groups are suitable for GDKM because the self-evaluation scores of the games they prepared are above average. In the scoring, the "biology bingo" game with 94 points was determined as the most suitable game for GDKM by the group that prepared it. In the scoring, the "biology bingo" game with 94 points was determined as the most suitable game for GDKM by the group that prepared it. However, expert evaluation and peer evaluation scores show that this game is below the self-assessment score in terms of compliance with GDKM. When the peer assessment mean scores of each group were examined, the 91-point "biopoly" game was found to be more suitable for GDKM by other pre-service teachers. Self-evaluation score and expert evaluation score averages also support the suitability of the game for GDKM. In the evaluations made by the experts, it is seen that the most suitable game for GDKM is "X-O". Peer evaluation and self-evaluation scores also support that the X-O game is suitable for GDKM.

Findings on the Game Design Process

The pre-service teachers were asked about their experiences in the educational game design process they prepared with the game design key model (GDKM), topic selection, their opinions on game elements and mechanics, and their thoughts on educational games in biology education. Most of the pre-service teachers stated that they found the game design and lesson planning process enjoyable. For example, one participant said, 'I had a lot of fun' (S3), while another participant said, 'I enjoyed the game process' (S2).

The pre-service teachers mentioned that the process of preparing educational games and educational planning is challenging and labor-intensive, and for example, one participant said, 'I realized that the process is very difficult. It requires a great deal of labor. It is a very big thought process and when you think of something, it is very difficult to transfer it and to concretize it and it was really difficult for us' (S4).

The pre-service teachers chose human physiology, classification of living things and organelles as the topics for their educational games. The students who tended to choose topics that were difficult in biology expressed this process as follows: 'We chose a topic that was easy to play and that we all lacked in biology' (S3), while another participant said, 'There is a topic that I could never learn or memorize. We preferred to emphasize on that subject.' (S2)

When the pre-service teachers were asked how they determined the game mechanics and elements during the game design process, the majority of the participants mentioned that they used the design of another game and therefore did not add mechanics and elements. When the game design templates were analyzed, it was observed that the candidates determined the elements and mechanics correctly. Candidates about the selection of game elements and mechanics: 'First of all, we chose the game we will play. Then I can say that we realized what the mechanics were. The cards and the questions asked were the mechanics, and the answers given in the auxiliary mechanics. We made the game, we realized

that we had only one element and we wrote it down. We thought that we could make another element, but it was not the basis of the game. There were no other elements and mechanics, so I used time.' (S1)

5e Findings on Lesson Planning

It was seen that the games prepared by the pre-service teachers were generally used in the evaluation phase of the lesson; whether the subject was understood by the students or not and for general review purposes. How can we reinforce the subject we have learned more. We started from here. We used it in the evaluation phase. (S2) One group developed their games in the exploration phase differently from the others. 'We gave more importance to exploration. This is so that it would be more interesting. Because the reason for this was actually this: The game was a known game but we needed to attract the attention of the class. Therefore, we gave more weight to exploration.' (S1)

The pre-service teachers did not concretely plan the 5E lesson plans on paper; however, they stated that they talked about the game planning process with their groupmates. 'Teacher, we did not do this in a written way, yes, but we actually thought and talked about it while designing the game. Now we said that when we enter the game, we will enter in this way while explaining the game. We made this game to reinforce the subject of classification. This is how we did the exploration.' (S1) and another candidate said, 'Each stage of the lesson plan is important. Therefore, I planned carefully.' (S5)

Findings on the use of educational games

The pre-service teachers were asked about their thoughts on educational games and lesson plan preparation and what changes they would like to make in this training. While all of the pre-service teachers stated that they found the lecture positive and useful, they stated that they did not want to make any changes in the content of this training. In addition, in the interviews, pre-service teachers stated that they would like to take a course on educational games and that they would like to use educational games in their professional lives. 'I think the course process was very useful, it was good, I think you were able to educate us. In fact, you taught us and I think it is a training that should be given to every student teacher because it is something very applicable. I would explain it like you...' (S1), while another participant said, 'These lessons will be useful for us when designing because they will stay in your mind in our future teaching career. We had seen the 5E plan in other lessons, but it was more permanent because you explained it and we designed it in the game.'(S2)

When the pre-service teachers were asked what they would do differently if they were to design an educational game again, it was discovered that the participants wanted to design their educational games in different ways. For example, one of the participants said 'If there was more time, I would like to do something on the computer, apart from that, bingo could be something more like that. A few more things could have been added, actually we cannot be a little bit individual. Since I got the opinions of all my friends in the group' (S3) I would pay more attention to the choice of subject, I could design a game with more physical activity (S5)

Pre-service teachers have different opinions about preparing educational games. In general, they want to differentiate their educational games and want to prepare a more original game.

When the data related to the educational game design and evaluation process of pre-service teachers are analyzed, it is seen that they designed educational games in accordance with the steps of OTAM, one of the educational game design approaches. They planned the game in a way to serve education in the process that started with determining the needs in the design process and ended with the evaluation phase. When the peer and self-evaluation situations are examined, it is observed that they evaluated the level of the features determined as criteria while evaluating the games of their peers in line with what they learned. In the self-evaluation phase, students were evaluated by marking the options that they thought were missing or fully met in their games. In the interviews conducted with pre-service biology teachers about the process of preparing educational games and 5E lesson plans, the opinions about the educational game design process were stated as a challenging process and enjoyable. The selection and implementation of the mechanics and elements that should be present in an educational game were determined correctly. In the subjects they aimed to teach with the educational game, they chose the subjects that the pre-service teachers themselves had difficulty with. The pre-service teachers stated that they did not prepare a 5E lesson plan as a written material for the educational games they designed, and that the planning process was discussed and decided with their groupmates. It is seen that they used the games mostly in the evaluation and least in the exploration step. The opinions of the prospective teachers about the educational game design and 5E lesson plan preparation training process were quite positive and they stated that they did not have any suggestions that could be included in the training plan. The candidates stated that these trainings should be taught as a course in the undergraduate program. Finally, the candidates stated that they could create more different and original games in a new educational game design process and that they would not make changes in their games.

Discussion and Conclusion

This study examined the educational games designed by biology teacher candidates using the Game Design Key Model (GDKM) and their perspectives on this process. The findings indicated that teacher candidates were generally successful in educational game design but faced challenges in integrating these games into lesson plans. This suggests that candidates approached educational games primarily from a design perspective and did not focus sufficiently on aligning them effectively with lesson planning. These shortcomings are believed to stem from the candidates' lack of experience in preparing lesson plans during their professional coursework. It was observed that teacher candidates generally incorporated games into the "Evaluation" phase of the 5E model, with limited use in other phases such as "Exploration" and "Explanation." Some candidates reportedly planned this integration through group discussions but did not produce written lesson plans. The absence of written plans may have hindered the effective integration of games into the 5E model. The necessity of integrating games into lesson plans is another critical point emphasized by Özdemir (2022). Additionally, studies by Gürpınar (2017), Uluay and Doğan (2016), and Ghosh (2022) have shown that teacher candidates can become more proficient in preparing game materials and lesson plans.

In this study, the games designed by teacher candidates were evaluated using the Game Design Key Model (GDKM) rubric developed by the researchers. Significant differences were observed between the self-assessments, peer assessments, and expert evaluations of the games. Self-assessment scores were generally higher, while peer and expert evaluations yielded more balanced results. This suggests that teacher candidates exhibited a subjective approach to evaluating their own games. The main shortcomings highlighted in expert evaluations included aligning game mechanics with educational objectives and integrating games into lesson plans. The high scores received for the games designed by the candidates demonstrate their ability to independently design educational games aligned with the model. Among the games, "Biology Bingo" received the highest self-assessment scores, while "Biopoly" was rated highest in peer evaluations, and "XO" was deemed the most suitable design in expert evaluations. This finding highlights the influence of different evaluative perspectives on game design. Studies by Üstün (2020), Kapucu and Çağlak (2016) have noted that teacher candidates effectively use design steps such as targeting specific audiences and ensuring game objectives align with their purposes, positively influencing the game development process and highlighting the beneficial impacts of educational games on the learning process.

In this study, teacher candidates described the educational game design process as enjoyable, providing them with valuable experience, and as an effective application of GDKM. However, the process was also perceived as time-consuming and challenging. During the selection of game mechanics and elements, candidates often drew inspiration from existing designs, which limited the originality of their creations. This suggests a need for training programs that encourage more creativity in game design among teacher candidates. The study supports the difficulties and benefits of educational game design mentioned in the literature. Studies by Uluay and Doğan (2016) and Keleş and his firends (2016) also reported positive views among teacher candidates regarding the preparation and use of educational games in classrooms. The enjoyment derived from games and their positive effects on individuals of almost all ages might explain the favorable attitudes expressed by biology teacher candidates toward the use of games in education.

This study concluded that an effective game design model facilitated the game development process and proved beneficial for students. Other studies in the literature (Korkusuz & Karamete, 2013; Samur & Cömert, 2022; Uluay & Doğan, 2016; Dönel Akgül & Kılıç, 2020; Üstün, 2020) have emphasized that while educational games are not inherently easy to create, the design process is critical and necessary. Thus, it is essential to introduce teacher candidates to educational games and the game design process as a teaching method and technique, providing opportunities for hands-on experience. Özdemir (2022) highlighted the importance of such training by demonstrating that educational games created without prior training were less suitable and moderately aligned with educational content. Özkan's (2018) thesis developed a key model for game design and indicated that teacher candidates could design their own educational games by following the model's steps.

In conclusion, teacher candidates need to gain more experience in designing educational games. However, additional training is required to ensure that these games are effectively integrated with lesson plans. The effective use of educational games necessitates a comprehensive understanding of game design and its integration into teaching processes. Therefore, increasing training opportunities that equip teacher candidates with both theoretical knowledge and practical skills is crucial. Additionally, this study demonstrated that GDKM distinguishes itself from other models by systematizing the game design process, providing a structured framework that contributes significantly to the literature.

Suggestions

● Based on the results of this study, it is recommended to raise awareness about the importance of educational games in teaching processes and to develop programs that will enable pre-service teachers to receive more comprehensive and practical training on this subject.

● Within the scope of the research, it was seen that the participants were inadequate in the scope of developing digital games for educational games. Considering this situation, trainings about digital game development tools can be designed.

● The findings of the study revealed that pre-service teachers generally adapted existing games and mostly focused on board games. Opportunities or environments can be designed where prospective teachers can use their imagination and creativity to design educational games.

● It is recommended that similar studies be conducted with different game design models, different branches and larger participant groups. Interdisciplinary research can provide a broader perspective on the integration of educational games into teaching processes.

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Genişletilmiş Özet

Giriş

Öğretmenlerin yapılandırmacı yaklaşımı esas alan öğretimler yapabilmesi için sınıf içinde ve sınıf dışında uygulayabilecekleri öğretim, yöntem ve tekniklerine ihtiyaçları vardır (Saraç & Bayrak, 2017). Özellikle fen öğretiminde; araştırmalar, etkinlikler ve deneysel çalışmalar ön planda olduğu için yapılandırmacı yaklaşımda, kullanılan öğrenme halkası modellerinden en kullanışlı olanı 5E öğretim modeli tercih edilmektedir (Saraç & Bayrak, 2017). Bu modele uygun planlamaların yapılmasında 5E ders planları kullanılmaktadır. Geleceğin öğretmenlerinin kendi alan bilgilerini kullanarak derslerini planlayabilecekleri yöntem ve tekniklerden biri de eğitsel oyunlardır.

Burgun'a göre (2015) oyun bireyin kendi seçimlerine göre ilerlediği, eğlence ya da yarışma ortamını deneyimlediği ve sisteminin öğeleri ile etkileşim kurduğu bütündür. Oyunların bir türü olan eğitsel oyunları, eğitimciler hedef kazanımları, ders içi etkinlikleri veya öğretim çıktılarını değerlendirme amacıyla kullanabilmektedirler (Samur & Cömert, 2022). Eğitsel oyun, kuramsal öğrenme ve uygulama arasındaki bağ ile kavramların somutlaştırılabildiği, bireyleri aktif öğrenmenin yanı sıra eğlence unsuru ile öğrenme ortamında tutan etkinlikler olarak tanımlanabilir (Ghosh, 2022; Karamustafaoğlu & Kılıç, 2020). Oyunları temel alarak tasarlanan öğrenme ortamlarında fiziksel aktiviteye dayalı oyunlar, eğitsel kutu oyunları ve dijital oyunlar öne çıkmaktadır.

Bir eğitsel oyun ve tasarım süreci incelendiğinde çok fazla bileşenin olduğu görülebilir, derse ilişkin kazanımlar, öğrenci seviyesine uygunluk, dikkat çekici, eğlenceli ve öğretici olma bunlardan bazılarıdır (Samur & Cömert, 2022). Oyun tasarım modellerinden biri olan, Oyun Tasarımı Anahtarı Modeli (OTAM), Özkan (2018) tarafından ADDIE öğretim tasarım modeli temel alınarak geliştirilmiştir. Fen bilimleri özellikle biyoloji eğitimi konu ve kapsamı bakımından gündelik yaşamın içinden ve soyut kavramlara sahip bir alandır. Alanındaki zor, karmaşık ve soyut kavramlar öğrencilerin fen konularını öğrenmelerinde çeşitli güçlüklere neden olmakta; bu sebeple fen konularını anlaşılır hale getirip, günlük hayatla bütünleştirerek somut hale gelmesi gerekmektedir (Can & Yıldırım, 2017).

Dünya genelinde eğitsel oyun çalışmaları sürekli artmakta ancak oyunların eğitim öğretimde kullanımına ilişkin hala keşfedilmemiş çalışma alanları da bulunmaktadır (Ghosh, 2022). Eğitsel oyunlar ile ilgili alan incelendiğinde, öğretmen adaylarının eğitsel oyun tasarımına ilişkin süreçleri ve görüşlerinin incelendiği çalışmalar yer almaktadır (Akcanca & Sömen, 2018; Dönel Akgül & Kılıç, 2020; Karamustafaoğlu & Aksoy, 2020; Keleş vd., 2016; Önen, vd., 2012; Özkan, 2018; Seçkin Kapucu & Çağlak, 2018; Uluay & Doğan, 2016; Usta & Güntepe, 2019; Üstün, 2020). Alanda öğretmen adaylarının eğitsel oyun tasarlama sürecinde kazanım ile ilişkilendirmede, oyun bulma konusunda güçlük çektikleri yönünde sonuçlara ulaşan çalışmalar (Akcanca & Sömen, 2018; Kapucu & Çağlak, 2018; Ghosh, 2022) olduğu gibi, öğretmen adaylarının hazırlandıkları oyunların nitelikli ve eğitici olduğu (Kapucu & Çağlak, 2018), dijital oyun tasarım sürecinde bazı zorlukların ve kolaylıkların olduğu, süreçte oyunlar ile eğlenceli ve etkili bir öğrenme ortamının oluştuğuna yönelik bulgulara ulaşan (Uluay & Doğan, 2016; Dönel Akgül & Kılıç,2020; Üstün,2020) çalışmalar da vardır. Alanyazın taramasında yurt dışında yapılan çalışmalar incelendiğinde eğitsel oyunların biyoloji kavramlarının öğretiminde etkili olduğu (Gutierrez, 2014); eğitimde kullanılan farklı eğitsel oyun tasarım ve geliştirme yaklaşımlarının kavram öğretimini desteklediği (Amory & Seagram, 2003); Hücre konusuna yönelik öğrencilerin etkileşimli olarak konuya yönelik bilgilerin ve öğretim programlarındaki kazanımların kazandırılmasında bir araç olarak kullanıldığı (Deus & Lopez, 2013); Mikroevrim ile ilgili konunun anlaşılmasında kullanılan eğitsel oyunun alternatif bir öğretim aracı olarak etkili sonuçlara sahip olduğu (Meekaew & Pratchayapong, 2020); dijital oyunların öğretimde sık kullanmayı tercih etmeyen ortaokul öğretmenlerinin, sınıf ortamlarında dijital oyunları kullandıktan sonraki görüşlerinin incelendiği çalışmada öğrencilerin ilgilerinde, bilişsel öğrenmelerinde ve motivasyonların arttığına yönelik algılarının incelendiği (Huizenga, Ten Dam, Voogt, & Admiraal, 2017); öğretmen adaylarının dijital eğitsel oyunlara yönelik görüşlerinin incelendiğinde müfredat içeriklerine uygun eğitsel oyunların eğitimi desteklediği (Sardone, Devlin-Scherer, Roberta, 2009); öğretmen adaylarının sınıflarında dijital eğitsel oyunları kullanacağı sonucuna ulaşıldığı (Sardone & Devlin-Scherer, 2010) araştırmalar yer almaktadır.

Eğitim fakültelerinde öğretmen adaylarının mesleki yeterliliklerini geliştirebilecekleri ortamların oluşturulması; adayların mesleğe geçtiklerinde öğretim sürecini, çağdaş öğretim tekniklerini kullanarak daha planlı ve programlı yürütmesine yardımcı olacaktır. Bu doğrultuda çalışmanın amacı, biyoloji öğretmen adaylarının Oyun Tasarım Anahtar Modeli [OTAM]'ne göre geliştirdikleri eğitsel oyunların ve hazırladıkları ders planlarının değerlendirilmesi; eğitsel oyun tasarlama sürecine ve süreç içerisinde hazırladıkları 5E ders planlarına yönelik görüşlerinin ortaya konmasıdır.

Yöntem

Çalışmada nitel araştırma yöntemlerinden durum çalışması kullanılmıştır. Çalışmanın örneklemini 2022-2023 eğitim öğretim yılında Marmara bölgesinde bir eğitim fakültesinde öğrenim görmekte olan 14 biyoloji öğretmen adayı

oluşturmaktadır. Çalışma biyoloji öğretmen adaylarının eğitsel oyun hazırlama ve bu oyunlar ile ilgili ders planı hazırlama sürecine yönelik tasarlanmıştır, bu nedenle çalışmaya başlamadan önce katılımcılara çalışmanın amacı ve süreci hakkında bilgi verilmiş; gönüllü katılım onam formu alınmıştır. Adayların hazırladıkları eğitsel oyunlar, araştırmacılar tarafından hazırlanan "Oyun Tasarımı Anahtar Modeli (OTAM) değerlendirme rubriği" ile değerlendirilmiştir. Çalışmada kullanılan bir diğer veri toplama aracı ise, araştırmacılar tarafından geliştirilen yarı yapılandırılmış görüşme formudur. Hazırlanan oyunların değerlendirilmesinde uzman değerlendirme, akran değerlendirme ve öz değerlendirme olmak üzere üç farklı değerlendirme yapılmıştır. Son olarak her gruptan, eğitsel oyun tasarımı ve ders planlama sürecine dahil olan bir öğretmen adayı seçilerek görüşmeler yapılmıştır. Öğretmen adaylarından izin alınarak bu görüşmeler kayıt altına alınmıştır. Yarı yapılandırılmış görüşme formunun analizinde ise içerik analizi yöntemi kullanılmıştır.

Bulgular ve Tartışma

Biyoloji öğretmen adaylarına öncelikle eğitsel oyun, oyun tasarımı, oyun tasarımı anahtar modeli ve eğitsel plan hazırlama konularında eğitim verilmiş ardından gruplar oluşturarak OTAM'a uygun istedikleri bir konuda eğitsel bir oyun tasarlamaları istenmiştir. Grupların oyunları OTAM oyun tasarım şablonuna uygun hazırlanan değerlendirme rubriği ile değerlendirilmiştir. Uzman, akran ve öz değerlendirme olarak 3 farklı değerlendirme sonucu oyunlara ait puanlar ortaya çıkmıştır. Ardından öğretmen adaylarıyla görüşme yapılarak eğitsel oyun tasarlama süreci hakkındaki görüş ve düşünceleri belirlenmiştir.

Çalışma sonucunda grupların OTAM değerlendirme rubriğinde en yüksek öz değerlendirme puanı "Biyoloji Tombalası" ve puanı 94'tür. Akran değerlendirmesine göre oyun tasarım modeline en uygun oyun ise 91 puan ile "Biyopoli" oyunu iken uzmanlar tarafından yapılan değerlendirmelerde ise en yüksek puanı alarak oyun tasarım anahtar modeline uygun bulunan oyun 75 puan ile "X-O" olmuştur. X-O oyunu öz değerlendirme puanı düşük iken, akran ve uzman puanlarına göre OTAM'a uygundur. Biyoloji tombalası oyunun da ise öz değerlendirme puanlarının yüksek olduğu görülmektedir. Yani oyunu hazırlayan adaylar, belirlenen kriterlere oyunda yeterince yer verdiğini düşünürken, akran ve uzman değerlendirmesine göre oyun üzerinde düzenlenmesi gereken noktaların olduğu söylenebilir. Biyotabu oyunu değerlendirme puanlarının birbirine yakın olduğu görülmektedir. Oyunun değerlendirilmesinde katılımcılar ve uzmanlar benzer görüşlere sahiptir. Öğretmen adaylarının eğitsel oyunlarının, analiz, değerlendirme, geliştirme, uygulama ve değerlendirme basamağında yer alan adımlara uygun olduğu söylenebilir. Hazırlanan eğitsel oyunlar incelendiğinde, var olan oyunlar (monopoly, X-O, tabu vb.) biyoloji içerikleri ile birleştirilmiştir. Öğretmen adayları eğitsel oyun tasarım sürecinde öğrendikleri bilgiler doğrultusunda oyunlar üzerinde düzenlemeler yaparak ve özgün bileşenler de ekleyerek oyunlarını hazırlamışlardır. Öğretmen adaylarının tasarladıkları eğitsel oyunlar dersin kazanımına uygun, farklı becerilerin kullanılmasına yönelik mekanik ve elementlere sahip olduğu görülmektedir. Eğitsel oyun tasarımlarında dijital oyunların tasarımlarını tercih etmedikleri görülmektedir. Çalışmanın diğer bölümünde öğretmen adaylarının eğitsel oyun süreci ile ilgili görüşleri alınmıştır. Bu görüşmede yer alan sorular; eğitsel oyun tasarım süreci, ders planlama süreci ve adaylara verilen eğitim ile ilgilidir. Bu sorulara verilen cevaplara göre öğretmen adaylarının eğitsel oyun tasarımında keyif aldıkları ancak zaman zaman zorlandıklarını belirtmişlerdir. Uluay ve Doğan (2016), çalışmalarında eğitsel oyun eğitimi verilen öğretmen adaylarının dijital oyun tasarım yetkinliklerinin ve görüşlerinin olumlu yönde geliştiği sonucu; çalışmamızda ulaştığımız eğitsel oyunların işe yarar olması, süreçten keyif almaları gibi bulgularla örtüşmektedir. Yine Keleş vd. (2016) yaptığı çalışmada, öğretmen adaylarının eğitsel oyun hazırlama sürecinde eğlendiklerini belirtmektedir. Öğretmen adaylarının konu seçiminde genelde kendilerinin hoşlandıkları veya zorlandıkları biyoloji konularını tercih ettiklerini paylaşmışlardır. Öğretmen adayları tasarladıkları oyunların piyasada bulunan oyunlar olduğu için oyun mekanik ve elementlerine ekleme veya çıkarma yapmadıklarını belirtmişlerdir. Üstün (2020) çalışmasında öğretmen adaylarının dijital oyun geliştirme sürecinde hedef kitleye uygunluk ve oyunun amacı gibi oyun tasarım basamaklarını kullandığını ve oyun geliştirme sürecini olumlu etkilediğini belirtmiştir; çalışmanın bu sonucu elde ettiğimiz sonuçları destekler niteliktedir: araştırma verilerine göre oyun tasarım sürecinde etkili bir oyun tasarım modelinin, süreci kolaylaştırıp öğrencilere yararlı olduğu sonucuna ulaşılmıştır. Özkan (2018) tez çalışmasında, oyun tasarımı anahtar modelini geliştirmiş ve öğretmen adaylarının model basamaklarını takip ederek kendi eğitsel oyunlarını tasarlayabileceklerini belirtmiştir. Bu çalışmada öğretmen adaylarının tasarladıkları oyunlardan aldıkları değerlendirme puanlarının yüksek olması öğretmen adaylarının modele uygun bir eğitsel oyunu bireysel olarak tasarlayabileceklerini göstermektedir. Yeniden bir oyun tasarlayacak olsalar daha yaratıcı ve farklı oyunlar tasarlamak istediklerini belirtmişlerdir. Öğretmen adayları eğitsel oyuna uygun ders planlama aşamasında zayıf kalmışlar, tasarladıkları oyunları genellikle değerlendirme aşamasında kullanmayı tercih etmişler, bir grup ise keşfetme aşamasında kullanmıştır. Gürpınar'ın (2017) çalışmasında da fen bilimleri öğretmen adayları eğitsel oyun materyali ve ders planı hazırlamada yeterli görülmüş ve adayların eğitsel oyunları eğitim öğretim sürecine önemli katkıları olacağı sonucuna ulaşmıştır. Araştırma sonucunda elde edilen bulgulara göre biyoloji öğretmen adayları ile yapılan görüşmelerde ders planlarının hazırlanmaması durumu araştırma ile benzer nitelik taşımamaktadır.

Eğitsel oyunların öğrencilerle paylaşılmasında öğretmenlerin üstlerine düşen görev; eğitim ortamının düzenlenmesi, konuya ilişkin bir planın hazırlanması ve konunun kazanımına uygun eğitici ve eğlenceli etkinliklerin seçilmesidir. Derslerini monotonluktan kurtarmak isteyen öğretmenler yeni ve konuya yönelik bir eğitsel oyunun oluşturulmasında; kaynakları

kullanarak, bir oyunun sahip olması gereken özellikleri bilerek bir eğitsel oyun tasarlayabilmelidir. Bu nedenlerle öğretmen adaylarının eğitsel oyunları öğrenme ortamlarında teorik ve pratik olarak uygulayabilmeleri gerekmektedir. Yapılan çalışmalar eğitsel oyunların eğitim öğretimdeki yerinin ve öneminin fark edilmediğini ve alanda öğretmen adaylarının eğitsel oyunlara yönelik daha geniş kapsamlı ve uygulamalı eğitim almak istediklerini göstermektedir. Eğitim fakültelerinde eğitsel oyunlar, tasarımı ve derse entegre süreci ile ilgili bir ders veya seçmeli ders olarak okutulabilir. Eğitsel oyunların ders planlama süreci ile ilgili daha ayrıntılı bilgiler verilebilir.

APPENDİX 1: Game Design Key Model (GDKM) Evaluation Rubric

Oyun Tasarım Anahtar Modeli Değerlendirme Rubriği

Kriter / Ölçüt	Hayır (1)	Kısmen (2)	Evet (3)
1) Hazırlanan oyuna verilen uygun bir isim verilmiştir.			
2) Hazırlanan oyunun oyuncu sayısı belirtilmiştir.			
3) Hazırlanan oyunun hedef kitlesi açıkça belirtilmiştir.			
4) Hazırlanan oyunun içine aldığı kazanımlar net bir şekilde belirtilmiştir.			
5) Hazırlanan oyunda oyuncunun hedefi net bir şekilde belirtilmiştir.			
6)Hazırlanan oyunun hangi becerilere yönelik olduğu ifade edilmiştir Stratejik düşünme ve akıl yürütme becerisi Problem çözme Yaratıcılık 3 boyutlu düşünme İşbirlikçi çalışma Bilgisayar becerileri Sağlıklı devamlılığını sağlama Duygusal gelişim Motor beceriler			
7) Oyun için gerekli malzemeler belirtilmiştir.			
8) Oyun da kullanılacak mekanikler net ve anlaşılır bir şekilde belirlenmiştir. Oyun tasarım amacı ile oyun mekaniği uyumludur Oyun tasarımında oyuncu fiziksel ve zihinsel anlamda aşırı zorlanmamaktadır. Oyun mekaniği kolay anlaşılabilirdir. Oyun hedef oyuncu kitlesinin yaşına uygundur. Oyun mekaniği tematik ve eğlencelidir.			
9) Oyunun her aşamasında oyunculara verilecek geri bildirimler belirlenmiştir. Geri bildirim güdüleyicidir. Geri bildirimler yönlendiricidir. Geri bildirimler pekiştiricidir.			
10) Oyun kuralları açık, net ve anlaşılır bir şekilde belirtilmiştir.			
11) Oyun tasarımını zenginleştiren eğlenceyi arttırıcı destekleyici mekaniklere yer verilmiştir.			
12) Hazırlanan oyunun nasıl biteceği belirtilmiştir.			
13) Hazırlanan oyun eğitsel açıdan uygulanabilir.			
14) Hazırlanan oyun eğitsel açısından kullanışlıdır.			
15) Hazırlanan oyuna uygun bir eğitsel planlama yapılmıştır.			

APPENDİX 1: Game Design Key Model (GDKM) Evaluation Rubric

APPENDİX 2: Game Design Key Pattern Template

Oyun tasarım Şablonu

Oyunun Adı:

Oyunu geliştirenler:

Oyunun mekanikleri nelerdir?

Oyunun kazanımları:

Oyuncunun hedefi/görevi?

Oyunun hedef kitlesi/ yaşları:

Oyunun destekleyici mekanikleri nelerdir?

Oyun hangi becerileri geliştirmeye yöneliktir?

Oyunu geliştirenler:

Oyun nerede nasıl oynanır?

Oyun malzemeleri nelerdir?

Oyundaki geri bildirimler nelerdir?

Oyun nasıl oynanır? kuralları nelerdir?

Oyun ne zaman biter ?