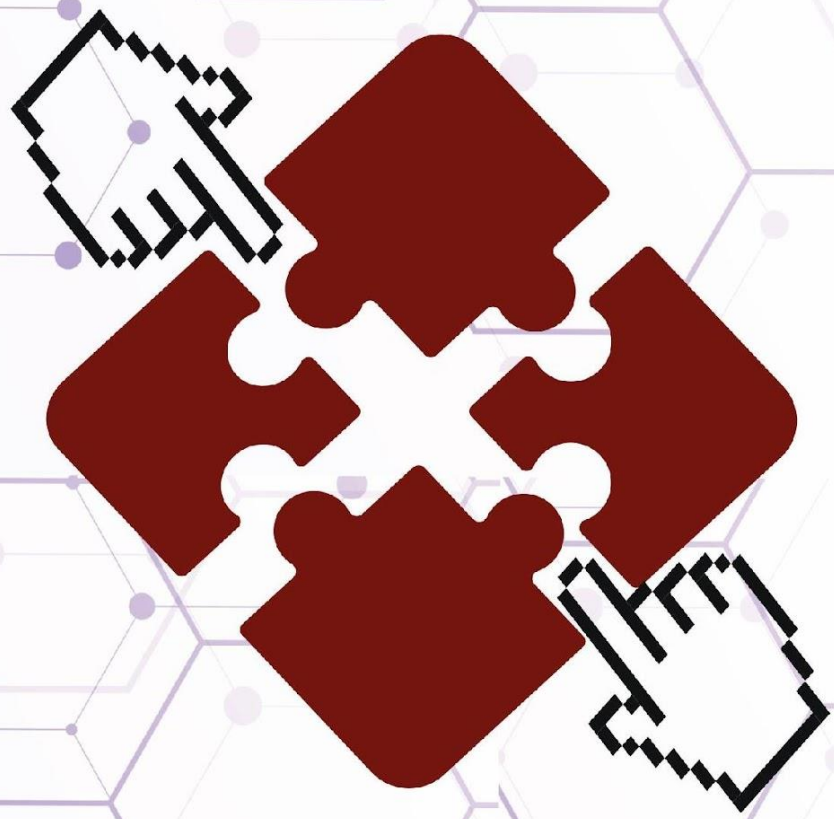
DIGITAL GAMES AND GAMIFICATION IN EDUCATION

Editors
Dr. Nurullah Taş
Dr. Yusuf İslam Bolat



www.istes.org

DIGITAL GAMES AND GAMIFICATION IN EDUCATION

Editors

Dr. Nurullah Taş

Dr. Yusuf İslam Bolat

www.istes.org

Digital Games and Gamification in Education

Editors
Asst. Prof. Dr. Nurullah Taş, Atatürk University, Turkiye
Asst. Prof. Dr. Yusuf İslam Bolat, Kahramanmaraş İstiklal University, Turkiye

Cover Designed by
Kemal Köksal, Kahramanmaraş İstiklal University, Turkiye

ISBN: 978-1-952092-58-9

Date of Publication

September, 2023

Publisher

ISTES Organization
Monument, CO, USA

Contact

International Society for Technology, Education and Science (ISTES)
www.istes.org
istesoffice@gmail.com

Citation

Citation

Taş, N. & Bolat, Y. İ. (Eds.). (2023). *Digital Games and Gamification in Education*. ISTES Organization.

Chapters

Chapter 1 - Introduction to Games and Gamification in Education: Basic Concepts 1

Nurullah Taş-Yusuf İslam Bolat

Chapter 2 - Theoretical Framework of Games and Gamification in Education 12

Nurullah Taş

Chapter 3 - Providing Motivation in Educational Games and Gamification 23

Can Meşe

Chapter 4- Game-Based Learning and Gamification Applications in Design Education..... 31

Meryem Geçimli-Kemal Köksal

Chapter 5 - Design Patterns in Game Development..... 43

Can Meşe

Chapter 6 - Game Engines 60

Mehmet Gök

Chapter 7 - Analyzing Digital Game Interface Designs in terms of Visual Communication Design 71

Kemal Köksal-Meryem Geçimli

Chapter 8 – Gamification in Education 79

Abdullatif Kaban

Chapter 9 – Gamification Models..... 94

Yusuf İslam Bolat

Chapter 10 – Games and Gamification in Online Learning..... 110

Hamza Polat

Chapter 11 – Assessment Based Games and Gamification..... 126

Önder Yıldırım

Chapter 12 – Smart Toys..... 137

Abdulkerim Aydın

Chapter 13 – Gamification in Educational Mobile Apps..... 152

Ömer Arpacık

Table of Contents

PREFACE xvi
Chapter 1 - Introduction to Games and Gamification in Education: Basic Concepts 1
Chapter Highlights 1
Introduction 2
The Potential of Educational Games 2
The Impact and Effectiveness of Educational Games 2
Games in Education 3
The Concept of Video Games 3
Analog Games: Unplugged Entertainment 3
Digital Games: Exploring a Digital Realm 4
Simulations: Bridging the Virtual and Real Worlds 5
Exploring Gamification in Education and Beyond 6
Harnessing the Power of Game-Based Learning 7
Serious Games: Merging Playfulness with Purpose 8
Chapter Summary 8
References 9
Chapter 2 - Theoretical Framework of Games and Gamification in Education 12
Chapter Highlights 12
Introduction 13
Self-Determination Theory 14
Flow Theory 14
Fogg Behavior Model 15
Cognitive Load Theory 16
Narrative Theory 17
Player Types Theory 17
Hedonic Motivation Theory 18
Goal Setting Theory 18

Chapter Summary 19
References 20
Chapter 3 - Providing Motivation in Educational Games and Gamification 23
Chapter Highlights 23
Introduction 24
Intrinsic Motivation 24
Extrinsic Motivation 25
Operant Conditioning 26
Self-Determination Theory (SDT) 27
Flow 28
Chapter Summary 28
References 29
Chapter 4- Game-Based Learning and Gamification Applications in Design Education 31
Chapter Highlights 31
Introduction 32
Basic Concepts 32
Engagement 33
Flow 33
Edutainment 34
Gamification 35
Game-Based Learning 35
Design Education and Game/Play 36
Chapter Summary 38
References 39
Chapter 5 - Design Patterns in Game Development 43
Chapter Highlights 43
Introduction 44
Game Development Process 44
Design Patterns in Game Development 44
Creational Design Pattern 46
Factory Pattern 46
Build Pattern 47

Abstract Factory Pattern 47
Prototype Pattern 47
Singleton Pattern 48
Creational Design Pattern 49
Adapter Pattern 49
Bridge Pattern 49
Composite Pattern 50
Decorator Pattern 50
Facade Pattern 51
Flyweight Pattern 51
Proxy Pattern 51
Behavioral Design Pattern 51
Chain of Responsibility 51
Command Pattern 52
Interpreter Pattern 55
Iterator Pattern 55
Mediator Pattern 56
Memento Pattern 56
Observer Pattern 56
State Pattern 56
Strategy Pattern 56
Template Method 57
Visitor Pattern 57
Unity Design Pattern 57
Chapter Summary 58
References 58
Chapter 6 - Game Engines 60
Chapter Highlights 60
Introduction 61
Game Engine Architecture and Fundamentals 61
Modularity 64

Usability 64
Library Resources 64
Efficiency 64
Game Engine Types 65
Unity 65
Unreal Engine 66
GameMaker 66
CryEngine 66
Godot 67
Advantages of Game Engines 67
Chapter Summary 68
References 69
Chapter 7 - Analyzing Digital Game Interface Designs in terms of Visual Communication Design 71
Chapter Highlights 71
Introduction 72
Communication 72
Digital Game Interface Designs in terms of Visual Communication Design 73
Rhythm 74
Alignment 75
Typography 75
Colors 76
Conclusion 76
Chapter Summary 77
References 77
Chapter 8 – Gamification in Education 79
Chapter Highlights 79
Introduction 80
The Theoretical Framework of Gamification 81
Elements of Gamification 83
Benefits of Gamification in Education 84
Gamified Learning Experience Design 84
Gamification Tools and Platforms 85

Kahoot 86
Quizizz 86
Socrative 88
Gamification and Future Trends 89
Chapter Summary 90
References 90
Chapter 9 – Gamification Models 94
Chapter Highlights 94
Introduction 95
Werbach & Hunter D6 Model 95
D1: Set Goals 96
D2: Delineate Target Behaviors 96
D3: Describe your players 97
D4: Devise Activity Cycles 97
D5: Don't Forget the Fun 97
D6: Deploy the Appropriate Tools 97
Elements of Gamification 98
Octalysis Gamification Model 99
Epic Meaning 100
Achievement 101
Empowerment and feedback 101
Ownership 101
Social Impact and Relatedness 101
Scarcity 101
Unpredictability 102
Avoidance 102
Hook Model 102
SAPS Gamification Model 103
Status 104
Access 104
Power 105

Stuff 105
Huang and Soman's Gamification Model in Education 105
Identifying the Target Audience and Context 106
Defining Learning Objectives 106
Structuring the Experience 106
Identifying Resources 106
Implementation of Gamification Elements 107
Chapter Summary 107
References 107
Chapter 10 – Games and Gamification in Online Learning 110
Chapter Highlights 110
Introduction 111
Online Learning 112
Games in Online Learning 114
Types of Games in Online Learning 115
Serious Games 115
Simulations 116
Quiz and Trivia Games 117
Collaborative Social Games 118
Gamification in Online Learning 119
The Effect of Games and Gamification on Motivation in Online Learning 119
The Effect of Games and Gamification on Participation in Online Learning 120
The Effect of Games and Gamification on Interaction in Online Education 121
Chapter Summary 122
References 122
Chapter 11 – Assessment Based Games and Gamification 126
Chapter Highlights 126
Introduction 127
The Importance of Game and Gamification-Based Assessment 127
How Games, Gamification, and Evaluation Intersect? 128
Quantitative Metrics in Game and Gamification-Based Assessment 128
Qualitative Evaluation Tools in Game and Gamification-Based Evaluation 129

Behavior Tracking with Gaming and Gamification 130
Behavior Tracking with Gaming and Gamification 130
Assessing Social and Collaborative Learning with Games and Gamification 131
The Future of Gaming and Gamification-Based Assessment 131
Learning Analytics with Games and Gamification-Based Learning 132
Conclusion 133
Chapter Summary 133
References 134
Chapter 12 – Smart Toys 137
Chapter Highlights 137
Introduction 138
Definition of Smart Toys 139
Benefits of Smart Toys 140
Motivation 140
Interaction 141
Creative Thinking Skills 142
Individuality 142
Ubiquitous Learning Environment 142
Types of Smart Toys 142
Development Process of Smart Toys 143
Usage Areas of Smart Toys 144
Special Education 144
Language Education 144
Coding 145
Mathematics 145
Digital Storytelling 146
Potential Barriers and Possible Enablers 146
The Future of Smart Toys 148
Chapter Summary 149
References 149
Chapter 13 – Gamification in Educational Mobile Apps 152

Chapter Highlights 152
Introduction 153
Gamification in Mobile Learning 154
Dynamics 156
Constraints 156
Emotions 156
Narrative 156
Progression 156
Storytelling 156
Relationships 156
Mechanics 157
Challenge 157
Chance 157
Collaboration 157
Competition 157
Feedback 158
Resource acquisition 158
Rewards 158
Trades 158
Turn 158
Winning Status 158
Components 158
Achievements 158
Avatars 159
Badges 159
Boss fight 159
Teams 159
Collections, virtual items, and gifts 159
Leaderboards, challenges, and social charts 159
Tasks, content unlocking 160
Levels, Points 160
Development Process 160

Chapter Summary 161

References 162

PREFACE

In the "Digital Games and Gamification in Education" pages, readers embark on a captivating journey through a landscape where traditional education converges with the engaging world of digital games and gamification. This comprehensive volume is designed to provide a rich and multifaceted exploration of this transformative trend reshaping our educational systems' very fabric.

The journey begins with *Chapter 1*, where readers are introduced to the fundamental concepts that underpin the integration of games and gamification in educational settings. Here, we establish a solid foundation by elucidating the core principles, setting the stage for a deeper and more nuanced understanding of this innovative approach.

As the reader progresses to *Chapter 2*, they are invited to delve into the theoretical framework that supports the use of games and gamification in education. This theoretical excursion provides educators, scholars, and researchers with the tools to critically analyze and evaluate the pedagogical implications of integrating games into the curriculum. It also offers insights into the diverse theoretical perspectives that inform the development and implementation of game-based educational strategies.

Chapter 3 examines one of the most profound effects of games and gamification in education: motivation. Motivation is often considered the engine that drives successful learning, and this chapter explores how the interactive and immersive nature of games can ignite a deep-seated passion for learning. By examining the intrinsic and extrinsic motivators that games provide, readers understand how to harness this motivational power for educational purposes.

Moving on to *Chapter 4*, we embark on a journey into the world of design education, exploring the innovative applications of game-based learning and gamification. Here, the reader will discover how the principles of creativity and innovation are seamlessly integrated into the educational process through engaging game mechanics. Practical examples and case studies provide a glimpse into the real-world applications of these strategies, showcasing their effectiveness in enhancing the learning experience.

Chapter 5 uncovers the art and science of design patterns in game development. Game design goes beyond mere aesthetics; it is a carefully structured process that involves the creation of captivating and compelling games. By dissecting the various design patterns used in game development, readers gain valuable insights into the strategies that make games engaging and educational.

The heart of digital gaming lies in its engines, and *Chapter 6* delves into the world of game engines. This chapter explores the technology that powers digital games, offering a behind-the-scenes look at the software that drives the immersive experiences players and learners enjoy.

Chapter 7 invites readers to explore the intersection of digital game interface design and visual communication. The intricate connection between visuals, user interface, and effective communication is examined here. This chapter sheds light on how game designers employ visual elements to convey information, foster engagement, and enhance the gaming experience.

Gamification takes center stage in *Chapter 8*, where we delve into the myriad strategies and techniques educators employ to infuse game design elements into the learning process. By exploring gamification in education, readers

gain valuable insights into creating dynamic and rewarding learning environments that captivate and motivate students.

Chapter 9 builds upon this foundation by investigating various gamification models and frameworks. Readers are presented with a comprehensive overview of the different approaches to gamification, equipping them with the knowledge to select and adapt the most suitable models for their specific educational contexts.

The digital era has ushered in a revolution in online learning, and *Chapter 10* explores the fusion of games and gamification with this mode of education. Online learning environments are evolving rapidly, and this chapter examines how games and gamification can enhance engagement and promote effective learning in digital spaces.

Chapter 11 introduces an innovative approach to assessment, one that is rooted in the world of games and gamification. Traditional assessments can often be seen as uninspiring and disengaging, but this chapter showcases creative methods for evaluating learning outcomes that are both enjoyable and effective.

Chapter 12 takes us into the world of smart toys, where technology meets education in exciting and interactive ways. The chapter explores how smart toys are being utilized to educate and entertain simultaneously, providing hands-on learning experiences that bridge the gap between play and education.

In the final chapter, *Chapter 13,* we venture into the dynamic world of mobile games and their potential to revolutionize education. Mobile games promise anytime, anywhere learning, and this chapter explores how they can be harnessed to make education more accessible and engaging.

As readers journey through the chapters of "Digital Games and Gamification in Education," they are invited to explore the dynamic fusion of play and education that holds the potential to revolutionize the future of learning. This book is an essential guide for educators, scholars, and enthusiasts, offering insights, strategies, and practical examples that illuminate the path to a more engaging and practical educational experience.

Thank you ISTES for making of each conference a meeting hub for educators, teachers and laypersons.

Asst. Prof. Dr. Nurullah Taş
Atatürk University
Erzurum, Turkiye
Contact e-mail: *nurullahtas2010@gmail.com*

Asst. Prof. Dr. Yusuf İslam Bolat
Kahramanmaraş İstiklal University
Kahramanmaras, Turkiye
Contact e-mail: *y.islambolat@gmail.com*

Chapter 1 - Introduction to Games and Gamification in Education: Basic Concepts

Nurullah Taş , Yusuf İslam Bolat

Chapter Highlights

- Game-based learning, including gamification, is an effective way to boost students' motivation, engagement, and comprehension.
- Gamification is a strategy that incorporates game design concepts into educational environments, and it has gained popularity for increasing academic success and active involvement in learning.
- Educational games' success depends on their design quality and how effectively they are implemented to achieve educational goals. These games blend enjoyment and learning.
- Analog games use tangible components like cards and dice for gameplay, while digital games use computer technology to create immersive experiences.
- Game-based learning, including gamification, is an effective way to boost students' motivation, engagement, and comprehension.
- "Serious games" are designed to help students achieve critical educational objectives and enhance their learning motivation.
- When developing and analyzing severe games, it's crucial to consider formal and conceptual design and how well they align with the intended educational goals.
- While gamification and game-based learning have gained popularity, there is still a need for more in-depth theoretical frameworks and research to understand their effects on education better.

Introduction

Games, often seen as sources of entertainment and leisure, have transcended their traditional roles to become potent tools in education. The fusion of games and education has given rise to a dynamic approach known as "gamification" or "game-based learning," where game design principles are seamlessly integrated into educational settings. This innovative approach harnesses the intrinsic engagement and motivation inherent in games, transforming the learning journey into a captivating and highly effective endeavor.

Incorporating games into education breathes fresh life into conventional teaching methods and presents opportunities for cultivating critical thinking, problem-solving skills, collaboration, and profound knowledge retention. Within the pages of this book, we embark on a journey to explore the transformative influence of games in education, shedding light on their diverse benefits and the ever-evolving landscape they offer within modern learning environments.

The Potential of Educational Games

Educational games combine enjoyment and learning to meet educational goals. According to Utami and Inawati (2022), these games' sophisticated designs engage learners, creating an enjoyable and dynamic learning experience. These games help children learn and develop their abilities. Educational games on PCs, consoles, and mobile devices cover various topics (Zhonggen, 2019).

The ability of educational games to seamlessly incorporate technology, social interaction, and critical thinking sets them apart. According to Shaffer et al. (2005), these games can provide fresh social and cultural settings, allowing students to participate in intentional activities that improve their material understanding actively. Yuxuan et al. (2021) found that adding challenges, awards, and feedback to educational games encourages active participation and a need for knowledge.

The Impact and Effectiveness of Educational Games

Numerous research have shown that instructional games work. According to several research, these games improve academic performance and encourage active learning (Zhonggen, 2019). Moreover, empirical research has demonstrated that educational games notably improve memory retention and strengthen problem-solving abilities (Utami & Inawati, 2022). Moreover, it is worth noting that educational games can be customized to cater to the various requirements and preferences of a wide variety of students. This characteristic further solidifies its significance as a useful resource for both the facilitation of teaching and the enhancement of the learning experience (Zhonggen, 2019).

However, it is essential to acknowledge that the efficacy of instructional games can vary considerably. The design

and execution of these games are pivotal factors that influence their impact on educational outcomes. Established guidelines exist designed to facilitate the development of educational games that embody engagement and motivation, thus enhancing the overall learning experience. These principles emphasize motivating factors like autonomy, effort, and the capacity to overcome challenges to maximize the educational experience's effectiveness (Yuxuan et al., 2021).

Games in Education

The integration of games into the field of education has garnered significant acknowledgment due to its capacity to enhance educational achievements and student involvement (Annetta, 2010). The effectiveness of educational games hinges on their design, which encompasses vital elements such as context, challenge, choice, control, consequences, and collaboration. Additionally, educational games can be meticulously tailored to address particular educational requirements and challenges, whether raising awareness of accessibility issues or developing critical thinking skills. In conclusion, educational games offer a potentially fruitful path for augmenting the educational experience and fostering efficacious learning.

The Concept of Video Games

Video games have garnered acknowledgment for their capacity to generate immersive and dynamic educational encounters. While video games may not have universal applicability in education, they undeniably harbor significant potential as powerful catalysts for developing innovative and improved pedagogical approaches (Shaffer et al., 2005). According to Yaman et al. (2023), educational games utilize gaming elements to infuse classes with enthusiasm and involvement, fostering a dynamic learning atmosphere that students perceive as captivating and pleasurable.

In essence, educational games encompass interactive settings that effectively integrate elements of gaming and education, thereby promoting educational achievements. The authors skillfully integrate the elements of critical thinking, social interaction, and technology, creating immersive and significant educational encounters. According to recent research conducted by Gordillo et al. (2021), there is evidence to show that the utilization of educational games has a positive impact on motivation levels and learning results in diverse academic disciplines and across different educational levels. Moreover, it is possible to meticulously craft them to effectively target certain educational requirements, highlighting their capacity as a revolutionary instrument within the education domain.

Analog Games: Unplugged Entertainment

Analog games, sometimes non-digital games, are a unique classification that eschews electrical or digital elements in their gameplay. These games stand out because they embody physicality by supporting gameplay with tangible

objects like cards, dice, game boards, and tokens. Within analog games, individuals are exposed to various recreational pursuits, encompassing board games, card games, tabletop role-playing games, and conventional sports. A frequent topic of analysis emerges when examining analog games and their digital equivalents played on electronic platforms such as computers, consoles, or mobile phones. According to Ramos and Silva (2019), computer-guided digital games frequently provide players with intricate and engaging experiences by utilizing various components such as visuals, sound, and interactivity to captivate their attention.

On the other hand, analog games are predicated upon the manual manipulation of game components and flourish via direct interpersonal interactions among players. The dichotomy between analog and digital gaming has incited scholarly discourse. Apperley (2006) posits that classifying games into analog or digital categories is subject to criticism by certain scholars, who advocate for a more nuanced comprehension of the medium. Apperley (2006) suggests a shift in attention towards each game's distinctive attributes and potentialities rather than emphasizing the medium through which it is played.

Analog games have several advantages over digital ones. These gaming technologies provide an immersive, user-friendly experience for all ages. Ramos and Silva (2019) found that these games promote social interaction and face-to-face dialogue. This strengthens social bonds and stimulates collaboration. Adaptable and innovative analog games allow players to develop their own rules and game components, according to Ridge (2019). Analog games are very useful for research and education. Kalar and Green (2013) used these platforms to test multi-agent command and control skills. Board games have been used to teach arithmetic and programming (Ramos & Silva, 2019). Analog games provide a tangible and engaging gaming experience without electrical components. These entities improve social interaction, adaptability, and inventiveness—the debate over whether games are analog or digital continues. Analog games are highly recognized for their unique qualities and contributions to research and education.

Digital Games: Exploring a Digital Realm

The definition of digital games has evolved alongside technological advancements, expanding from electronic games to encompass emerging technologies that provide digital audio and video experiences (Pinheiro et al., 2022). Digital games leverage computer technology to offer interactive and immersive experiences, enabling online multiplayer gaming, web browsing, and digital game acquisition without physical media (Pinheiro et al., 2022). Within various fields, including advertising, health, and education, digital games have captured significant attention. They stand as a medium of entertainment that uniquely blends interactivity, storytelling, and challenges. In these digital worlds, players assume roles ranging from heroes and explorers to strategists and problem solvers, immersing themselves in imaginary realms, historical epochs, and futuristic settings. This immersive quality has given rise to entirely virtual universes where players chart their paths, make impactful choices, and experience the consequences.

The definition of digital games has been a subject of ongoing debate among researchers, yielding various

perspectives and definitions. One perspective centers on their persuasive potential. Bogost (2008) contends that digital games possess expressive power, serving as persuasive tools to influence players' attitudes and behaviors. Conde-Pumpido (2018) also underscores the persuasive role of digital games across diverse domains. It is worth noting that different researchers may interpret the persuasive potential of digital games differently. Nevertheless, the impact of digital games extends beyond entertainment. They have engendered a paradigm shift in education through gamification and game-based learning. Gamification involves integrating game elements like points, achievements, and leaderboards into non-game contexts to enhance engagement and motivation. Game-based learning, on the other hand, employs specially designed games to teach specific topics or skills. Both approaches harness the innate allure of games to render learning more engaging, interactive, and effective. Complex concepts become conquerable challenges, and the joy of surmounting obstacles fosters a positive attitude toward learning. Digital games are useful in education and therapy, enhancing the learning experience.

In teaching and learning among adults, digital games have been harnessed to enrich the learning journey. Past studies have identified crucial dimensions in using digital games for teaching and learning, such as technology acceptance models (Pinheiro et al., 2022). These models scrutinize adults' acceptance and utilization of digital games, offering insights into their efficacy in educational settings. Another perspective on defining digital games relates to the concept of gamification. Huotari and Hamari (2016) propose a definition of gamification that underscores its experiential nature. They view gamification as infusing game design elements into non-game contexts to trigger positive motivations and psychological states. This interpretation diverges from the notion that only non-gaming elements can be gamified. Intergenerational digital games have also garnered attention, as they bring many benefits. They strengthen familial bonds, foster mutual learning, bridge understanding between different generations, and mitigate social anxiety (Conde-Pumpido et al., 2017). The design of intergenerational digital games should carefully consider these aspects to craft engaging and meaningful experiences catering to players of various age groups.

Simulations: Bridging the Virtual and Real Worlds

In a broad sense, simulations can be described as techniques that either replace or enhance real-world experiences with guided, interactive experiences that faithfully replicate crucial aspects of reality (Gaba, 2004). Their scope is not confined to any particular technology but encompasses various applications spanning various fields, including healthcare, education, and research. Simulations serve as interactive tools that replicate or augment real-life encounters. Their applications are diverse and extend across healthcare, education, and beyond. Simulations can bolster safety, enrich the learning process, and infuse life with a sense of purpose.

Within fuzzy systems, the concept of real-world semantic interpretability opens up avenues for simulating human approaches to handling language in computational systems. Simulations, in this context, provide valuable insights and foster opportunities for innovation across many disciplines. Education, too, is experiencing the integration of simulations. For instance, it is increasingly recognized that video games transcend mere entertainment and can construct fresh social and cultural environments conducive to learning (Shaffer et al., 2005). While video games

are not a universal remedy, they offer valuable insights into developing novel and more potent approaches to learning within educational institutions, communities, and workplaces (Shaffer et al., 2005).

Exploring Gamification in Education and Beyond

Gamification has emerged as a compelling concept within the realm of educational processes. One proposed definition, put forth by Huotari and Hamari (2016), characterizes gamification as the incorporation of game design elements into non-game contexts to elicit positive motivations and psychological states in individuals. This definition underscores the presence of game elements and their potential to influence individuals' motivations and psychological experiences. Another perspective on gamification is offered by Landers (2014), who defines it as the utilization of game features, as outlined in Bedwell's taxonomy, outside of a game context to shape learning-related behaviors or attitudes. This definition places a particular emphasis on harnessing game features to impact learning outcomes.

Huotari and Hamari (2016), viewing gamification as a process, contend that Landers' (2014) definition aligns more closely with service marketing theory. However, they also acknowledge that this definition remains somewhat broad and lacks precision when establishing the connection between gamification and the service marketing literature. Gamification has found widespread application across various domains, with education being a notable area of focus. Fulcini et al. (2023) delve into the application of gamification within the realm of software testing, underscoring its effectiveness in enhancing engagement and performance, particularly in industrial and educational contexts. Also, the authors point out several essential study topics and problems, such as the need to create custom gamified mechanisms and do empirical tests to quantitatively measure the benefits of gamification mechanisms. In education, gamification has been leveraged to create educational games that inspire and engage students.

In summary, gamification represents a theoretical framework integrating game-like elements into non-game contexts to stimulate and engage users. The notion is subject to continuing disputes and discussions within academic and industrial environments as its definition and theoretical underpinnings continue to change. The application of gamification in many fields, such as software engineering and education, has demonstrated encouraging outcomes in augmenting user engagement and efficacy. However, further study is required to get a more comprehensive comprehension of the advantages and difficulties linked to gamification and create more sturdy theoretical frameworks for its use. In a more expansive perspective, gamification pertains to incorporating game design elements or characteristics into situations that do not possess intrinsic game-like qualities. This integration aims to stimulate positive motivations and psychological states, influence behaviors and attitudes related to learning, and enhance various activities across multiple fields. Nevertheless, ongoing research and development efforts are required to harmonize this definition with various perspectives and contexts..

Harnessing the Power of Game-Based Learning

Beatman and Duff (2019) define game-based learning as incorporating digital and non-digital games into educational contexts to improve learning outcomes and promote motivation, engagement, and understanding. This approach involves integrating pedagogically sound principles into gaming contexts and harnessing the captivating elements of games to attain educational objectives. The concept of game-based learning acknowledges the inherent potential of games to provide immersive and interactive educational experiences that foster knowledge acquisition and problem-solving skills (Beatman & Duff, 2019).

Video games have gained recognition as effective educational tools because they create unique social and cultural environments that successfully incorporate cognitive processes, social engagement, and technological elements (Shaffer et al., 2005). These educational platforms offer opportunities for active learning, the cultivation of critical thinking skills, the promotion of problem-solving abilities, and the facilitation of collaborative endeavors. As emphasized by Shaffer et al. (2005), games can enhance motivation and facilitate profound learning by engaging students in purposeful and enjoyable activities.

Nevertheless, it is imperative to emphasize that game-based learning is not a universal solution and should not supplant traditional teaching methods. While games can potentially augment learning outcomes, research suggests their impact on learning might be limited. Critiques of game-based learning include a lack of a comprehensive understanding of what constitutes a game, insufficient integration of learning theories into game design, and an absence of meticulously crafted empirical studies (Flanagan, 2019).

The definition of game-based learning can fluctuate across different disciplines and contexts. Terms like "serious games," "digital game-based learning (DGBL)," and "learning games" are frequently used interchangeably with game-based learning (Beatman & Duff, 2019; Breuer & Bente, 2010). Serious games are computer and video games intentionally crafted for educational objectives (Breuer & Bente, 2010). Learning games, conversely, are meticulously designed to provide structured and immersive problem-solving experiences that effectively transfer knowledge and skills into real-world applications (Beatman & Duff, 2019). Microgames represent relatively straightforward computer games with clearly defined objectives that can be completed quickly (Rahmadi et al., 2021).

In conclusion, game-based learning entails strategically using games to enrich learning experiences while bolstering motivation, engagement, and comprehension. It acknowledges the potential of games to establish immersive and interactive learning environments conducive to active learning and problem-solving. However, it is imperative to scrutinize the efficacy of game-based learning critically and address the associated limitations and challenges. Further research and well-structured empirical studies are requisite to gain a more comprehensive understanding of the impact of game-based learning on learning outcomes.

Serious Games: Merging Playfulness with Purpose

Serious games represent a distinctive genre deliberately crafted to extend their influence beyond the confines of the gameplay itself (Mitgutsch & Alvarado, 2012). These games are meticulously designed to immerse players in an engaging realm that seamlessly blends "serious" content, themes, narratives, rules, and objectives, all aiming to foster meaningful learning outcomes. The central objective of serious games is to harness play's allure to serve a purpose of significance (Mader et al., 2012). Moreover, they incorporate the aspect of entertainment and, at times, employ multimodal interaction to enrich the user's experience (Al Fatta et al., 2019). Mitgutsch and Alvarado (2012) advocate examining a game's formal, conceptual design, constituent elements, and the intricate relationships concerning the game's underlying intent as an essential initial step in assessing serious games. They underscore the criticality of intention-based design and pursuing a deliberate impact (Mitgutsch & Alvarado, 2012). In the quest to categorize serious games, Al Fatta et al. (2019) propose a taxonomy composed of five elements: activity, modality, interaction style, environment, and interaction style, while distinguishing serious games from educational simulators, video games, and sports.

Furthermore, serious games often intersect with the concept of game-based learning. They are regarded as invaluable tools for educational purposes, where the act of playing itself assumes a pivotal role (Al Fatta et al., 2019). Serious games provide a dedicated space that delivers users distinctive content, often with an educational or expertise-driven focus (Al Fatta et al., 2019). They are also believed to elevate user motivation compared to other media (Mader et al., 2012)..

In summation, serious games are thoughtfully designed to harbor a purpose beyond mere entertainment, striving to impart a meaningful impact on players' lives. Within these games lies a harmonious blend of enjoyable gameplay and profound objectives, making them valuable tools for educational purposes by enhancing user motivation and delivering distinctive experiences. The design and evaluation of serious games should consider their formal, conceptual design, constituent elements, and alignment with the intended purpose of the game (Mitgutsch & Alvarado, 2012).

Chapter Summary

The application of gamification, a strategy that incorporates game design concepts into educational environments, has grown in popularity due to its efficiency in increasing academic success and fostering active involvement in the learning process (Battal et al., 2023). This rise in popularity may be attributed to gamification, which incorporates game design ideas into educational environments. The efficacy of educational games depends on the quality of both their design and how they are implemented to achieve educational goals. Educational games combine aspects of enjoyment and learning to accomplish educational goals. The gameplay of analog games is facilitated by using tangible components such as cards and dice. In contrast, the immersive experiences of digital games are achieved via computer technology. Because game-based learning is recognized as an effective way to develop motivation, engagement, and comprehension, gamification has gained popularity in educational settings.

This is because gamification encourages students to become more actively involved in learning. To encourage players and boost their level of motivation, "serious games" are video games that have been designed with the express purpose of assisting students in accomplishing vital educational goals. It is essential to consider the games' formal and conceptual design, as well as their constituent parts and how well they correspond with the game's intended goal, when one is developing and analyzing severe games. However, further study is necessary to reconcile the consequences of game-based learning and gamification and establish more thorough theoretical frameworks.

References

Annetta, L. A. (2010). The "I's" Have It: A Framework for Serious Educational Game Design. *Review of General Psychology*, *14*(2), 105-113. https://doi.org/10.1037/a0018985

Apperley, T. H. (2006). Genre and game studies: Toward a critical approach to video game genres. *Simulation & Gaming*, *37*(1), 6–23. https://doi.org/10.1177/1046878105282278

Battal, A., Kayaduman, H., & Polat, H. (2023). The Use of Gamification Elements in an Online Introduction to Programming Course. In G. Durak & S. Cankaya (Eds.), *Shaping the Future of Online Learning: Education in the Metaverse* (pp. 284-300). IGI Global. https://doi.org/10.4018/978-1-6684-6513-4.ch015

Beatman, T. R., and Duff, R. J. (2019). Games in Learning: Shedding Light on a Problematic Taxonomy. *EAI Endorsed Transactions on Game-Based Learning*, *5*(17). https://doi.org/10.4108/eai.13-9-2018.156151

Bogost, I. (2010). *Persuasive games: The expressive power of videogames*. MIT Press.

Breuer, J. S., & Bente, G. (2010) "Why so serious? On the relation of serious games and learning". *Eludamos: Journal for Computer Game Culture*, 4(1), pp. 7–24. https://doi.org/10.7557/23.6111

Conde-Pumpido, T. de la H. (2018). The Persuasive Roles of Digital Games: The Case of Cancer Games. *Media and Communication*. https://doi.org/10.17645/mac.v6i2.1336

Al Fatta, H., Maksom, Z., & Zakaria, M. H. (2018). Game-based learning and gamification: Searching for definitions. *International Journal of Simulation: Systems, Science and Technology*, *19*(6), 41-1. https://doi.org/10.5013/ijssst.a.19.06.41

Flanagan, K. (2020). *Creating Meaningful Learning Environments Through Games: The Case for Measuring Play* [Doctoral dissertation, University of Georgia].

Fulcini, T., Coppola, R., Ardito, L., & Torchiano, M. (2023). A Review on Tools, Mechanics, Benefits, and Challenges of Gamified Software Testing. *ACM Computing Surveys*.

Gaba, D. M. (2004). The Future Vision of Simulation in Health Care. *BMJ Quality & Safety*, *13*(suppl 1), i2-i10. https://doi.org/10.1136/qhc.13.suppl_1.i2

Gordillo, A., Barra, E., & Quemada, J. (2021). SGAME: An authoring tool to easily create educational video games by integrating SCORM-compliant learning objects. *IEEE Access*, *9*, 126414-126430. doi: 10.1109/ACCESS.2021.3111513.

Huotari, K., & Hamari, J. (2017). A definition for gamification: anchoring gamification in the service marketing literature. *Electronic markets*, *27*(1), 21-31. https://doi.org/10.1007/s12525-015-0212-z

https://doi.org/10.48550/arxiv.2301.10541

Kalar, D., & Green, C. (2013). Assessing interfaces supporting situational awareness in multi-agent command and control tasks. In *Virtual Augmented and Mixed Reality. Designing and Developing Augmented and Virtual Environments: 5th International Conference, VAMR 2013, Held as Part of HCI International 2013, Las Vegas, NV, USA, July 21-26, 2013, Proceedings, Part I 5* (pp. 277-284). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-39405-8_31

Landers, R. N. (2014). Developing a Theory of Gamified Learning: Linking Serious Games and Gamification of Learning. *Simulation & Gaming*, *45*(6), 752-768. https://doi.org/10.1177/1046878114563660

Mader, S., Natkin, S., & Levieux, G. (2012). How to Analyse Therapeutic Games: The Player/Game/Therapy Model. In *Entertainment Computing-ICEC 2012: 11th International Conference, ICEC 2012, Bremen, Germany, September 26-29, 2012. Proceedings 11* (pp. 193-206). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-33542-6_17

Mitgutsch, K., & Alvarado, N. (2012, May). Purposeful by design? A serious game design assessment framework. In *Proceedings of the International Conference on the foundations of digital games* (pp. 121-128). https://doi.org/10.1145/2282338.2282364

Pinheiro, A., Oliveira, A., & Alturas, B. (2022). Conceptual Dimensions in Technology Use and Acceptance Models. *EDULEARN22 Proceedings*, pp. 6078-6085. https://doi.org/10.21125/edulearn.2022.1434

Rahmadi, F., Lavicza, Z., & Houghton, T. (2021). Defining Microgames in Education Context. *International Journal of Emerging Technologies in Learning*, *16*(22), 4-16. https://doi.org/10.3991/ijet.v16i22.20929

Ramos, D. K., & da Silva, G. A. (2019). Professional Development for the Use of Digital Games in Schools: Changes in the Pedagogical Practice? *RIED. Revista Iberoamericana de Educación a Distancia*, *22*(2), 265-285.

Ridge, M. (2019). Play and games: An opinionated introduction. *Philosophy Compass*, *14*(4), e12573. https://doi.org/10.1111/phc3.12573

Shaffer, D. W., Squire, K. R., Halverson, R., & Gee, J. P. (2005). Video Games and the Future of Learning. *Phi Delta Kappan*, *87*(2), 105-111. https://doi.org/10.1177/003172170508700205

Utami, U. U., & Inawati, I. (2022). The Use of Educational Games to Enhance the English Skill of Children with Special Needs. *Premise: Journal of English Education and Applied Linguistics*, *11*(1), 114-125. https://doi.org/10.24127/pj.v11i1.4185

Yaman, H., Bekar, Ş. N., Yildiz, H., Koyun, S., & Nas, S. E. (2023). Secondary School Students' Cognitive Structures Regarding Educational Games. *Science Education International*, *34*(1), 15-24. https://doi.org/10.33828/sei.v34.i1.2

Yuxuan, C., Souza, R. C., Contessoto, A. G., & Amorim, A. R. (2021). Guidelines for the Development of Educational Games to Motivate the Learning of Theoretical Concepts in Engineering and Computing Courses. *Computer Applications in Engineering Education*, *29*(5), 1312-1323. https://doi.org/10.1002/cae.22387

Zhonggen, Y. (2019). A Meta-analysis of Use of Serious Games in Education over a Decade. *International Journal of Computer Games Technology*, *2019*. https://doi.org/10.1155/2019/4797032

Author Information

Nurullah Taş	**Yusuf İslam Bolat**
https://orcid.org/0000-0002-8312-8733	https://orcid.org/0000-0002-6120-3157
Atatürk University	Kahramanmaraş İstiklal University
Erzurum	Kahramanmaraş
Turkiye	Country
Contact e-mail: *nurullahtas2010@gmail.com*	Contact e-mail: *y.islambolat@gmail.com*

Citation

Taş, N. & Bolat, Y.İ. (2023). Introduction to Games and Gamification in Education: Basic Concepts. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp.1 -11). ISTES Organization.

Chapter 2 - Theoretical Framework of Games and Gamification in Education

Nurullah Taş

Chapter Highlights

- The primary goal of using games and gamification in education is to enhance both the effectiveness and enjoyment of the learning process.
- Games and gamification can substantially increase students' engagement by tapping into their inherent motivation.
- These techniques have shown effectiveness in making the learning process more appealing and meaningful.
- These techniques have shown significant effectiveness in making the learning process more appealing and meaningful.
- Four primary categories of individuals engaged in gameplay are described: killers (competitive), achievers (goal-oriented), socializers (emphasis on interaction), and explorers (inclination towards exploration).
- Integrating games and gamification in educational settings is proposed to enhance student motivation and engagement.

Introduction

Contemporary education is constantly evolving to improve learning experiences and enhance student engagement. Gamification, a technique incorporating game features and principles, aims to enhance the educational experience by enhancing student motivation and facilitating more effective learning outcomes. This approach surpasses traditional classroom lectures and seeks to improve the learning experience. A game is an interactive activity that encourages interaction, problem-solving, discovery, and rewards. Playmaking provides an interactive platform for students to understand complex topics, making learning more meaningful and enjoyable. It offers competition, cooperation, compensation, and learning from mistakes, making boring issues enjoyable.

The primary objective of gamification is to enhance students' intrinsic motivation and promote their active engagement in educational endeavors. Students might enhance their learning experience by engaging in competitive activities or striving to win rewards. Simultaneously, there is an increase in the application and retention of knowledge acquired through games. For instance, engaging in historical events through interactive gameplay in a history game can provide more productive educational outcomes compared to passive consumption of textual materials. Nevertheless, the successful execution of gamification necessitates the utilization of precise methodologies. Several factors need to be considered, including integrating educational material into games, establishing equitable incentive systems to promote fairness among learners, and providing flexibility and autonomy to learners. In addition, it is essential to customize the gamification approach according to the specific characteristics and educational goals of each cohort of learners.

The phenomenon of gamification, which involves incorporating game features into contexts not traditionally associated with games, is currently garnering heightened interest in education. Using gamification in educational settings enhances student motivation, engagement, and performance, as highlighted by Hallifax et al. (2019). According to Hursen and Bas (2019), educators have the potential to elevate the interactivity and immersion of the learning journey for students through the incorporation of game elements, such as points, levels, badges, and leaderboards. The emerging concept known as adaptive gamification entails customizing game elements to suit learners' unique needs and characteristics within a specific domain. This approach recognizes the diversity in student preferences and learning styles with the overarching goal of delivering tailored learning experiences to maximize engagement and enhance educational outcomes (Hallifax et al., 2019). Nevertheless, it is worth noting that a comprehensive study investigating the influence of gamification components on the educational process remains absent in the literature (Alhammad & Moreno, 2018). Thus, further research is essential to precisely ascertain the impact of game elements on intrinsic motivation, as Hürsen and Baş (2019) emphasized.

The landscape of gamification in education is undergoing rapid evolution, with researchers identifying ten prominent themes across various fields. Integrating games and gamification into educational environments promises to transform traditional pedagogical methods, as it fosters heightened student motivation and cultivates a more enjoyable learning atmosphere (Chugh & Turnbull, 2023). Games incorporating competition, collaboration, incentive systems, and problem-solving mechanisms facilitate skill acquisition and nurture self-confidence. This chapter delves into the theoretical underpinnings of games and gamification techniques in

education to enhance learning experiences and boost engagement. It guides the development of more effective and captivating learning experiences by exploring practical applications and their potential to introduce innovative and enthralling educational methodologies.

Self-Determination Theory

Deci and Ryan's self-determination theory (SDT) emphasizes the crucial role inherent agency and autonomy play in influencing human behavior. It delineates three distinct psychological needs: autonomy, competence, and relatedness. Research has unequivocally demonstrated that clearly defined performance criteria can elevate intrinsic motivation, resulting in heightened commitment, attendance, and overall well-being. Conversely, unmet conditions can trigger the emergence of extrinsic motivation, characterized by external rewards or pressures influencing behavior. To foster intrinsic motivation and enhance overall well-being, the cultivation of independence, intimacy, and competence is imperative. Individuals granted greater autonomy in their work tasks tend to exhibit elevated motivation and job satisfaction. The construct of self-compassion, characterized by acts of kindness and self-help, is positively associated with improved well-being and psychological health. Self-Determination Theory (SDT) provides a theoretical framework for understanding human motivation and behavior, paying particular attention to intrinsic psychological needs such as autonomy, relatedness, and competence. This perspective facilitates success in many areas, including education, work, and relationships.

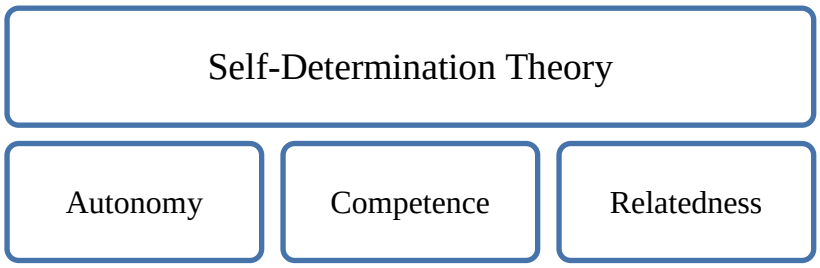


Figure 1. Self-determination theory

Flow Theory

In the 1970s, Mihaly Csikszentmihalyi first introduced flow theory, a psychological construct that describes an ideal state of engagement and immersion in various activities. This phenomenon evokes high absorption, attention, energy, engagement, and enjoyment. The harmony between one's abilities and the task's difficulty determine the flow state. When an individual's level of ability corresponds with the amount of challenge presented, they undergo a psychological condition known as flow, sometimes referred to as being "in the zone" or "in the groove" (Finneran & Zhang, 2005).

The theory of flow also posits several fundamental components that contribute to the phenomenon of flow. Xu and Zhao (2019) say that the factors in this situation include well-defined goals, prompt evaluation, a balance between perceived difficulties and abilities, a deep state of focus, less self-awareness, a sense of control, a distorted

sense of time, and a naturally satisfying experience. Extensive studies have been conducted in several disciplines about utilizing flow theory. Within the realm of technology, scholars have successfully incorporated flow theory into several models, such as the technology acceptance model, to encompass emotional elements within the process of accepting technology or websites. Flow theory has been utilized in computer-mediated settings to comprehend the flow experience of computer users and construct prognostic models for the determinants that impact flow (Finneran & Zhang, 2005).

Despite its extensive utilization, flow theory has problems and critics. There is contention among scholars on the subjective nature and challenging objective measurement of the flow idea. Teng and Huang (2012) suggest considering other factors like boredom, dissatisfaction, and indifference in computer-mediated settings, while Finneran Zhang (2005) highlights inconsistent academic discussions on flow usage. Flow theory provides a framework for understanding user involvement and experience in various activities, such as technology, advertising, and computer-mediated settings. It improves the overall user experience and formulates practical actions. Additional investigation is required to overcome challenges and assess its appropriateness in various contexts.

Fogg Behavior Model

The Fogg Behavior Model (FBM) is a framework for understanding and evaluating human behavior, focusing on motivation, ability, and triggers. Motivation refers to an individual's inclination to engage in specific behaviors; aptitude measures their ability to perform these behaviors; and triggers are stimuli or cues that evoke the activity (Fogg, 2009; Rist & Masoodian, 2019). FBM theory states that behavior occurrence depends on three elements' simultaneous presence, with absent conditions unlikely to manifest. As mentioned above, the paradigm has been implemented across several domains, including persuasive design, health, education, sales, and organizational culture (Fogg, 2009; Mukhtar, 2016; Rist & Masoodian, 2019).

In persuasive design, using the FBM makes it easier to make accurate predictions about what makes people change their behavior. This model aids designers in creating persuasive technologies that shape and manipulate behavior by understanding the target audience's motives, abilities, and triggers. (Fogg, 2009). Within the realm of corporate culture, the utilization of FBM may serve as a means to enhance and optimize said culture. This is achieved by carefully considering and analyzing several factors, including employee behavior, motivation, ability, and external normative restrictions, as highlighted by Чжао and Brychko (2023). Organizations may enhance employee behavior and foster cohesiveness and core competitiveness by establishing a robust connection between corporate culture and employee conduct while simultaneously mitigating conflict (Чжао & Brychko, 2023).

The behavior model offers a methodical approach to comprehending and examining human behavior. Researchers and designers may build successful techniques to impact behavior in numerous domains by considering aspects such as motivation, ability, and triggering circumstances. FBM is a recent framework with ongoing studies (Fogg, 2009).

Cognitive Load Theory

Cognitive load theory (CLT) focuses on learning and teaching processes, emphasizing cognitive aspects and working memory constraints. Based on the principles of CLT, it is posited that working memory possesses finite capacity and endurance. Consequently, knowledge acquisition is impeded when the cognitive load exceeds these limitations. According to Kalyuga (2011), CLT posits the existence of three distinct categories of cognitive burden: extrinsic load, intrinsic load, and related load.

Extrinsic load refers to the cognitive stress imposed by redundant or irrelevant components within the learning environment. One approach to minimizing cognitive load is implementing instructional tactics, such as utilizing untargeted activities, working examples, and eliminating redundant information (Merrinboer & Sweller, 2010). Intrinsic load refers to cognitive strain from educational materials or activities. Effective learning management involves strategic task sequencing, scaffolding, and progressing tasks from simpler to more complex, as Merrinboer and Sweller (2010) suggested. The concept of German load, which has been incorporated into the cognitive load framework through theoretical analysis, pertains to the cognitive burden associated with the processing and integrating novel information into pre-existing knowledge systems (Kalyuga, 2011). Optimization can be achieved by using strategies such as enhancing task diversity, employing contextual intervention, and promoting self-explanation (Merrinboer & Sweller, 2010).

The difference between intrinsic and related load has been the subject of scholarly discourse. Some proponents contend that semantic load is identical to intrinsic load, rendering it superfluous. On the other hand, some academics have proposed that Germanic load serves a distinct purpose within the CLT paradigm, particularly in allocating working memory resources for managing intrinsic load (Kalyuga, 2011). Although CLT has made valuable contributions to educational research, it is essential to acknowledge that it also possesses certain limits. Several philosophical, methodological, and practical concerns require attention and resolution. One illustration of this is that the assessment of cognitive strain frequently relies on questionnaire measures of general load. In contrast, physiological measures capable of capturing instantaneous load are seldom employed (Jong, 2009). Moreover, there have been questions about the suitability of CLT in practical teaching and learning scenarios (Jong, 2009).

Consequently, the theory of CLT offers valuable perspectives on the cognitive mechanisms underlying the learning process and the constraints imposed by working memory. The text differentiates between external and intrinsic stressors and offers instructional design recommendations for mitigating external demands and regulating intrinsic burdens. There exists a discourse surrounding the significance of German load and the potential constraints of this theory. Nonetheless, CLT has made notable strides in educational research and has found practical application across several domains, including health professions education. Nonetheless, it is crucial to acknowledge that specific significant inquiries and issues within cognitive load necessitate additional research.

Narrative Theory

Narrative theory represents a multidimensional field dedicated to exploring the order, intention, and analysis of narratives across diverse forms of communication, spanning literature, cinema, visual arts, and oral traditions (Kova & Kova, 2018). Its scope extends beyond traditional storytelling, encompassing visual narratives, digital texts, sequential imagery, films, and spoken discourse, enabling the comprehension of stories within various contexts and settings. Narrative theory is a multifaceted discipline that delves into the grammar, layers, and functions of storytelling, offering valuable insights into the structure and impacts of fairy tales through the examination of their composition, purpose, and interpretation (Krautter et al., 2021).

Player Types Theory

Player type theory, often called player motivation theory, delves into the motivations behind individuals' engagement in online games, emphasizing factors including age, gender, usage patterns, and in-game behaviors (Yee, 2006). Extensive research has revealed a connection between player motivation and demographic variables: male gamers tend to be more inclined toward achievement and competition, whereas female gamers often place greater importance on social connections within the gaming context. This concept is crucial for understanding the motivation and impact of gaming on psychological and physical health. Researchers have developed a model based on self-determination theory that emphasizes the role of social environments in motivation (Przybylski et al., 2010). Player typology categorizes individuals into four types based on motives, competence, and preferences in gaming, with Bartle's hypothesis suggesting four fundamental categories: killers, achievers, socializers, and explorers.

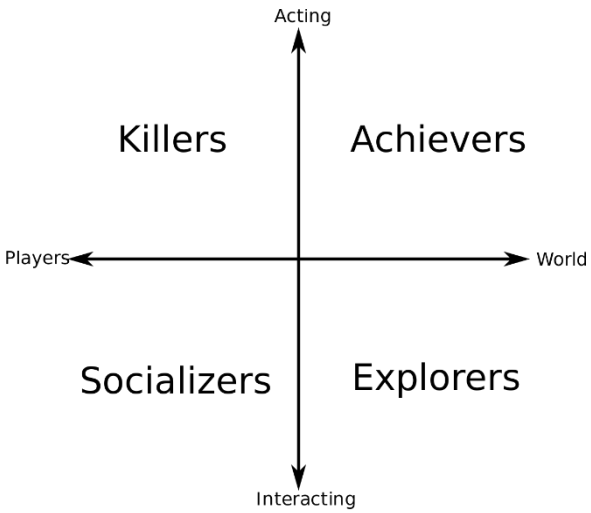


Figure 2. The theory of player types (Bartle, 1996)

Killer gamers are strongly motivated to surpass and defeat their opponents within the game. For these individuals, the primary focal points of the game are competition and achieving victory. Players of this kind, who are frequently encountered in online multiplayer games, have a propensity for showcasing their aptitude in the domain

of leadership. The acquisition of reputation and renown has significant importance for individuals.

Achievers actively participate in a game with the primary objective of achieving specific goals and obtaining prizes. Motivational factors for individuals include the attainment of objectives, such as the successful completion of tasks, progression to higher levels, or the acquisition of exclusive prizes. Individuals are strongly inclined to obtain recognition and validation from their peers, frequently tending to monitor in-game statistics and accomplishments closely.

Socializer participants utilize the gaming platform to interact socially and foster connections with fellow players. For the individual in question, the most esteemed elements of the game revolve around friendship, cooperation, and active engagement within the community. Engaging in online gaming, fostering cooperation, and employing efficient communication strategies contribute to individuals' happiness.

Explorer players who choose the explorer playstyle are motivated to traverse the game universe, unravel enigmas, and get comprehensive insights into the game's intricacies. This phenomenon serves as a source of motivation for individuals to explore uncharted areas, concealed artifacts, and the underlying mechanisms inside the realm of the game. The primary focus for individuals is centered on the educational aspects of the game and the investigation process. The Theory of Player Types offers a framework for understanding motivations driving online gameplay, classifying players based on age and gender. This knowledge is crucial for game developers and researchers to create engaging gaming experiences and positively impact players' psychological and physical well-being.

Hedonic Motivation Theory

Hedonic motivation theory emphasizes pleasure and avoidance of pain as the primary motivations for human action, leading people to have pleasurable experiences. It also emphasizes intrinsic motivation leading to satisfaction or satisfaction-based activities. Self-determination theory emphasizes autonomy and self-determination, which increase satisfaction and happiness by increasing engagement in activities consistent with values and interests. Extrinsic motivation involves external incentives or punishments, and those who prioritize extrinsic goals experience worse well-being than those who prioritize intrinsic goals. Hedonic motivation significantly influences consumer choices and purchase intentions, and research shows a positive relationship between hedonic motivation and brand loyalty (Yuanita & Marsasi, 2022). This theory has implications for various disciplines, including education, marketing, and psychology.

Goal Setting Theory

The theoretical framework known as goal-setting theory (GST) plays a pivotal role in exploring the connection between conscious goals and task performance (Jeong et al., 2021). Initially proposed by Locke and Latham in 1990, GST has since garnered significant attention and widespread acceptance across diverse fields, including business, medicine, sports, and exercise (Jeong et al., 2021). This theory underscores the significance of

establishing robust, challenging goals to enhance performance and motivation (Gollwitzer, 1999). In parallel, Fogg's Behavior Model (FBM) provides a theoretical lens to comprehend and analyze human behavior, emphasizing motivation, capabilities, and triggers. Motivation represents an individual's inclination to engage in specific behaviors, while capabilities pertain to the competence to effectively execute those behaviors. Triggers encompass stimuli or cues that prompt desired actions.

By GST principles, formulating positive intentions and setting specific goals are pivotal in fostering a resolute commitment to desired outcomes or favorable behaviors. Nonetheless, merely establishing goals does not guarantee success. The temporal gap between goal establishment and attainment is substantial, necessitating efficient problem-solving techniques and unwavering determination. The effectiveness of goal pursuit hinges on several factors, including robust intentions, heightening the likelihood of achieving ambitious goals. It is worth noting, however, that the relationship between intentions and behavior is modest, with intentions accounting for only a fraction of behavior variability. Prior behaviors and other variables also contribute to behavior prediction, as outlined by Gollwitzer in 1999. Another significant aspect of goal-setting is how objectives are articulated. Research has indicated that establishing ambitious and well-defined objectives is associated with enhanced performance, unlike setting ambiguous or easily attainable goals (Gollwitzer, 1999). Moreover, the successful attainment of goals heavily relies on their effective execution. Individuals sometimes encounter challenges while attempting to translate their objectives into tangible actions, and it is not uncommon for concerns to arise over the efficacy of well-intentioned endeavors. Hence, it is vital to employ efficacious implementation tactics to close the disparity between establishing goals and their actual attainment (Gollwitzer, 1999).

In summary, GST serves as an excellent theoretical framework for comprehending the intricate interplay between conscious intentions and the subsequent performance of tasks. This statement underscores the need to establish precise and ambitious objectives, as well as employ effective tactics for their successful execution, to enhance the achievement of these goals. Research has indicated a positive relationship between solid intentions, challenging objectives, and improved performance. However, it is essential to note that the association between intentions and actual actions is only moderate. Hence, goal-setting therapies must consider other elements, including prior behaviors and efficacious execution mechanisms. Additional investigation is required to investigate the many domains in which HBT may be applied and enhance the efficacy of goal-setting treatments.

Chapter Summary

The primary objective of using games and gamification in educational settings is to enhance the efficacy and enjoyment of the learning process. This particular methodology has the potential to substantially improve students' levels of involvement through the amplification of their inherent drive. The utilization of games and gamification techniques has demonstrated significant efficacy in enhancing the appeal and significance of the learning process. This section discusses the theoretical underpinnings of games and gamification in the context of education. The importance of intrinsic motivation and individual autonomy in the learning process is underscored by self-determination theory. Flow theory posits that cognitive concentration and engagement are crucial in learning.

According to the Fogg Behavior Model, converging motivation, ability, and triggers is necessary to manifest a behavior. Narrative theory examines narratives impacting education, meaning conveying, and individual worldviews, while player types theory explores diverse motives in online gaming. Based on the theoretical framework proposed, it is posited that four primary categories of individuals are engaged in gameplay: killers, achievers, socializers, and explorers. Killers are characterized by their competitive nature, achievers by their goal-oriented behavior, socializers by their emphasis on interaction, and explorers by their inclination towards exploration. Hedonic motivation theory suggests that human behavior is driven by pleasure and evasion, while goal-setting explains the connection between objectives and task execution. Integrating games and gamification in educational settings enhances student motivation and engagement.

References

Alhammad, M. M., & Moreno, A. M. (2018). Gamification in software engineering education: A systematic mapping. *Journal of Systems and Software*, *141*, 131-150. https://doi.org/10.1016/j.jss.2018.03.065

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD research*, *1*(1), 19.

Beardsley, M., Gutierrez, N., & Hernàndez-Leo, D. (2020, July). Examining University Students' Motivation, Abilities and Preferences Related to Learning to Learn. In *2020 IEEE 20th international conference on advanced learning technologies (ICALT)* (pp. 346-348). IEEE. https://doi.org/10.1109/icalt49669.2020.00111

Chen, Q., & Tang, X. (2023, March). A Summary of Research on Flow Theory Based Interactive Mobile Advertising Design. In *Proceedings of the 2nd International Conference on Culture, Design and Social Development (CDSD 2022)* (pp. 420-427). Atlantis Press. https://doi.org/10.2991/978-2-38476-018-3_48

Chugh, R., & Turnbull, D. (2023). Gamification in Education: A Citation Network Analysis Using CitNetExplorer. *Contemporary Educational Technology*, *15*(2), ep405. https://doi.org/10.30935/cedtech/12863

Cohn, N. (2013). Visual Narrative Structure. *Cognitive science*, *37*(3), 413-452. https://doi.org/10.1111/cogs.12016

Deci, E. L., & Ryan, R. M. (2013). *Intrinsic Motivation and Self-Determination in Human Behavior*. Springer Science & Business Media. https://doi.org/10.1007/978-1-4899-2271-7

Dunn, N. A., & Luchner, A. F. (2022). The Emotional Impact of Self-Criticism on Self-Reflection and Rumination. *Psychology and Psychotherapy: Theory, Research and Practice*, *95*(4), 1126-1139. https://doi.org/10.1111/papt.12422

Finneran, C. M., & Zhang, P. (2005). Flow in Computer-Mediated Environments: Promises and Challenges. *Communications of the Association for Information Systems*, *15*(1), 4. https://doi.org/10.17705/1cais.01504

Fogg, B. J. (2009, April). A Behavior Model for Persuasive Design. In *Proceedings of the 4th international Conference on Persuasive Technology* (pp. 1-7). https://doi.org/10.1145/1541948.1541999

Gollwitzer, P. M. (1999). Implementation Intentions: Strong Effects of Simple Plans. *American psychologist*, *54*(7), 493. https://doi.org/10.1037/0003-066x.54.7.493

Hallifax, S., Serna, A., Marty, J. C., & Lavoué, É. (2019). Adaptive Gamification in Education: A Literature Review of Current Trends and Developments. In *Transforming Learning with Meaningful Technologies: 14th European Conference on Technology Enhanced Learning, EC-TEL 2019, Delft, The Netherlands, September 16–19, 2019, Proceedings 14* (pp. 294-307). Springer International Publishing. https://doi.org/10.1007/978-3-030-29736-7_22

Hursen, C., & Bas, C. (2019). Use of Gamification Applications in Science Education. *International Journal of Emerging Technologies in Learning*, *14*(1), 4. https://doi.org/10.3991/ijet.v14i01.8894

Jeong, Y. H., Healy, L. C., & McEwan, D. (2021). The Application of Goal Setting Theory to Goal Setting Interventions in Sport: A systematic review. *International Review of Sport and Exercise Psychology*, 1-26. https://doi.org/10.1080/1750984x.2021.1901298

De Jong, T. (2010). Cognitive Load Theory, Educational Research, and Instructional Design: Some Food for Thought. *Instructional Science*, *38*(2), 105-134. https://doi.org/10.1007/s11251-009-9110-0

Kalyuga, S. (2011). Cognitive Load Theory: How Many Types of Load Does it Really Need? *Educational Psychology Review*, *23*, 1-19. https://doi.org/10.1007/s10648-010-9150-7

Kasser, T., & Ryan, R. M. (1996). Further Examining the American Dream: Differential Correlates of Intrinsic and Extrinsic Goals. *Personality and Social Psychology Bulletin*, *22*(3), 280–287. https://doi.org/10.1177/0146167296223006

Narančić Kovač, S., & Kovač, I. (2018). Narrative as a Term in Narratology and Music theory. *Rasprave: Časopis Instituta za hrvatski jezik i jezikoslovlje*, *44*(2), 567-579. https://doi.org/10.31724/rihjj.44.2.16

Ketschik, N., Krautter, B., Murr, S., & Zimmermann, Y. (2021). On the Theory of Narrative Levels and Their Annotation in the Digital Context. *Journal of Cultural Analytics*, *6*(4). https://doi.org/10.22148/001c.30700

Van Merriënboer, J. J., & Sweller, J. (2010). Cognitive Load Theory in Health Professional Education: Design Principles and Strategies. *Medical Education*, *44*(1), 85-93. https://doi.org/10.1111/j.1365-2923.2009.03498.x

Mukhtar, H. (2016). Using persuasive recommendations in wellness applications based upon user activities. *International Journal of Advanced Computer Science and Applications*, *7*(8). https://doi.org/10.14569/ijacsa.2016.070847

Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement. *Review of general psychology*, *14*(2), 154-166. https://doi.org/10.1037/a0019440

Rist, T., & Masoodian, M. (2019). Promoting Sustainable Energy Consumption Behavior Through Interactive Data Visualizations. *Multimodal Technologies and Interaction*, *3*(3), 56. https://doi.org/10.3390/mti3030056

Sun, W., Liu, L., Jiang, Y., Fang, P., Ding, X., & Wang, G. (2023). Why Are Hedonists Less Happy Than Eudaimonists? The Chain Mediating Role of Goal Conflict and Mixed Emotions. *Frontiers in Psychology*, *14*, 1074026. https://doi.org/10.3389/fpsyg.2023.1074026

Teng, C. I., & Huang, H. C. (2012). More Than Flow: Revisiting the Theory of Four Channels of Flow. *International Journal of Computer Games Technology*, *2012*, 4-4. https://doi.org/10.1155/2012/724917

Türk, F. (2019). The Role of Self-Compassion and Self-Criticism on Eating Symptomatology. In *XVI European*

Congress of Psychology (pp. 1585a-1585a). https://doi.org/10.26226/morressier.5cf632c0af72dec2b05547e0

Yu-Ting, X. U., & Ying-Si, Z. H. A. O. (2019, January). Study on the Influential Factors of the Social Platforms Users Loyalty: The Flow Theory Perspective——Take Mobile Short Video Software as an Example. In *4th Annual International Conference on Social Science and Contemporary Humanity Development (SSCHD 2018)* (pp. 107-114). Atlantis Press. https://doi.org/10.2991/sschd-18.2019.19

Yee, N. (2006). Motivations for Play in Online Games. *CyberPsychology & Behavior*, *9*(6), 772-775. https://doi.org/10.1089/cpb.2006.9.772

Yuanita, A. D., & Marsasi, E. G. (2022). The Effect of Brand Attachment, Brand Experience, and Self-Image Congruence on the Purchase Intention of Luxury Brand. *Jurnal Ekonomi Bisnis dan Kewirausahaan*, *11*(3), 292-310. https://doi.org/10.26418/jebik.v11i3.57542

Zeyrek-Rios, E. Y., Canter, D. V., & Youngs, D. (2022). Offense Narrative Roles of Turkish Offenders. *International Journal of Offender Therapy and Comparative Criminology*, *66*(12), 1237-1262. https://doi.org/10.1177/0306624x211010285

Zhao, J., & Brychko, A. (2023). The Association and Conflict Between Corporate Culture and Employee Behavior in the VUCA Era. *Economy and Society*, (48) https://doi.org/10.32782/2524-0072/2023-48-46

Author Information

Nurullah Taş

https://orcid.org/0000-0002-8312-8733

Atatürk University

Erzurum

Turkiye

Contact e-mail: *nurullahtas2010@gmail.com*

Citation

Taş, N. (2023). Theoretical Framework of Games and Gamification in Education. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp.12 -22). ISTES Organization.

Chapter 3 - Providing Motivation in Educational Games and Gamification

Can Meşe

Chapter Highlights

- The motivating features of games are identified by exploring the reasons why people play games.
- The motivation of games is applied in different environments, such as game-based learning and gamification.
- The implications of motivation theories will guide game designers in applying the motivational features of games.

Introduction

Every year, people spend a certain amount of money on games and spend time playing games. However, what characteristics of games lead people to this behavior? The answer to this question is undoubtedly that games are fun (Przybylski et al., 2010) and that there are motivational tools for playing games used to develop games. This chapter will explain how games motivate people to play or learn within the motivation theories.

In recent years, there has been an increasing trend for using games and their features in educational environments because games create an exciting and enjoyable learning experience. Thanks to the studies on human-computer interaction, game designers focus on the design of an enjoyable and interactive learning environment (Deterding, 2015). Thanks to this design, people play games for long periods. Sherry and Lucas (2003) explained why people play video games under six personal and social gratification principles.

- Competition: They play to be the best player of the game;
- Challenge: They play to beat someone in the game or to reach a higher level;
- Social interaction: They play to have a social experience with friends in the game;
- Diversion: They engage in play to pass the time or to beat boredom;
- Fantasy: They play to perform things they are unable to perform in real life and
- Arousal: They play to experience positive emotions in the game.

As seen above, the reasons for individuals' game-playing behaviors are explained within the scope of personal and social gratifications. The question of how motivation is used in games to get individuals to play comes to mind. Because motivation is seen as the driving force that enables an individual to perform a specific behavior, motivation can be defined as an individual's desire to perform in order to complete a task in line with a specific goal (Keller & Deimann, 2012). Motivation, which is closely related to learning, is considered a factor that encourages students to do their best on a task (Howard & Crotty, 2017). Motivation is critical in the learning process because when students are motivated to do an activity, they are generally better at paying attention, solving problems, and retaining information (Hodent, 2020). The analyses of the studies have shown that game-based learning is not only effective on students' performance but also on their motivation (Connolly et al., 2012). In addition, it can be said that the formation of motivation is divided into various types. Intrinsic and extrinsic motivation are assumed to arise from the sum of intrinsic and extrinsic rewards and provide satisfaction when a particular activity is performed (Gagné & Deci, 2005). Thus, the explanations regarding the use of motivational factors behind individuals' playing games are explained below.

Intrinsic Motivation

In intrinsic motivation, people are motivated by the pleasure of doing a specific task. Considering that there are many tasks in games, the characteristic form of these tasks indicates the level of a person's interest in the activity (Ryan et al., 2006). Challenge, curiosity, control, and fantasy are frequently preferred in games to increase intrinsic motivation.

Challenge: As stated in many traditional types of motivation, people's intrinsic motivation increases when they engage in activities that challenge and challenge them (Malone & Lepper, 1988). This situation is created by creating a competitive environment in games. In games, both the individual's struggle to increase his/her success and the struggle with other people in the game are used as a kind of intrinsic motivation source. To explain this with an example, the player must struggle to overcome the difficulty of a specific task or level in the game. In this case, the player will enter a struggle for this, and his/her intrinsic motivation to achieve this will increase. However, adjusting the difficulty of these tasks according to the player's competence is discussed underflow. Therefore, creating an environment of struggle to increase intrinsic motivation in games is a remarkable game element.

Curiosity: In many games, various components provide players with positive emotions. These game components increase players' sense of curiosity, and intrinsic motivation is provided. Thus, a fun game-playing experience is obtained. Sensory and cognitive curiosity provides a sense of curiosity in games. In order to arouse sensory curiosity, sounds, lights, and other sensory stimuli are changed in the game environment. In addition, completeness, consistency, and parsimony are regulated to arouse cognitive curiosity (Malone & Lepper, 1988).

Control: One of the reasons why people are so fascinated by computer games is that games offer players a strong sense of control (Malone & Lepper, 1988). Thus, players can control many things in the game. Simply put, they can also control a character, modify the appearance of a car, or change the environment's appearance. However, what provides the intrinsic motivation here is the feeling of autonomy experienced within the game. In other words, players make many decisions themselves in the game, they control the tasks presented in the game and obtain the results, they experience a sense of progress or success in the game according to their control, or they get or do not receive rewards as a result of their actions in the game.

Fantasy: Fantasy, defined as evoking mental images of physical or social situations that do not exist in reality, increases intrinsic motivation within games (Malone & Lepper, 1988). Therefore, while the students are performing the tasks given in a particular scenario in the game, the skills that should be gained by the student in the designed situation that is not real for him/her can be taught. For example, addition can be taught by popping balloons in the game. In this game, additional questions are asked to the student, and the student pops the balloon in which the result is written by making a mental addition. In fact, by creating a fantasy environment that is not real, students can gain the behaviors that they need to acquire through the game.

Extrinsic Motivation

Extrinsic motivation arises from environmental factors outside the individual's inner world (Zichermann & Cunningham, 2011). Extrinsic motivation arises from the external consequences of the activity rather than the activity itself (Gagné & Deci, 2005). Also, extrinsic motivation can depend on the individual's behavior being rewarded or punished externally (Ryan & Deci, 2008). Within the game, players are motivated to win virtual

rewards. For example, in the Mario game, playing the game to get the virtual mushroom reward for the character's growth is an extrinsic motivating factor. In addition, completing the level with a higher score in the game can be another extrinsic motivating factor. Moreover, individuals are extrinsically motivated to earn additional equipment, costumes, or similar virtual equipment for the characters in the games. Also, extrinsic motivation of the players is provided by situations such as being at the top of the leaderboard in the games, being selected as the first of the week, and being the first in tournaments or memorable matches. Thus, players can be directed to the desired behaviors in games. Therefore, by providing extrinsic motivation in games, it can be ensured that the individual can acquire the relevant information by being more motivated in situations that he/she is not very willing to do. However, if the rewards distributed in games are distributed too much for extrinsic motivation, it may create an obstacle for the players to be motivated. This is because virtual rewards are not a game component to be distributed excessively enough to be wasted. Instead, using rewards in the game with the frequencies specified in operant conditioning may be more appropriate.

Operant Conditioning

Studies have been carried out for years to understand and explain human behavior. Human behavior has been tried to be explained with behaviorist theories developed in this direction. However, it has been observed that experiments conducted with different living creatures lead the way in explaining human behavior—for example, B.F. Skinner's (1904-1990) studies on operant conditioning on rat behavior are generalized to other living organisms. Skinner demonstrated that an organism can respond a certain way by manipulating an object outside itself (Malone & Lepper, 1988). Research findings on operant conditioning are used to understand human behavior in education and other fields. Operant conditioning, developed by Skinner, indicated that an individual's behaviors are motivated by rewards. However, it would be wrong to consider people as rats or machines because people are affected by multiple variables, and it would not be right to motivate them with single external rewards (Hodent, 2020). Skinner discovered that the organism's behavior could be shaped by rewarding it immediately after it showed behavior close to the desired behavior (Kapp, 2012). However, in this process, he specified four ways of reinforcing: Variable Ratio, Fixed Ratio, Fixed Interval, and Variable Interval.

Variable Ratio refers to behavior reinforcement at an unpredictable interval (Kapp, 2012). For example, in a Mario game, when the character hits his head on a brick, he does not earn mushrooms or coins; in some, he does, and in some, he does not. In other words, the reinforcer reward is not always given when the character shows each behavior; it is given at unpredictable intervals. In a Fixed Ratio, reinforcement is provided after the desired behavior is exhibited a predetermined number of times (Kapp, 2012). For example, it is used in games where every five-star collector gets a life. In addition, to pass a certain level in games, the player must collect the points previously determined for that level. In other words, the player must complete specific tasks to receive an extrinsic reward. In this way, the player will be directed to the desired behavior in the game. Fixed Interval means that an individual's behavior is reinforced after a predetermined period to direct the individual to a desired behavior (Kapp, 2012). This situation is reinforced in games depending on time. For example, in Candy Crush, the right to play the game is renewed after a specific time. In another example, as in the Age of Empires, the construction of

a building is completed after a certain amount of time has passed. Therefore, the player is rewarded for the time spent in the game at fixed intervals. Variable Interval means that an individual's behavior is reinforced at variable intervals rather than after a fixed period (Kapp, 2012). Thus, the individual cannot predict when the reward will come. However, the individual will be motivated to receive the reward because of the uncertainty of when the reward will come. In games, variable time intervals are used as the distribution of rewards by the game. As a result, the distribution of rewards in games is reinforced in different situations depending on the time and frequency of the behavior.

Self-Determination Theory (SDT)

Revealing that people have mental needs just like their physical needs, SDT states that some needs must be met to be mentally well (Schell, 2015). Also, intervention-focused researchers show that games positively contribute to psychological and physical well-being (Przybylski et al., 2010). SDT provides guidelines and principles to motivate people to adapt to identified goals, behaviors, and relationships (Ryan & Deci, 2008). In addition, SDT explains that an individual is intrinsically motivated when performing a task when their needs for competence, autonomy, and relatedness are met (Ryan & Deci, 2000).

Autonomy: In SDT, autonomy refers to the approval of one's behavior by oneself and, as a result, showing a sense of will or willingness regarding the situation that affects this behavior (Ryan & Deci, 2008). Autonomy represents individuals' need to self-regulate their experiences and actions (Ryan & Deci, 2017). In other words, it is the sense of autonomy that a person feels that he/she is in control and can determine the outcome of his/her actions (Kapp, 2012). This is widely used in games. The player is aware that they can control their actions through their game behavior. In addition, players know they can make their way in the actions they will take in the game (Schell, 2015). Thus, in educational games and environments such as gamification, students can feel autonomy to increase their motivation.

Competence: Competence is related to a sense of progress; individuals feel competent and subsequently motivated when they feel that they are progressing by doing specific tasks (Hodent, 2020). In SDT, competence can be considered as the individual's sense of mastery in meeting the need to challenge oneself or others in the game. In games, after completing the tasks given in the game, the individual experiences both a progression in the game and a development in situations such as the character in the game. Thus, the player shows development and progress depending on his/her behavior. Therefore, in the game, players have a feeling of mastering or gaining competence. In games, for example, this is also represented by the character. In games, lower-level characters have limited abilities, while higher-level characters have superior abilities. In this way, a feeling of competence is created based on the character.

Relatedness: Relatedness, expressed as an individual's need to be connected to others (Schell, 2015), represents what an individual experience when they feel connected to others (Kapp, 2012). Game-relatedness is achieved through communication and interaction between players, especially in multi-player games. For example, the

number of active online users in multiplayer games on STEAM is between 19 and 27 million gamers, which indicates participation in games due to relatedness. In educational environments, relatedness can be seen as an important motivating factor for students to support collaborative learning. Firdaus et al. (2023) explain that students working in a game or gamification environment positively affect collaborative learning. Therefore, students' related learning experience in an educational environment will ensure they are motivated and gain skills for collaborative tasks.

Flow

People often want to feel happiest by experiencing a sense of optimal experience; this state expressed as flow is considered the secret of happiness (Hodent, 2020). In other words, it can be said that people expect to be optimally challenged when carrying out a particular task. It is recommended that the difficulty of tasks given to the players in the games should be appropriate to the player's ability and should not be too much or too easy (Kapp, 2012). Imagine playing games for long hours with great concentration, sometimes losing track of time. You are probably experiencing flow in this game. Because the individual in a state of flow experiences intense and focused concentration on their work, combining action and awareness, loss of reflective self-consciousness, and distortion of time perception (Csikszentmihalyi, 2014). As seen in Figure 1, flow occurs when there is an almost perfect balance between the task's difficulty and the individual's skills and abilities (Kapp, 2012). Therefore, for the player to feel the flow of experience in games, it is recommended that the tasks given in the game should vary according to the player's abilities. Thus, while increasing the challenges in games, they should not be increased at a very high level but at a level appropriate to the development of the individual in the game.

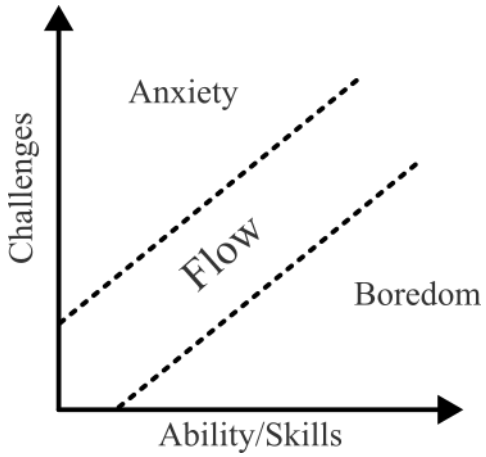


Figure 1. Flow experience (Csikszentmihalyi, 1990)

Chapter Summary

The fact that players lose their sense of time and play games for extended periods reveals games' motivational power. For this reason, the motivating power of games is applied in different environments, such as game-based learning and gamification. In this section, the motivational power of games is discussed in the context of motivation theories. For example, the reward is given when an activity is performed successfully and the related

behavior is acquired. These rewards will ensure the student is extrinsically motivated to do the assigned task. There is also a need to consider the consequences of operant conditioning for awarding rewards in games. In addition, the games are organized on the tasks given to ensure intrinsic motivation. Thus, it is aimed to ensure that students experience flow in game-based applications in the educational environment. For this, it is suggested that the competence, autonomy, and relatedness components of SDT should be considered.

References

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education, 59*(2), 661–686. https://doi.org/10.1016/j.compedu.2012.03.004

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. Harper and Row.

Csikszentmihalyi, M. (2014). *Flow and the Foundations of Positive Psychology: The Collected Works of Mihaly Csikszentmihalyi*. Springer.

Deterding, S. (2015). The Lens of Intrinsic Skill Atoms: A Method for Gameful Design. *Human–Computer Interaction, 30*(3–4), 294–335. https://doi.org/10.1080/07370024.2014.993471

Firdaus, F. M., Fadhli, R., & Abidin, Z. (2023). Promoting collaborative learning in elementary mathematics through the use of gamification flipbooks: A mixed-methods study. *International Journal of Instruction, 16*(4), 987-1008. Retrieved from: https://www.e-iji.net/dosyalar/iji_2023_4_54.pdf

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior, 26*(4), 331–362. https://doi.org/10.1002/job.322

Hodent, C. (2020). The Psychology of Video Games. Routledge.

Howard, S., & Crotty, Y. (2017). The potential of an interactive game-based software to motivate high-achieving maths students at primary school level. *Electronic Journal of Mathematics & Technology, 11*(2), 112–127. Retrieved from: https://php.radford.edu/~ejmt/deliverAbstract.php?paperID=eJMT_v11n2n3

Kapp, K. M. (2012). *The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education*. Pfeiffer.

Keller, J. M., & Deiman, M. (2012). Motivation, volition, and performance. In R. A. Reiser, & J. V. Dempsey (Eds), *Trends and issues in instructional design and technology*, Boston: Pearson Education.

Malone, T.W., & Lepper, M.R. (1988). Making learning fun: A taxonomy of intrinsic motivations for learning. In R.E. Snow & M.J. Farr (Eds.), *Aptitude, learning, and instruction: Vol. III. Cognitive and affective process analyses* (pp. 229–253). Mahwah, NJ: Lawrence Erlbaum Associates.

Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A Motivational Model of Video Game Engagement. *Review of General Psychology, 14*(2), 154–166. https://doi.org/10.1037/a0019440

Ryan, R. M., & Deci, E. L. (2000). *Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being*. American Psychologist.

Ryan, R. M., & Deci, E. L. (2008). A self-determination theory approach to psychotherapy: The motivational basis for effective change. *Canadian Psychology / Psychologie Canadienne, 49*(3), 186–193. https://doi.org/10.1037/a0012753

Ryan, R. M., & Deci, E. L. (2017). Self-Determination Theory: Basic Psychological Needs in Motivation,

Development, and Wellness. In *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness*. The Guilford Press.

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The Motivational Pull of Video Games: A Self-Determination Theory Approach. *Motivation and Emotion, 30*(4), 344–360. https://doi.org/10.1007/s11031-006-9051-8

Schell, J. (2015). *The Art of Game Design: A Book of Lenses* (2nd Edition). CRC Press.

Sherry, J. L., & Lucas, K. (2003). Video game uses and gratifications as predictors of use and game preference. Paper presented at the annual conference of the International Communication Association, San Diego, CA.

Zichermann, G., & Cunningham, C. (2011). *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps*. O'Reilly Media.

Author Information

Can Meşe https://orcid.org/0000-0002-9759-7055

Kahramanmaraş Istiklal University,

Kahramanmaraş,

Turkey

Contact e-mail: *canmese@gmail.com*

Citation

Meşe, C. (2023). Providing Motivation in Educational Games and Gamification. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp. 23-30). ISTES Organization.

Chapter 4- Game-Based Learning and Gamification Applications in Design Education[1]

Meryem Geçimli, Kemal Köksal

Chapter Highlights

- This study demonstrates the existence of numerous similarities between design and gameplay. These similarities relate to both the process and the resulting product.
- The findings of this study have revealed that the utilization of game design concepts can be successfully implemented in the field of design education, specifically in the domain of space design.
- This study posits that the integration of game-based learning methodologies will have a substantial influence on the trajectory of design education in the future.
- Game-based learning supports both those who learn design and those who teach it in terms of supporting creative thinking and generating alternatives.

[1] This work was supported by Kahramanmaraş İstiklal University Scientific Research Projects Coordination Unit. Project Number: 2022/3-2 BAP. Project Title: Developing Sustainability Knowledge Level Scale and Sustainability Question Bank

Introduction

Technology-based methods, devices, and applications that have been designed for digital natives or net citizens, people who view and understand technology as an intrinsic part of their daily lives, are becoming an increasingly diversified and pervasive phenomenon (Canbolat, 2022; Sabirli & Çoklar, 2020). Teaching and learning methods are prone to being influenced and transformed due to the rapid changes and advancements in information technology (Bolat, 2022; Çoban et al., 2022). The ideas and methods connected to education advance one step further every day to accommodate the comprehension of a subsequent generation (Bolat et al., 2017). At this time, there is no question whatsoever that the most effective techniques of nonformal education are those that use games and approaches connected to games (Sercanoğlu et al., 2021). On the other hand, design, which can be traced back to the beginning of human history, has been interpreted and described in various ways by many scholars and scientists. Regardless of the design, nearly all definitions agree that innovation is finding solutions to predetermined issues. This is true regardless of the sort of design being discussed. It is fair to say that the game and the design share many similarities, including the process, goals, tools, and approaches utilized. Consequently, this relationship possesses a feature that supports the growth of game-oriented applications within design education. The chapter on digital games and gamification in education contains evaluations on using these technologies in design education.

Basic Concepts

Beginning with the very beginning of life, people have been known to engage in the activity known as play. Play is a form of entertainment that both people and animals occasionally engage in, mainly to communicate with one another. Because of this, play has an essential place in the growth and education of humans. The fact that Huizinga described man as "playing creatures" (Homo Ludens) highlights the fact that the relationship between man and game is present in all aspects of existence (Gaver, 2002). According to the definition generally accepted in the field of research, a game is an action carried out voluntarily and accompanied by a sense of tension and joy. This action is agreed upon with free will, but it has a specific purpose within the limits of time and space that are determined within the imperative rules. This action is also accompanied by the awareness that it is distinct from "ordinary life" (Huizinga, 2006). The method of attempting to achieve the desired result by freely behaving according to the predetermined guidelines while working toward a particular goal has a structure analogous to that of the design. Play is one of the earliest representations of human interaction with their surroundings and one of the most essential components of cultural structure. This is one of the similarities between the design of play spaces and other physical spaces (Dursun et al., 2015; Güney & Cemelelioğlu, 2022). A structure analogous to that of the invention can be found in trying to achieve the desired result by freely behaving according to the prescriptive guidelines that govern the endeavor. One of the things that play and space design have in common is that they are both one of the first representations of human connection with their surroundings and one of the most essential components of cultural structure. This is one of the similarities between the two.

Engagement

One of the concepts used in research related to the game is called "engagement." This term comes from the French root "gage," which means to pledge or commit, and it is one of the notions employed (Sezgin et al., 2018). In the field of educational research, the idea of engagement, which aids in the academic development of students, is brought up quite frequently (Kim et al., 2018). A "learning experience" is referred to as a "state of increasing concentration, interest, and pleasure for the completion of a job or task," according to one definition of the term (Shernoff, 2013). According to Wu and Lee (2015), games are natural instruments that can be used in the teaching process to increase students' level of engagement. The results of several research indicate that due to the engagement required to play a game or use a game-related application, participants can maintain a clear focus on their perceptions for relatively extended periods, which is included in the findings of these studies. Not only does supporting a high degree of engagement facilitate learning, but it also helps turn the learned information into action (Meşe & Dursun, 2019). The designer may also feel engaged in their work due to the discovery and excitement they experience during the design process.

In several researches, engagement has been divided into various categories or facets, including affective, behavioral, cognitive, emotional, motivational, and psychological, each of which has been defined in several ways (Schwartz & Plass, 2020). Some of them will be mentioned to make the subject more understandable. Focused fulfillment of specific physical actions by the participant constitutes behavioral engagement (Bianchi-Berthouze, 2013). Beyond the click of a mouse, behavioral meetings in a game may also include players' actions and gestures. To reach the game's goals, players need to try out the tools they have and pay attention to what happens when they use them. This kind of active thinking is cognitive engagement, as players process information, plan their moves, and make choices (Plass et al., 2012). Their emotional response to game features can illustrate the affective engagement of learners. Game environments that incorporate attitudes and beliefs have the potential to elicit affective engagement as well. Participants define their goals, decide on strategies to attain them, and allocate roles to players. Forums, fan fiction, and walkthroughs give insights into these meaning-making activities. Sociocultural engagement emphasizes social interactions as crucial to learning (Schwartz & Plass, 2020). Clearly, engagement types cannot be distinguished. A player can be engaged in multiple ways. Quantifying engagement is challenging since time spent could indicate numerous types of involvement. However, developing an engagement construct encompassing various activities reminds us that learning is not solely a cognitive process but is influenced by our embodied actions, emotions, motivation, and sociocultural context.

Flow

The state of being in the flow is an advanced molecular notion that emerged as a consequence of the analysis of the lives of various people. Being in the flow may be characterized as being immersed in a stream of water while having an experience (Csikszentmihalyi, 1965). During a flow experience, a person loses track of both time and their current anxieties. This raises their degree of focus, which in turn boosts their ability to perform and their level of enjoyment in the activity (Chen, 2007). Those who have experienced flow describe it as engaging when

they can achieve specified goals while facing manageable hurdles. This encounter should neither be mind-bogglingly challenging nor uninterestingly straightforward (Franciosi, 2011). The first structured model of the flow theory suggested that flow was between monotonous and worrying regarding difficulties and abilities. In the updated and currently accepted flow theory model, however, in addition to anxiety and boredom, the areas of arousal, control, relaxation, apathy, and worry were determined (Figure 1).

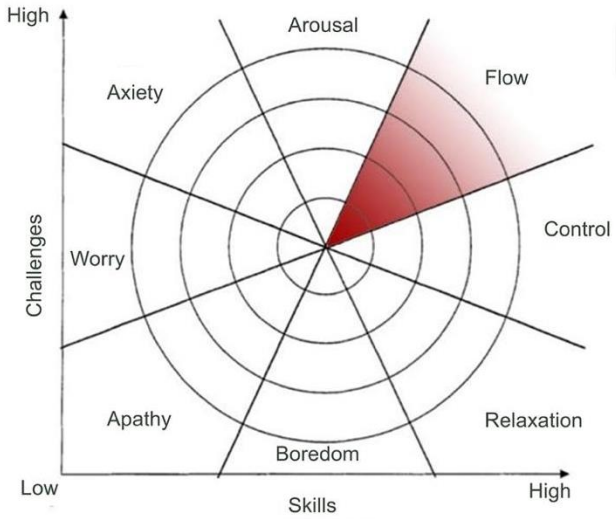


Figure 1. The currently available representation of the flow state (Nakamura & Csikszentmihalyi, 2002)

The difficulty of an experience should correspond to one's level of capability, yet this is a delicate balancing act. To go with the flow of an incident, the difficulty of the background and the person's skill level need to be high. An experience that is too tough and beyond one's abilities can result in anxiety and arousal. At the same time, an encounter that is too simple and under-skilled can result in relaxation and boredom. Both states can be caused by the same thing: an experience. The level of difficulty and complexity of the design problem has the potential to have the same effect on the designer. It is malleable enough to be used in the graphic design process depicted in Picture 1. Therefore, to cultivate originality in the field of design education, it is planned to have students tackle design issues that progress in terms of their difficulty level from semester to semester.

Edutainment

The term "edutainment," which is a portmanteau formed by combining the words "education" and "entertainment," is most frequently connected with the use of various forms of multimedia. The following examples include educational versions of the next: television programs, video games, movies, music, websites, applications, and software. Tools explicitly intended for educational purposes, such as these, incorporate elements of enjoyment. The term "education," which is formed from the combination of "games" and "education," often refers to instructional video games that are designed based on various learning theories (Shulman & Bowen, 2011). The state of investigating, speaking, and interacting through trial and error while also bringing about a consciousness of learning is what we mean when we talk about edutainment. It is common knowledge that applications that

feature educational content are more attractive for students to use, mainly because of the connection that these applications have with the gameplay. According to Keane (2020), providing entertaining content is the primary factor in luring and retaining athletes. In teaching design and design, it is possible and required to use approaches with instructional content in today's society.

Gamification

Nick Pelling, a game designer, is credited as being the first person to introduce the term "gamification" in 2002; nonetheless, its application has grown increasingly common since 2010 (Bozkurt & Genç-Kumtepe, 2014; Marczewski, 2013). "gamification" refers to applying game design elements in settings that are not games to improve user engagement and retention. This definition of the term is generally accepted (Hiraoka et al., 2016; S. Meşe & Meşe, 2022). This idea refers to a combination of people who provide experience and behavioral aspects in entertainment, the elements of game design, and the creation of entertainment that incorporates these qualities (Deterding et al., 2011). It is the application of game-related rules and game thinking in the classroom to capture the students' attention (Zichermann & Cunningham, 2011). The term most commonly used in the study describes it as applying game design to different types of material than games (Bolat & Taş, 2023; Deterding et al., 2011). Game design components are listed as follows (Yıldırım & Demir, 2014).

- Point: It is an award given for achievement in the game.
- Rosette: These are awards given based on general opinion within a particular system.
- Experience points: These are increased rewards based on time spent in-game
- Levels: These are the stages passed with experience points
- Leaderboard: The table shows the leadership race among those who play the game.

Game-Based Learning

"Game-based learning" is frequently confused with "gamification," which refers to applying game-related methods in educational settings. While the term "gamification" describes the incorporation of elements of game design into non-game contexts (Battal et al., 2023), such as the realm of education, "game-based learning" refers to the creation of games with a specific objective in mind (Ifenthaler et al., 2012). For instance, game-based learning refers to constructing a game for the entirety of a lesson and ensuring that students continue to learn while playing this game. Gamification refers to awarding points and badges to students for adequately responding to questions presented within a lesson. To equip students to meet the challenges of the twenty-first century, proponents of game-based learning claim that we should teach students to be imaginative, creative, and flexible to deal with the challenges of learning in complicated and ill-structured domains. This will allow students to tackle the challenges of the twenty-first century.

Several game design elements can be used to accomplish the desired interactions with the learning content

engagingly and playfully. These components include game mechanics, visual aesthetic design, aural design, narrative design, an incentive system, and content and skills (Plass et al., 2020).

- Game mechanics are the player's repeated actions. In learning games, learning mechanics have a learning aim and are built using learning theory, while assessment mechanics have a diagnostic goal and are designed using testing theory.
- Visual aesthetic design encompasses game settings, characters, and, in certain games, player avatars. It also involves game learning content information design, visual cue and feedback design, and tool and control design.
- Sound design may include a soundtrack, ambient sounds, and player or character actions. The game sounds motivate and direct the player's attention. Sounds can also affect learning through emotional design since they evoke distinct emotions in learners.
- The narrative of a game is told through chats with other players, game characters, or agents, voice-overs, cutscenes, and in-game events. Narratives motivate play, contextualize learning content, and link game features.
- The incentive system in a game uses reward systems to give feedback and guide player behavior. Rewards might include point scores, experience points, cash, tokens, stars, badges, power-ups, trophies, loot, and more.
- Learning game content and skills are the last design elements. The game's content should determine its learning mechanics, graphic design, narrative design, incentive system design, and sound design.

Design Education and Game/Play

The design corresponds to the definition of "game" articulated by Wittgenstein (Karatani, 1995). In a manner analogous to the game's development, the design process is moving forward. Both the game and the design have objectively unbounded potential and delineated parameters to follow (Yürekli, 2003). Designers substantiate their design thoughts and behaviors by adhering to a prescribed set of principles and carefully chosen limitations. While designers have a vast array of alternatives, decision-making processes are guided by principles resembling a set of laws. These principles facilitate the emergence of intricate designs.

The desire to play the game and the drive to design it bring these two ideas into closer proximity with one another. The design process is also connected to the potentials found as limitations are tested, just like in a game (Wilson, 2000). In addition to the studies that argue that the reactions given while solving puzzles occur during the design process (Akın & Akın, 1998), other researchers suggest the exhilaration of developing new structures by using the units that are accessible in the puzzle game is comparable to the process of designing anything (Frascari, 1991). Because of the similarities between the game's development and the design process, including the game in design education is feasible and essential. Using game/design analogies proves advantageous in identifying conceptual frameworks to facilitate design learning (Scriver & Wyeld, 2003). These analogies possess heuristic value about the theory of design thinking and the exploration of design discourse and practice from a critical and engaging perspective.

The process of designing concrete and abstract environments is called "spatial design." Place contains visible and touchable components like floor, ceiling, walls, etc., and invisible conceptual parts like identity, belonging, personalization, etc. This demonstrates beyond a reasonable doubt that the design discipline contains measurable and non-measurable dimensions. Therefore, the educational process of such a discipline seeks to impart knowledge about concrete and abstract concepts and assist and develop the creative thinking talents of candidates for the designer position. Education in spatial design needs to be distinguished from standard education approaches to allow students to develop their abilities to solve design challenges and engage in the design process in a way that fosters creativity. The inclusion of games and game-related methodologies in design education, which are analogous to the design process and the practice of design, should be considered an everyday occurrence and accepted. During the design education process, a path is taken based on expanding students' creativity and boosting their skill level (Hodgkin, 1985). In addition to basic design and design workshops, which foster students' visual and perceptual development, the design education process includes theoretical and technical classes (Onur & Zorlu, 2017). In the research conducted by Yurekli (2003), space design education is considered a part of the game. Elements such as rules, motivation, intuition, coordination, and randomness are highlighted as examples of the study's contribution to gamification. Game-based learning methods that apply to design education are also connected to the structure that is inherent in this education (Coşkun & Çağdaş, 2022). For instance, game-oriented methodologies will likely be used in the design process's visualization studies. At this point, the working process and presentation of computer-aided designs in two and three dimensions are the best in their fields. On the other hand, working with unpredictability and different possibilities during the design process is highly similar to how the game acts.

The spatial design process: If it is agreed that it consists of stages including the creation of a function chart, concept development, color and material selections, alternative generation, plan and section exercises, three-dimensional modeling, working on details, and visualization, then these stages can be created with the support of gamification. Gamifying the steps that students could experience while designing a particular place allows for the opportunity to experiment with various design strategies. They will be better able to think creatively and seek different answers if they use these strategies.

Research findings that demonstrate the existence of a social structure in design highlight the significance of collaborative effort. Especially in space design, collaboration among designers, consumers, and practitioners is encouraged and possible. Once more, this is a circumstance that is inevitable in games that are played in teams (Brandt, 2006). The intersections with the design process allow the nature of exploratory games to be integrated (Brandt & Messeter, 2004). The competitiveness that may be found in design studios shares many similarities with the competition that can be found between gamers. A design competition is a type of competition in which a group of designers, either amateur or professional, compete against one another to see who can come up with the best solution to a specific problem (specific2010). The proliferation of social media and interactive platforms, along with the growth of information technology, has resulted in the introduction of design competitions into this context.

According to Klopfer and Yoon (2005), simulation is the reproduction of the distinguishing characteristics of an existing system or organization associated with a particular era (Tansey & Unwin, 1969) and a copy of reality. The term "virtual reality" refers to a technology that allows users to interact with computer-generated three-dimensional virtual environments and objects, known as "virtual worlds," to feel like they are in a natural setting. This is accomplished by employing various technological tools to fool the mind into thinking that the environment and the objects inside are natural (Kayabaşı, 2005). The technology of adding virtual things to the real-world environment that a person sees and touches is known as augmented reality. This technology aims to enhance a person's image of their surroundings (Azuma, 1997). Therefore, it can be observed that the primary distinction between virtual reality and augmented reality is determined by how a person interacts with the world around them in the physical world. The concept of augmented reality, in which the real world is supplemented with virtual objects and pictures, is the foundation for the virtual reality phenomenon of entirely severed relationships with the natural world (Gülel & Arabacıoğlu, 2019).

Chapter Summary

It is accurate to claim that the game and the design have a great many things in common, such as the process, the aims, the tools, and the techniques that were used. As a consequence of this, this connection possesses a quality that contributes to the development of application-based games within the realm of design education. Evaluations of the use of these technologies in design education may be found in the chapter that covers gamification in education and digital games in education. Play and space design share the first representations of human connection with their surroundings and the most important components of cultural structure. Being in the flow means experiencing a water stream. People lose sense of time and anxiety during flow. This increases focus, which improves performance and enjoyment. Flow is engaging when you can attain goals while overcoming obstacles. This contact should not be difficult or boring. The first structured flow theory model claimed flow was boring and concerned about challenges and skills. However, the modified and recognized flow theory model included arousal, control, relaxation, apathy, and worry in addition to anxiety and boredom. Designers support their ideas and actions with a set of principles and well determined constraints. Designers have many options, yet decision-making is governed by laws. These concepts enable elaborate designs. The desire to play and design the game bring these two thoughts together. Like a game, testing restrictions connects the design process to potentials. Other studies imply that the excitement of constructing new structures using puzzle game units is similar to designing anything. The game's creation is analogous to design, making it feasible and essential for design education. Game/design parallels help identify conceptual frameworks for design learning. These comparisons can help us understand design thinking theory and critically examine design discourse and practice. Designing physical and abstract surroundings is "spatial design." Place has tangible elements like floors, ceilings, and walls and intangible concepts like identity, belonging, and customization. This proves design has measurable and non-measurable dimensions. Thus, such a discipline teaches concrete and abstract concepts and fosters creative thinking in designer candidates. The spatial design process: Gamification can be used to create stages like function chart creation, concept development, color and material selections, alternative generation, plan and section exercises, three-dimensional modeling, details, and visualization. Gamifying pupils' place-designing steps lets them try out different strategies. These tactics will help them think creatively and find new answers.

References

Construction, 7(2), 123–138. https://doi.org/10.1016/S0926-5805(97)00057-5

Azuma, R. T. (1997). A Survey of Augmented Reality. *Presence: Teleoperators & Virtual Environments*, 6(4), 355–385.

Bianchi-Berthouze, N. (2013). Understanding the Role of Body Movement in Player Engagement. *Human–Computer Interaction*, 28(1), 40–75. https://doi.org/10.1080/07370024.2012.688468

Battal, A., Kayaduman, H., & Polat, H. (2023). The Use of Gamification Elements in an Online Introduction to Programming Course. In G. Durak & S. Cankaya (Eds.), *Shaping the Future of Online Learning: Education in the Metaverse* (pp. 284-300). IGI Global. https://doi.org/10.4018/978-1-6684-6513-4.ch015

Bolat, Y. İ. (2022). Eğitici Oyunlar, Simülasyonlar ve Oyunlaştırma. In T. Talan & V. Batdı (Eds.) *Teknoloji Çağında Eğitim ve Güncel Yaklaşımlar* (pp. 163–189). İstanbul: Efe Akademi Publishing

Bolat, Y. İ., Şimşek, Ö., & Ülker, Ü. (2017). The Impact of Gamified Online Classroom Response System on Academic Achievement and Views About This System. *Abant İzzet Baysal University Eğitim Fakültesi Dergisi*, 17(4), 1741–1761.

Bolat, Y. İ., & Taş, N. (2023). A meta-analysis on the effect of gamified-assessment tools on academic achievement in formal educational settings. *Education and Information Technologies*, 28(5), 5011–5039. https://doi.org/10.1007/s10639-022-11411-y

Bozkurt, A., & Genç-Kumtepe, E. (2014, November 5-7). Oyunlaştırma, Oyun Felsefesi ve Eğitim: Gamification. [Paper presentation] Akademik Bilişim'14 - XVI. Akademik Bilişim Conference, Mersin University

Brandt, E. (2006, August 1-5). Designing Exploratory Design Games: A Framework for Participation in Participatory Design? [Paper presentation] PDC: Participatory Design Conference. Trento, Italy https://doi.org/10.1145/1147261.1147271

Brandt, E., & Messeter, J. (2004, July 27-31). Facilitating collaboration through design games. PDC: Conference on Participatory Design Artful Integration: Interweaving Media, Materials and Practices - PDC 04, 1, 121, Toronto, Canada. https://doi.org/10.1145/1011870.1011885

Canbolat, C. (2022). Gastronomy and Innovation. In İ. Çekiç & C. Canbolat (Eds.), *Digitalization and Smart Technologies in Gastronomy* (pp. 33–53). Eğitim Publishing

Chen, J. (2007). Flow in games (and everything else). *Communications of the ACM*, 50(4), 31–34. https://doi.org/10.1145/1232743.1232769

Çoban, M., Bolat, Y. İ., & Göksu, İ. (2022). The potential of immersive virtual reality to enhance learning: A meta-analysis. *Educational Research Review*, 36, 100452. https://doi.org/10.1016/j.edurev.2022.100452

Coşkun, E., & Çağdaş, G. (2022). Basic Design Studio: Understanding and Designing a Computer Game-Based Approach. *JCoDe: Journal of Computational Design*, 3(2), 59–86.

Csikszentmihalyi, M. (1965). *Artistic Problems and Their Solutions an Exploration of Creativity in the Arts* [Doctoral dissertation, University of Chicago]. ProQuest Dissertations and Theses Global.

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011, May 7-12). *Gamification. Using game-design elements in non-gaming contexts.* [Paper presentation] CHI Conference Human Factors in Computing Systems, 2425–2428. https://doi.org/10.1145/1979742.1979575

Dursun, Ö. Ö., Dulkadir, N., & Meşe, C. (2015). Etkileşim Kavramı ve Öğrenme Ortamlarına Yansımaları. In B. Akkoyunlu, A. İşman, H. F. Odabaşı (Eds.), *Eğitim Teknolojileri Okumaları,* (pp. 195–212) Ankara: TOJET

Franciosi, S. J. (2011). A Comparison of Computer Game and Language-Learning Task Design Using Flow Theory. *Call-EJ*, 12(1), 11–25.

Frascari, M. (1991). *Monsters of Architecture: Anthropomorphism in Architectural Theory*. Rowman & Littlefield.

Gaver, B. (2002). Designing for Homo Ludens. *13 Magazine*, 12, 2–6.

Gülel, Z., & Arabacıoğlu, B. C. (2019). Arttırılmış Gerçekliğin (AG) Mekan Tasarımı Eğitiminde Kullanımına Potansiyeller ve Kısıtlamalar Işığında Güncel Bir Bakış. *Sanat ve Tasarım Dergisi*, 23, 151–177.

Güney, K., & Cemelelioğlu, N. (2022, October 13-14). *Aksiyon Rol Yapma Oyunlarındaki Gösterge ve İkon Tasarımlarının Oyun Deneyimine Etkisi.* [Paper presentation] Yaratıcı Endüstriler Sempozyumu II, İstanbul, Yıldız Technical University. http://yes.yildiz.edu.tr/yesKitap_FullText2023.pdf#page=22

Hiraoka, T., Wang, T.-W., & Kawakami, H. (2016). Cognitive Function Training System Using Game-Based Design for Elderly Drivers. *IFAC-PapersOnLine*, 49(19), 579–584. https://doi.org/10.1016/j.ifacol.2016.10.613

Hodgkin, Robin. A. (1985). *Playing and exploring: Education through the discovery of order*. Methuen. https://cir.nii.ac.jp/crid/1130282269042876032

Huizinga, J. (2006). *Homo Ludens: Oyunun Toplumsal İşlevi Üzerine Bir Deneme* (M. A. Kılıçbay, Trans.). Ayrıntı. (Original work published 1938)

Ifenthaler, D., Eseryel, D., & Ge, X. (2012). Assessment for Game-Based Learning. In D. Ifenthaler, D. Eseryel, & X. Ge (Eds.), *Assessment in Game-Based Learning* (pp. 1–8). Springer New York. https://doi.org/10.1007/978-1-4614-3546-4_1

Karatani, K. (1995). *Architecture as Metaphor: Language, Number, Money.* MIT Press.

Kayabaşı, Y. (2005). Sanal Gerçeklik ve Eğitim Amaçlı Kullanılması. *The Turkish Online Journal of Educational Technology*, 4(3), 150–158. http://www.tojet.net/volumes/v4i3.pdf#page=151

Kim, S., Song, K., Lockee, B., & Burton, J. (2018). *Gamification in Learning and Education.* Springer International Publishing. https://doi.org/10.1007/978-3-319-47283-6

Marczewski, A. (2013). Gamification: a simple introduction & a bit more.

Meşe, C., & Dursun, Ö. Ö. (2019). Effectiveness of Gamification Elements in Blended Learning Environments. *Turkish Online Journal of Distance Education*, 20(3), 119–142. https://doi.org/10.17718/tojde.601914

Meşe, S., & Meşe, C. (2022). Research Trends on Digital Games and Gamification in Nursing Education. *Journal of Computer and Education Research*, 10(20), 734–750. https://scholar.google.com.tr/citations?view_op=view_citation&hl=tr&user=7H6sOkUAAAAJ&citation_for_view=7H6sOkUAAAAJ:P5F9QuxV20EC

Nakamura, J., & Csikszentmihalyi, M. (2002). The Concept of Flow. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 89–106). Oxford University Press.

Nalbantoğlu, O. (2019). Planlama ve Tasarım Yarışmaları Üzerine. *PEYZAJ Eğitim Bilim, Kültür ve Sanat Dergisi*, 1(1), 9–34.

Onur, D., & Zorlu, T. (2017). The Relation Between the Training Methods Applied in Design Studios and the Creativity. *The Turkish Online Journal of Design, Art and Communication*, 7(4), 542–555. https://doi.org/10.7456/10704100/002

Plass, J. L., Homer, B. D., Hayward, E. O., Frye, J., Huang, T.-T., Biles, M., Stein, M., & Perlin, K. (2012). The Effect of Learning Mechanics Design on Learning Outcomes in a Computer-Based Geometry Game. In:

Göbel, S., Müller, W., Urban, B., Wiemeyer, J. (eds) *E-Learning and Games for Training, Education, Health and Sports. Edutainment GameDays* 2012. Lecture Notes in Computer Science, vol 7516. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-33466-5_7

Plass, J. L., Homer, B. D., Mayer, R. E., & Kinzer, C. K. (2020). Theoretical foundations of game-based and playful learning. In J. L. Plass, R. E. Mayer, & B. D. Homer (Eds.), *Handbook of Game-Based Learning* (pp. 3–24). The MIT Press.

Sabirli, Z. E., & Çoklar, A. N. (2020). The effect of educational digital games on education, motivation and attitudes of elementary school students against course access. *World Journal on Educational Technology: Current Issues,* 12(4), 325–338. https://doi.org/10.18844/wjet.v12i3.4993

Schwartz, R. N., & Plass, J. N. (2020). Types of engagement in learning with games. In J. L. Plass, R. E. Mayer, & B. D. Homer (Eds.), *Handbook of Game-Based Learning* (pp. 53–80). MIT Press.

Scriver, P., & Wyeld, T. (2003). Exploring Architectural Discourse and Form through Game-like On-line Learning Strategies. *International Journal of Design Computing,* https://digital.library.adelaide.edu.au/dspace/handle/2440/33915

Sercanoğlu Öden, M., & Bolat, Y. İ. (2021). Kahoot! As a Gamification Tool in Vocational Education: More Positive Attitude, Motivation and Less Anxiety in EFL. *Journal of Computer and Education Research,* 9(18), 682–701. https://dergipark.org.tr/en/pub/jcer/issue/63562/924882

Sezgin, S., Bozkurt, A., & Yılmaz, E. A. (2018). Oyunlaştırma, Eğitim ve Kuramsal Yaklaşımlar: Öğrenme Süreçlerinde Motivasyon, Adanmışlık ve Sürdürülebilirlik. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi,* 45, 169–189.

Shernoff, D. J. (2013). *Optimal Learning Environments to Promote Student Engagement.* Springer New York. https://doi.org/10.1007/978-1-4614-7089-2

Shulman, J. L., & Bowen, W. G. (2011*). The Game of Life: College Sports and Educational Values. In the Game of Life.* Princeton University Press. https://doi.org/10.1515/9781400840694

Tansey, P. J., & Unwin, D. (1969). *Simulation and gaming in education.* Methuen Educational. https://cir.nii.ac.jp/crid/1130282271894274304

Tomak, A. (2010). Grafik ve Endüstriyel Tasarım Yarışmalarının Tasarım Eğitimi Sürecine Etkileri ve Good 50X70 2008 Örneği. *Sanat Dergisi,* 15, 1–10.

Wilson, C. S. J. (2000). *Architectural Reflections: Studies in the Philosophy and Practice of Architecture.* Manchester University Press.

Yıldırım, İ., & Demir, S. (2014). Oyunlaştırma ve eğitim. *Journal of Human Sciences,* 11(1), 655–670. https://www.j-humansciences.com/ojs/index.php/IJHS/article/view/2765

Yürekli, İ. (2003). Mimari Tasarım Eğitiminde Oyun [Doctoral dissertation, University of Chicago]. İstanbul Technical University. http://hdl.handle.net/11527/10325

Zichermann, G., & Cunningham, C. (2011). *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps.* O'Reilly Media, Inc.

Author Information

Meryem Geçimli
https://orcid.org/0000-0002-1776-1936
Kahramanmaraş İstiklal University
Kahramanmaraş
Turkiye
Contact e-mail: *meryem.gecimli@istiklal.edu.tr*

Kemal Köksal
https://orcid.org/0000-0002-1883-4674
Kahramanmaraş İstiklal University
Kahramanmaraş
Turkiye
Contact e-mail: *kemall.koksal86@gmail.com*

Citation

Geçimli, M. & Köksal, K. (2023). Game-Based Learning and Gamification Applications in Design Education. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp. 31-42). ISTES Organization.

Chapter 5 - Design Patterns in Game Development

Can Meşe

Chapter Highlights

- The design pattern allows objects developed in the game to be used reusable.
- The design pattern in the known as GoF can also be used in game development process.
- Game development engines such as Unity enable the use of new design patterns.

Introduction

Some cases must be considered when developing games that people of all ages enjoy. Considering that game development is a complex process, it is not surprising that developers face great difficulties as the game's development grows. However, to overcome this challenge, there are some things that game developers should pay attention to in terms of scalability, flexibility, and readability. Accordingly, this section will explain the design patterns many game developers use.

Game Development Process

The UNI Global Union publication on the video game industry, which emerged in 2022, emphasizes how quickly this industry is growing. In addition, it is stated in the literature that there are three stages to developing a game (Doran & Casanova, 2017; Uni Global Union, 2022). The first stage of this development process is pre-production. In the pre-production phase, game designers draw outlines to guide the game artist and developer participating in the game's development. Moreover, the game artist and developer develop a prototype for the game. In the next stage, the production stage, the team of designers, artists, and programmers collaborates to develop the game within the framework of the design document. In this process, artists design the characters, objects, and environments that will take place in the game. In addition, they create textures, models, and animations to be included in these components. The developer, on the other hand, prepares the codes containing the game's rules to organize the graphics and physics systems of the game. The designer provides the necessary controls for the completion of the related tasks. The next stage of game development is the post-production phase. In the post-production phase, tests are conducted to play the game. In these tests, errors are detected and eliminated. In addition, when unwanted situations are noticed in the game, they are destroyed. Also, in this process, translations are made for the languages in which the game will be published. The game is then published. However, even after the game is released, the designer, artist, and programmer continue to work on updates and corrections to the game. So, this development process takes work, especially for large-scale games. As the game grows, there is a need for some rules to be followed in this development process. Thus, in this section, some suggestions will guide game developers in the game development process within the design patterns concept.

Design Patterns in Game Development

Architectural models are also preferred in the game development process and the software development process. An architectural model details a basic solution to a design problem in the form of predefined pattern patterns, such as pattern-specific components, classes, or objects that work together to solve some problem. Therefore, this architectural model or design pattern can overcome game developers' challenges. Although software architecture is a type of design pattern, software architecture focuses on the design phase of software, while a design pattern represents the creation of the software. In this respect, software architecture is an umbrella concept that includes design. On the other hand, the design pattern focuses on using components in software development. A design pattern helps identify differences that make a system reusable and aids reusability (Gamma et al., 1997).

Therefore, to guide game developers, this section focuses on design patterns used in game development.

Often associated with object-oriented design, design patterns are considered a way of reusing the knowledge and experience of other designers (Sommerville, 2016). The most comprehensive description of design patterns is "Design Patterns: Elements of Reusable Object-Oriented Software" by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides. Since four authors wrote this book, the design patterns for programming are called Gangs of Four (GoF) design patterns. There are four important components of design patterns in this book (Gamma et al., 1997):

1. *Pattern name:* A name to describe a particular design problem, its solutions, and its results in one or two words.

2. *Problem*: This component element represents when the design pattern will be applied, specifying the conditions that must be met before the design pattern can be used.

3. *Solution*: Describes the relationships, responsibilities, and collaboration of the elements that make up the design, as well as providing guidance on how the problem is solved.

4. *Conclusion*: The result component, which refers to the implementation of the design pattern, is critical for evaluating alternative aspects of the design and understanding the costs and benefits of implementing the model.

Gamma et al. (1997) categorized design patterns into three categories: creational, structural, and behavioral. While the creational design pattern represents the creation of objects within the game, the structural design pattern refers to the product of classes and objects into larger structures. The behavioral design pattern is related to creating responsibilities between the algorithm and the objects. The components of these design patterns are presented in Table 1.

Table 1. Design patterns and components (Gamma et al., 1997)

Purpose	**Design Pattern**
Creational	Abstract Factory
	Builder
	Factory
	Prototype
	Singleton
Structural	Adapter
	Bridge
	Composite
	Decorator
	Facade
	Flyweight
	Proxy
Behavioral	Chain of Responsibility
	Command
	Interpreter
	Iterator
	Mediator
	Memento
	Observer
	State
	Strategy
	Template Method
	Visitor

Björk and Holopainen (2005) discussed the design patterns of games in four categories. **Game worlds** are related to the parts of the game that define the context of the game. **Objects** are related to game components that players can manipulate. **Abstract objects** are related to game components that represent abstract values associated with game situations, and **Locations** are related to the locations of game components within the game. An example of these components is presented below.

- **Game Worlds:** Game World, Reconfigurable Game World, Levels, Inaccessible Areas, Coherent Reality Logic, Alternate Reality, Moving Tiles
- **Objects:** Enemies, Boss Monsters, Deadly Traps, Obstacles, Avatars, Units, Vehicles, Controllers, Alarms, Pick-Ups, Power-Ups, Tips, Non-Game Information, Invisible Walls, Finger of God, Mule, Buttons, Helpers, Traces, Resource Generators, Tiles, Dice, Cards, Card Hands, Draw Piles, and Discard Piles
- **Abstract Objects:** Score, High Score Lists, Lives, Parallel Lives, Cameras, Ghosts, Book-Keeping Tokens
- **Locations:** Strategic Locations, Exceptional Features, Chargers, Resource Locations, Destination Points, Rescue Points, Spawning Points, Safe Havens.

A design pattern can be perceived as a theme that can be applied to different situations (Gamma et al., 1997). Notably, different design pattern types (Baron, 2021; Nystrom, 2014) are preferred in game development. Each pattern is anticipated to guide game developers in the game development process. In this part of the book, the design patterns described by Gamma et al. (1997), which are widely accepted and used in the literature, are included. In this direction, an overview of design patterns is presented based on Unity, among the most common game engines in game development.

Creational Design Pattern

Factory Pattern

The factory design pattern is commonly preferred in cases where subclasses are created from a superclass. At this point, subclasses are made from the superclass, defined as a superclass in which the type of objects is changed, and the class instantiation is done in subclasses (Gamma et al., 1997). Thus, classes can be managed from a single point, thanks to the superclass. To explain this with an example, let us imagine that there is a class defined as a warrior that represents the hero character in the game. There may be more than one warrior in the game. In this case, a warrior object representing a superclass is created. Then, as shown in Figure 1, different types of sub-warriors can be made from this warrior class.

Figure 1. Sample fighter creation for factory pattern (image: Freepik.com)

Build Pattern

The Builder Design Pattern is a generative design pattern used especially for creating complex objects. This design pattern enables the creation of different types of things from the same structure code (Gamma et al., 1997). Considering the above warrior character and the generative design pattern, an object named warrior is in the game, and this warrior can have multiple properties and types. Some warriors may have a cape, and some warriors may have a helmet. These attributes can be set on the same warrior object in such cases. One created warrior can be defined as having a cloak, but no helmet, and another built warrior can have a helmet but no cover. This way, new types with different properties can be made from the same object.

Abstract Factory Pattern

The abstract keyword allows a base class to be defined and means that subclasses can inherit common functions such as methods, fields, and constants. In this direction, the abstract design pattern is more useful than the factory design pattern when creating and using interrelated groups of objects by creating multiple interfaces is necessary. As in the example above, in the factory design pattern, numerous fighters are made from a single fighter class, while in the abstract factory design pattern, sub-objects are created using two different interfaces to create the weapons and armor of this fighter. The abstract factory design pattern is preferable for creating interrelated sub-objects (Gamma et al., 1997).

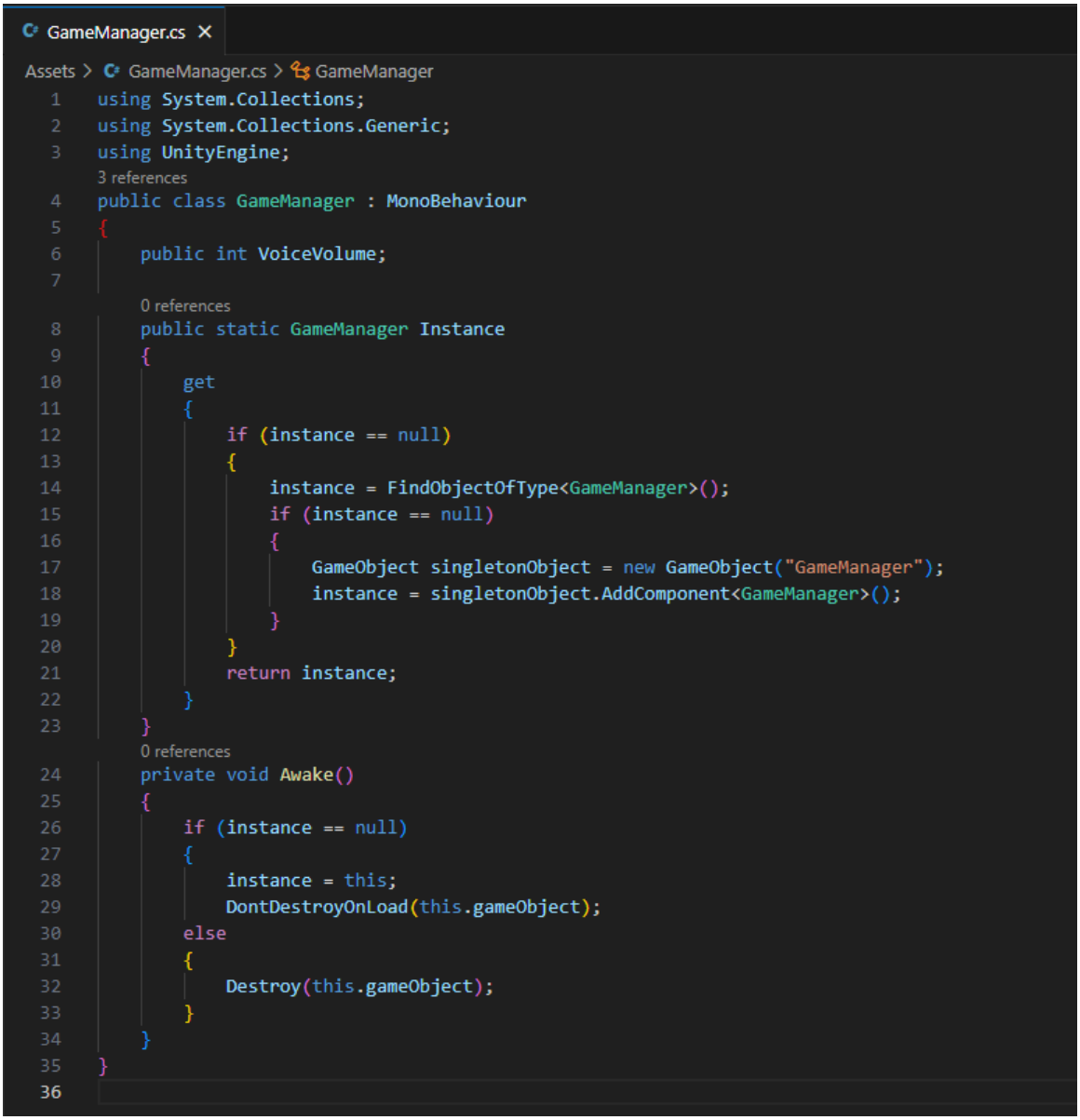
Prototype Pattern

Instead of creating new objects, the prototype pattern allows the creation of copies of an object from a reference object called a prototype through a cloning mechanism (Baron, 2017). In other words, it is used to create a prototype instance of an object and copy it (Doran & Casanova, 2017). A prototype is the most primitive form of

an object, representing its basic properties. This design pattern is preferable when classes to be dynamically instantiated are specified (Gamma et al., 1997).

Singleton Pattern

A singleton design pattern is used to create only one class instance. The singleton design pattern provides global access to this instance (Gamma et al., 1997). In other words, the created instance can be accessed globally from other code files in the game. The singleton design pattern is preferred for globally controlled objects throughout all game scenes, such as game and sound management (Lin et al., 2022). Accordingly, it is recommended to be preferred when global access is provided, and the game is controlled. The singleton design pattern can be preferred for system settings used in games. At this point, a code blog can be prepared to determine the volume of the game. In this way, locations such as increasing, decreasing, or decreasing the importance of the game can be made through the example of this class. At this point, a GameManager.cs file is created, as shown in Figure 2, and the volume setting can be controlled with a variable named VoiceVolume. The important point here is to create a public and static instance of the GameManager class. In this way, sound settings can be changed globally in the game.



```
GameManager.cs
Assets > GameManager.cs > GameManager
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
3 references
public class GameManager : MonoBehaviour
{
    public int VoiceVolume;

    0 references
    public static GameManager Instance
    {
        get
        {
            if (instance == null)
            {
                instance = FindObjectOfType<GameManager>();
                if (instance == null)
                {
                    GameObject singletonObject = new GameObject("GameManager");
                    instance = singletonObject.AddComponent<GameManager>();
                }
            }
            return instance;
        }
    }
    0 references
    private void Awake()
    {
        if (instance == null)
        {
            instance = this;
            DontDestroyOnLoad(this.gameObject);
        else
        {
            Destroy(this.gameObject);
        }
    }
}
```

Figure 2. Sample code file for the game manager that provides voice control in the game via Unity.

Creational Design Pattern

Adapter Pattern

An adapter transforms a component into a different form (Sommerville, 2016). In this direction, the adapter design pattern is considered to change the interface of a class into another interface in line with the client's expectations (Gamma et al., 1997). The adapter design pattern can be used in Unity when some base classes and interfaces are modified to add new features to third-party libraries downloaded from the Unity Asset Store (Baron, 2021).

Bridge Pattern

A bridge design pattern refers to separating an abstraction from an implementation so that two properties of an object can change independently (Gamma et al., 1997). In other words, a bridge design pattern allows performance

and abstraction to be used separately. For example, let us imagine that there is a tree in the game. The tree has more than one species and colors that change according to the season. In this direction, the tree class can be abstracted, and colors can be used as an application.

Composite Pattern

The composite pattern allows objects to be built in a tree structure to represent a part-whole hierarchy and ensures that combinations of individual things behave similarly (Gamma et al., 1997). In this way, objects can be created with a more modular structure. It can be preferred for making things in the game and creating a hierarchy between these objects. For example, when we consider a warrior character in the game, many components of this character, such as a helmet, sword, and shield, can be prepared separately and made to behave as a single object as a warrior.

Decorator Pattern

Decorators typically work with composite patterns and share a parent class, and operations like Add, Remove, and GetChild support the component interface (Gamma et al., 1997). In other words, decorators can be considered composite patterns with a subclass. The purpose of a decorator pattern is to dynamically give an object extended behavior at runtime (Doran & Casanova, 2017). For example, let us say there is a weapon in the game. A decorator pattern may be appropriate for adding and removing a generic property for this weapon at runtime. The UML diagram below shows an example of this (Baron, 2021).

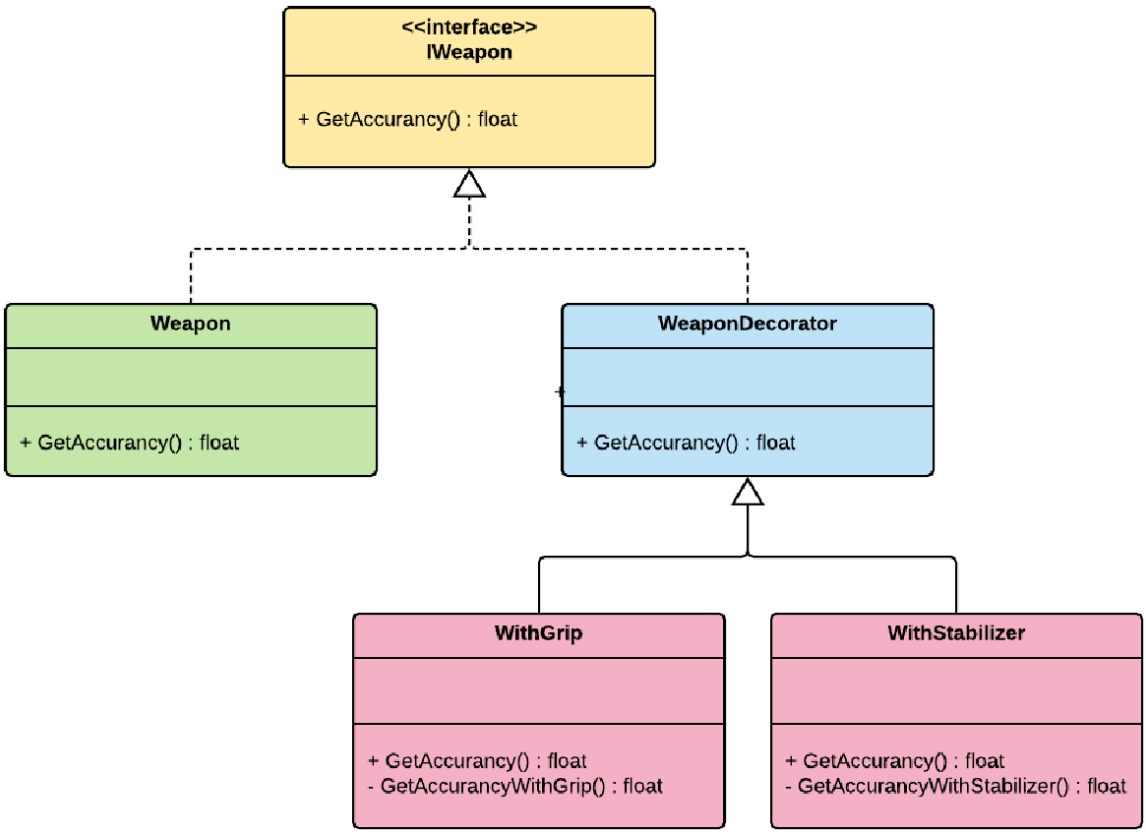


Figure 3. UML diagram of the decorator model (Baron, 2021).

Facade Pattern

In most complex systems, the user interacts with smaller classes without realizing it. This is because there is a user-response system in which many types are involved on the code side with the user's behavior. The Facade Pattern knows which subsystem classes are responsible for a request received from the player and delegates requests to the appropriate subsystem objects (Gamma et al., 1997). This way, the player is presented with a set of classes responsible for subsystems in a unified structure. For example, when the warrior character is in a battle in the game, categories such as energy reduction, health reduction, point gain, etc., are running in the background while the events taking place in the background are presented to the player through an interface without being reflected to the player.

Flyweight Pattern

A game may contain objects with very small parts. In such cases, the repeated creation of each object can consume many system resources and cause errors in the game. The solution to this problem is to organize flyweight objects, which are small particles, in a good way. Therefore, to efficiently use many fine-grained things, it is possible to use shares within the game (Gamma et al., 1997). In other words, the flyweight pattern abstracts the common parts of the objects in the game and shares each instance with unique data.

Proxy Pattern

For performance, each object in the game must be created as long as it is not needed. As the player interacts with many interface components in the game, access to each object may be restricted. Therefore, a proxy controls the player's access to another entity (Gamma et al., 1997). In other words, a proxy pattern is preferred to ensure that the player only accesses the authorized states.

Behavioral Design Pattern

Chain of Responsibility

Instead of linking the player's requests to a single object, the game creates a chain between objects, and the object corresponding to the player's request processes the game's request, creating a chain of responsibility. Therefore, the player's demands go through a series of checks, and feedback is provided to the player after the corresponding object is processed. An example illustration is presented in Figure 4.

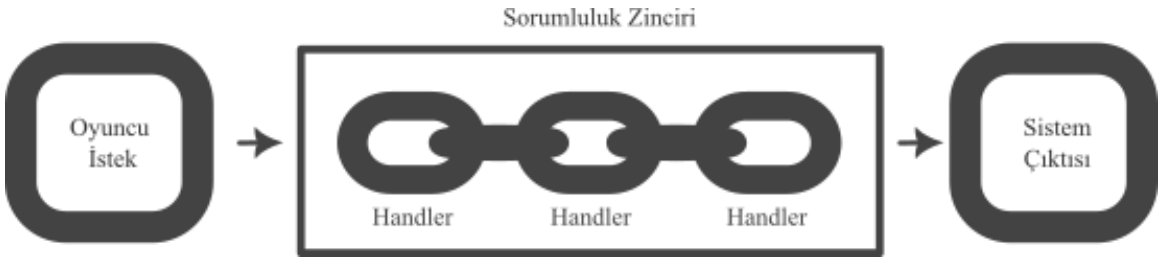


Figure 4. Example illustration of the chain of responsibility pattern

In this model, multiple objects can fulfill the player's request, separating senders and receivers. The request travels along a chain of objects until one of them receives it (Gamma et al., 1997).

Command Pattern

A command design pattern is a design pattern that allows an action in the game to be converted into an object and executed at different points in the game. For example, from the perspective of the command design pattern, the player's behavior in the game is recorded, and, if necessary, the player's actions in the game can be undone or redone. In this case, the command design pattern allows the player's efforts to be stored as a command object. At this point, the Execute method is called to execute the actions. For example, let us consider a situation where a character named "Player" attacks in a game. In this scenario, the interface components of the command design are prepared first. For this, a file named "ICommand.cs" is created, and ICommand is defined at the public level. An example code representation for Unity is given in Figure 5.

.

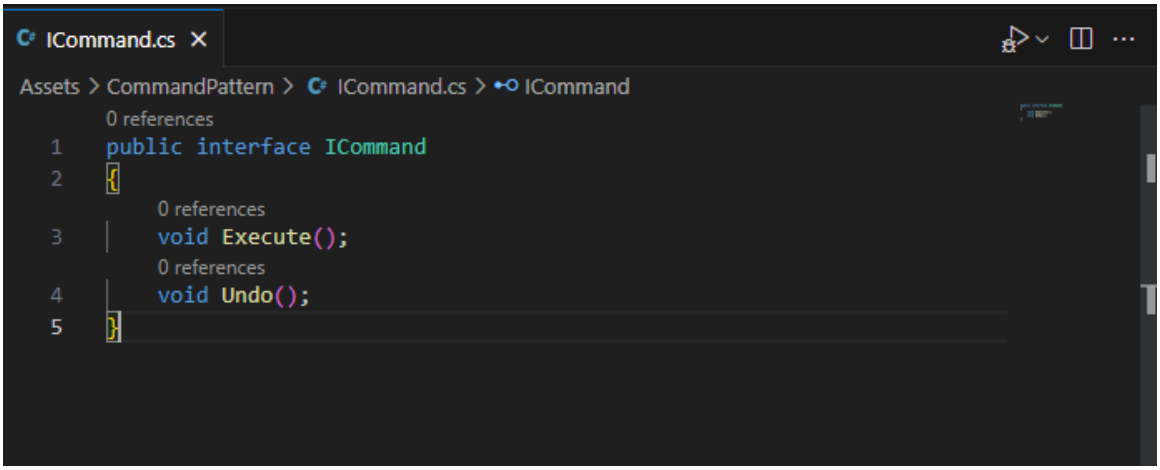


Figure 5. Example interface definition in the command design pattern in Unity

After the interface design of the command design pattern is done, an invoker file is prepared to call this command. With this file named "CommandInvoker.cs", commands are executed. An example view is given in Figure 6.

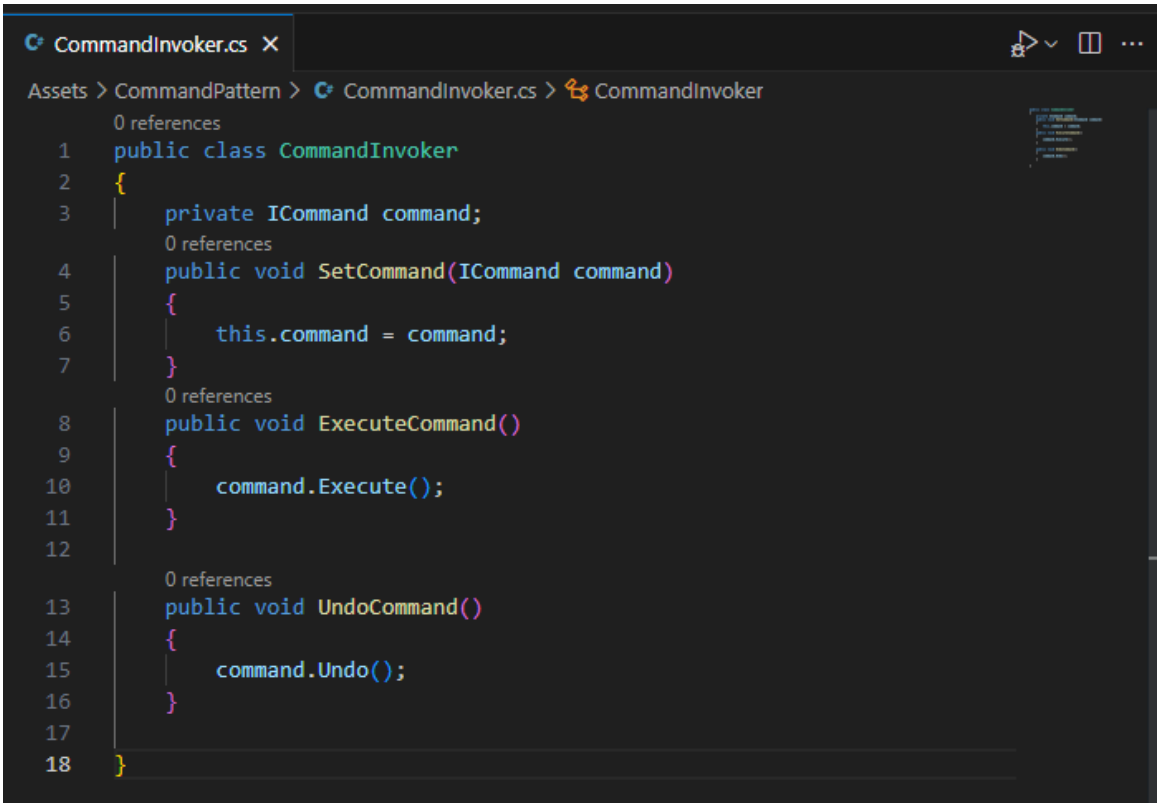


Figure 6. Example invoker usage in the command design pattern in Unity

The character named Player attacks with the Execute method. Therefore, the attack method on the player character itself will work in this file. A command design pattern can be supported through Unity with the "AttackCommand.cs" file, as shown in Figure 7.

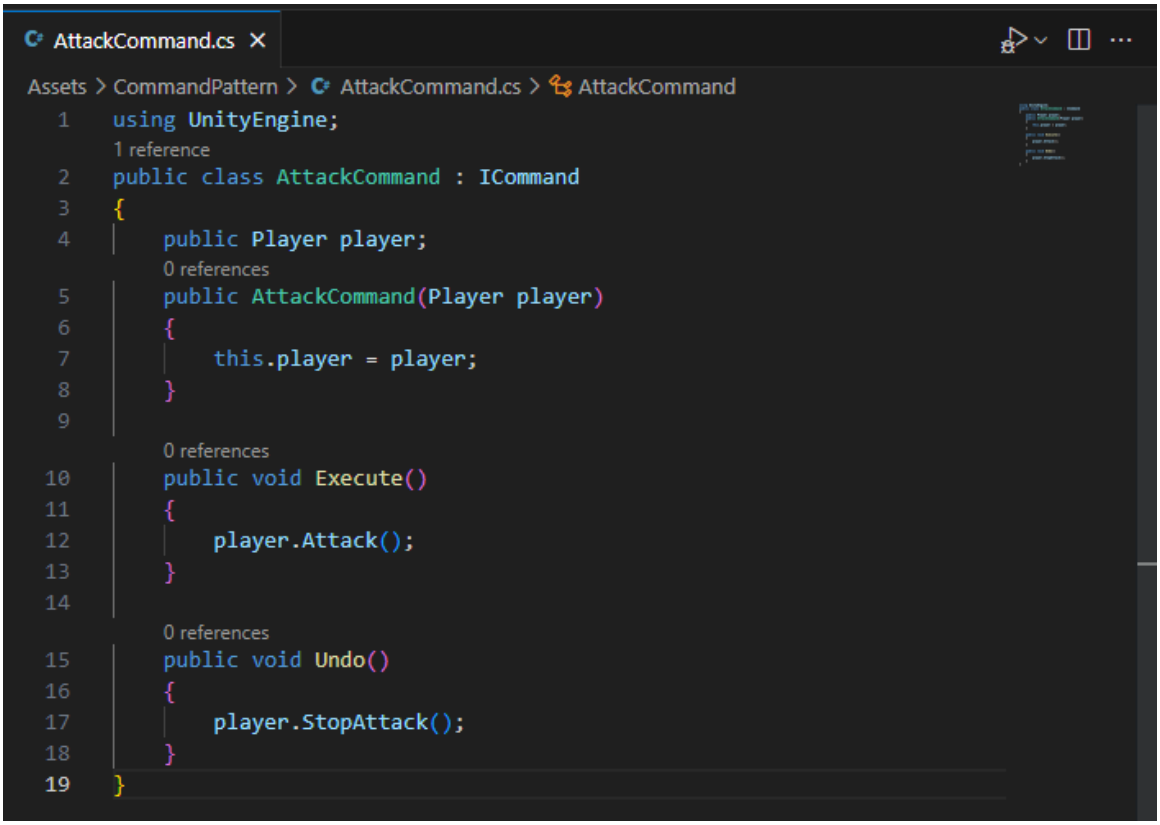


Figure 7. Command design pattern code sample in Unity

Each character can be assigned an attack technique in this design pattern. The activation of the "Player.cs" file seen in Figure 8 may be achieved by using the PerformAttack method.

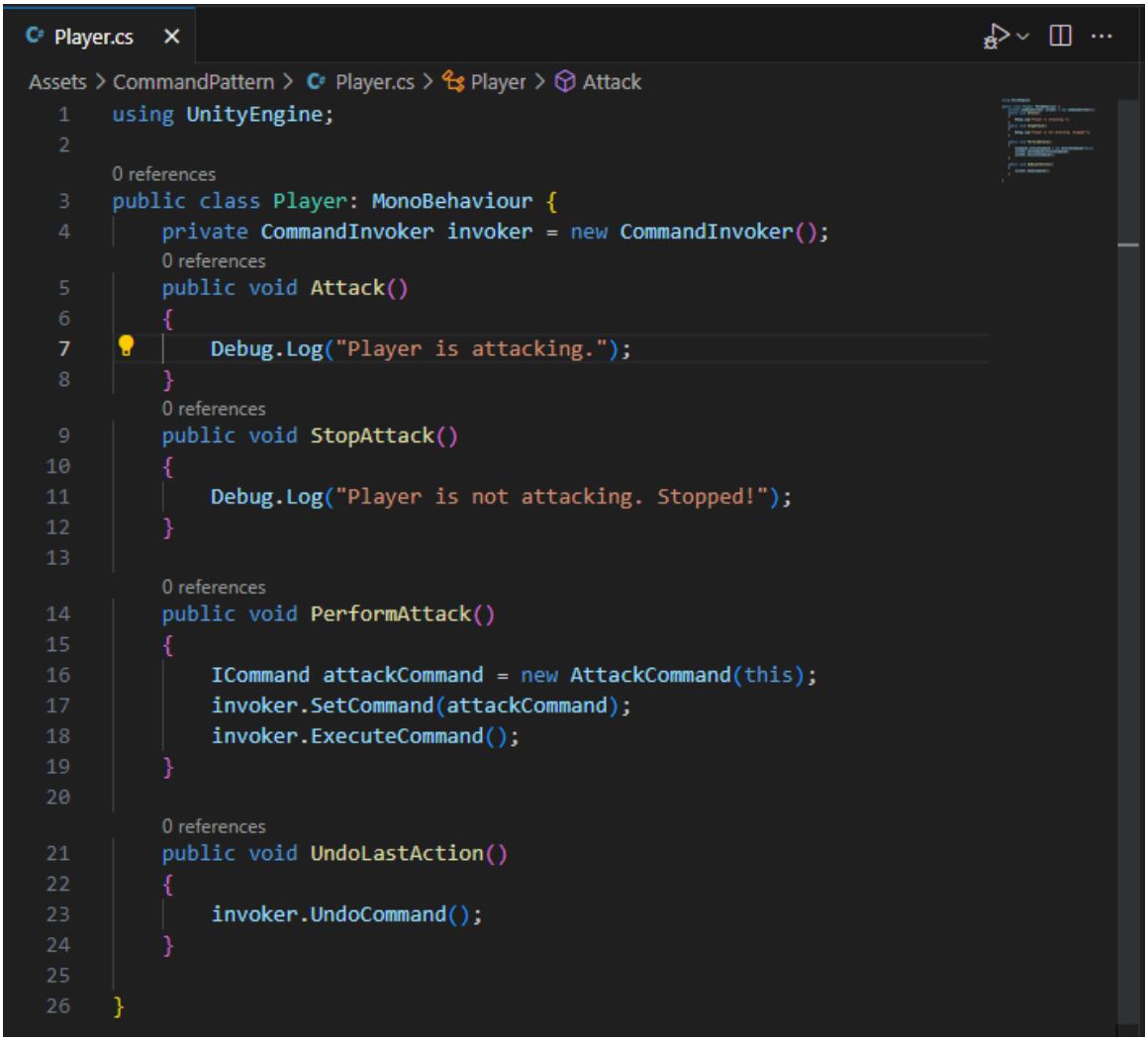


Figure 8. A sample Player code file

Interpreter Pattern

The interpreter pattern is a design pattern that describes how to define the grammar of the language used in the game, how to represent sentences in the language, and how to interpret these sentences (Gamma et al., 1997). In other words, it can describe situations with basic patterns, such as language.

Iterator Pattern

According to iterative design, an object is responsible for keeping track of the current item. Still, it is also where information about which things are already in place is kept (Gamma et al., 1997). An example can be given of a list of users on the leaderboard of a game sorted from the highest score to the lowest score. However, in addition to this situation, it also represents a path created according to the order in which a data set in the game will be accessed.

Mediator Pattern

An object is defined within a mediating pattern that determines how a group of things in the game will interact (Gamma et al., 1997). Thus, rather than each object interacting with each other directly, they interact through a mediating thing. This mediating object is responsible for controlling and coordinating the interactions of a group of objects (Gamma et al., 1997).

Memento Pattern

When objects in the game are inaccessible to other objects, the player may need to undo an action. For example, the player may want to revert the user settings in the game back to the scenes they had previously set. In this case, the object representing the user's behavior is saved in a specific location and can be recalled from there. This way, a memory pattern can be used to keep track of the game's behaviors. Therefore, the object defined by a memory pattern can be expressed as an object that stores a snapshot of another thing's state where records are kept (Gamma et al., 1997).

Observer Pattern

The main purpose of the observer design is to establish a one-to-many relationship between objects so that when a change is made in an object, the object in the observer role notifies the other objects in the observer role (Baron, 2021). In other words, a state change in one object is reported to all dependent objects, and necessary updates are made. This type of interaction is also known as publish-subscribe, where notifications are sent without the need to know who the observers are, and any number of observers can subscribe to receive information (Gamma et al., 1997).

State Pattern

A state pattern enables the identification of states for a particular property of objects. Thus, when the state of an object changes, its behavior can also change (Gamma et al., 1997). For example, the game has states according to the player's controls. According to the player's controls, the character behaves by standing, walking, jumping, etc. When the player does not press any key, the character goes to the default state and stands. When the player presses the direction keys, the character starts walking in the corresponding direction. For this, the state of an object representing the character, defined as a player, is changed.

Strategy Pattern

In a strategy design, a family of behaviors is defined, which are kept in individual classes called strategies (Baron, 2021). In other words, a character with various variants of the same behavior can change its behavior in the game. For example, it can be used when it is desired to be completely independent of the behavior used by the game object and when it is desired to give each enemy a different form of attack (Doran & Casanova, 2017).
form of attack (Doran & Casanova, 2017).

Template Method

The template method expresses an abstract description of an algorithm and allows the algorithm to be defined step by step (Gamma et al., 1997). In other words, a master template that defines the basic structure of the algorithm that determines the interaction between the classes in the game is determined. In this master template, it may not be possible to control everything, and it may be intended to leave some steps to subclasses. This way, while the basic algorithm structure is preserved in the main template, different steps can be customized in subclasses.

Visitor Pattern

Thanks to the visitor pattern, operations can be added without changing the structure of an existing object in the game (Baron, 2021; Gamma et al., 1997). This way, new functions can be added without changing the existing object.

Unity Design Pattern

The Unity game engine saves game developers much trouble thanks to some design patterns that are already available. The Unity game engine's design patterns, built on four design patterns (Lin et al., 2022), are used in various ways in games. Explanations about this usage are given below.

- The game loop design uses a fixed time step in the game's development (with a set frame per second) and a time variable that measures the time from the previous to the current frame. In this case, MonoBehavior methods such as Update, LateUpdate, and FixedUpdate provided by Unity are used in the game.
- The Update design pattern refers to using the appropriate Update, LateUpdate, or FixedUpdate methods within the MonoBehavior class to update the behavior of each object in the game frame by frame.
- Prototype can be defined as copying the objects in the game without affecting the original. In this way, by replicating and cloning an object to make other objects similar, there is no need to define a separate class to create each type of object in games.
- The component pattern, as well as being used as a publication in games, is based on creating smaller components that each do a single thing rather than creating large classes with multiple responsibilities. For example, Rigidbody and Collider components are preferred for physical movements. In addition, a MeshFilter and MeshRenderer are used for 3D geometry. Thus, there are many situations where the GameObject component collection in Unity can be used in games. In addition, there is a need to create components in certain situations in the game. In this way, developing games with small components that do certain tasks rather than a large class is recommended.

Object pooling is another design pattern used in games developed by Unity. In the Unity game engine, object pooling is an optimization technique that relieves the CPU when creating and destroying many GameObjects (Lin,

2022). In the object pool pattern, the object pool contains ready-and-waiting objects required for the game. When an object is needed in the game, it is not initialized in the application, but instead, GameObject is called from the pool and activated. The object is then deactivated after use, and the object is not destroyed but returned to the pool.

Chapter Summary

Considering that game development is a complex process, developers face difficulties as the project grows. Considering the three stages of game development: pre-production, production, and post-production; design patterns will be an effective method in the development of digital games. Design patterns are considered a way of reusing the knowledge and experience of other designers. The most comprehensive description of design patterns has been presented by Gangs of Four (GoF). According to this, the creational design pattern represents the creation of objects within the game, the structural design pattern refers to the product of classes and objects into larger structures. The behavioral design pattern is related to creating responsibilities between the algorithm and the objects. Additionally, the design patterns under these basic categories are explained in this section.

References

Baron, D. (2021). *Game Development Patterns with Unity 2021: Explore Practical Game Development Using Software Design Patterns and Best Practices in Unity and C*. Packt Publishing Limited.

Björk, S., & Holopainen, J. (2005). *Games and design patterns*. Charles River Media: Hingham, Massachusetts.

Doran, J. P., & Casanova, M. (2017). *Game development patterns and best practices*. Packt Publishing.

Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1997). *Design patterns: Elements of reusable object-oriented software*. Pearson Deutschland GmbH.

Indeed (2023). *Paypal, Instructional Designer*. Retrieved date: 20 Ağustos 2023. Retrieved from: https://www.indeed.com/q-instructional-game-designer-jobs.html?vjk=8abf300b272fbe73.

Kapp, K. M. (2012). The gamification of learning and instruction: game-based methods and strategies for training and education. John Wiley & Sons.

Lin, W., Krough-Jacobsen, T., Andreasen, P., Bilas, S. (2022). *Level up your code with game programming patterns* [ebook]. Unity Technologies. Erişim adresi: https://resources.unity.com/games/level-up-your-code-with-game-programming-patterns?ungated=true.

Nystrom, R. (2014). *Game Programming Patterns*. Genever Benning.

Uni Global Union, (2022). *The video game industry: A resource for organizers*. Retrieved date: 12 August 2023. Retrieved from: https://uniglobalunion.org/report/the-video-game-industry/.

Sommerville, I. (2016). Software engineering (12th Editon). Pearson Education: Boston

Author Information

Can Meşe

https://orcid.org/0000-0002-9759-7055

Kahramanmaraş İstiklal University

Kahramanmaraş

Turkiye

Contact e-mail: *canmese@gmail.com*

Citation

Meşe, C. (2023). Design Patterns in Game Development. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp. 43-59). ISTES Organization.

Chapter 6 - Game Engines

Mehmet Gök

Chapter Highlights

- Emergence and development of Game Engines are presented.
- Components of a typical game engine are explained.
- Benefits of game engines are discussed.
- Principles for an ideal game engine are described.
- Brief information on distinguishing features of commonly used game engines is given.

Introduction

Games, which people prefer for entertainment and socializing, are among the indispensables of the digital world today. In terms of size and popularity, games have become a mainstream industry with a billion-dollar volume rivaling the movie and music industries. Although the genres and the social groups they appeal to are different, appropriate software development environments are needed to design games. For games developed before the 90s, programming languages and environments were used to create ordinary software. This changed in 1993 when ID Software introduced the "Game Engine" concept when they introduced their FPS (First Person Shooter) game DOOM. ID Software employees first conceptualized the game engine, which they defined as the technology behind it, in 1991 and realized the DOOM game with this engine (Gregory & Lemarchand, 2014; Politowski et al., 2021). A game engine is a software framework that combines various tools and software libraries, allowing the game designer to focus on the game itself (Sherrod, 2007). Game engines started to be opened to other game developers in 1998 with Quake III by ID Software and Unreal Engine developed by Epic Games. Examples of widely used game engines include Unity, Unreal, CryEngine, Godot, and GameMaker. Today, game engines combine the design and programming environment, rendering engine, collision and physics engine, animation mechanism, sound infrastructure, and artificial intelligence system. While transferring these components one by one to a software development environment is laborious and time-consuming, game engines isolate developers from all this complexity. For example, while developing games using DirectX or OpenGL interfaces, which are rendering engines, requires writing a lot of code, with the Unreal Engine Blueprint interface, a certain level of games can be realized without writing code. Similarly, rendering interfaces relieve the programmer from the graphics processor (GPU) programming workload, which requires knowledge of hardware details and low-level programming skills. Physics engines are interfaces that simulate basic physics phenomena in the game world, such as acceleration, collisions, and falls. Havok Physics library, Bullet, Box2D, ODE (Open Dynamics Engine), and PhysX are examples of current physics engines. Animation development tools such as Granny 3D and Spine can be used for the animation functionality used in the game.

With the game engine's emergence, the game's software parts (3D skinning and collision detection system), the artistic assets of the game (assets), and the game rules infrastructure started to be separated. This allowed game developers to use game engines created by other developers with their purchases and scenarios and to work as a team. For example, the machine of the popular game Unreal was used in the design of another popular game, Gears of War (Epic Games). In this way, it can be seen that the game industry started to proliferate with the licensing of game engines (Gregory and Lemarchand, 2014).

Game Engine Architecture and Fundamentals

A game engine can be considered a tool that organizes and manages game graphics, configuration files, user commands, and all other inputs, such as maps and sounds (Zarrad, 2018). Figure 1 shows the component diagram of a game engine.

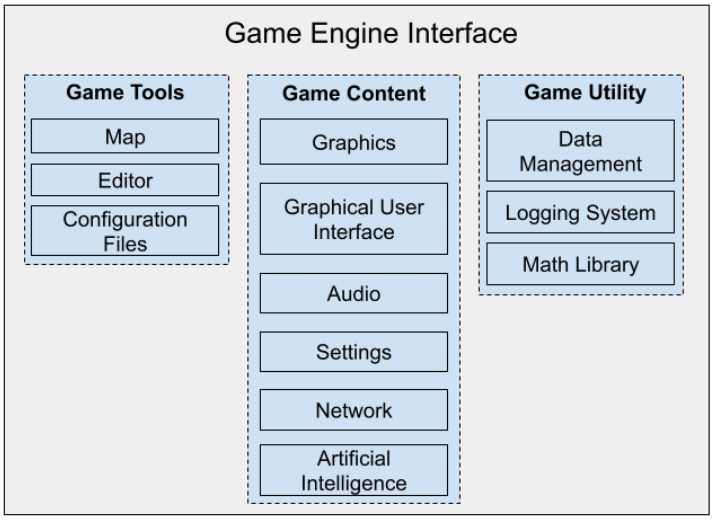


Figure 1. Game Engine Components (Zarrad, 2018)

Game tools, Utilities, and Content are a game's core components. Game tools refer to all the tools used to develop the visual elements of a game, such as the character editor, configuration files, and the game map. For example, in Age of Empires, even players with no experience in visual design can use the map editor to create their maps and use them in their games. Configuration files are used to store and reuse the settings made for the game. In game engines, editors are either code editors for writing program code or design editors for creating animation paths.

Game content refers to all relevant features in any game. Graphics and sound files are the game's most important data types. Game engines provide a particular object interface for image sequences called sprites, usually used in 2D games for simple character animations. However, the skeletal animation of a 3D model can be defined as the simultaneous rendering of that model's textures with the model's skeleton. Sound files, on the other hand, serve as a complementary part of game fiction. Sound files can be divided into background music, and sounds played when certain events occur. While the background music in a game reflects the script and story of that game, the sounds played when weapons are fired can provide a more realistic experience for the player (Vohera et al., 2021).

Game engines may not provide a sound or image editing tool directly. However, they should allow different audio and video files to be added to the project tree as assets. Designing a model with game engine tools can negatively affect the development process. In this case, 3D design tools such as 3D Max and Blender can be used. In this case, it is essential to transfer the blend file of a model designed with Blender and the materials used for this model to the game engine with minimum effort.

Network components allow multiple users to connect and access game data. The network feature enables multiplayer games to be played on the local network and over the Internet. Especially in games played over the Internet, players can meet in virtual worlds through game servers. In addition, the network feature is also used to collect game and player information for account management and evaluation of game analytics.

In addition, artificial intelligence is a component that makes the game flow and user experience more realistic. For example, analyzing player behavior and adapting enemy behavior accordingly is an example of in-game AI (Kaban, 2023). Today, NVIDIA has introduced DLSS (Deep Learning Super Sampling) technology to increase the number of frames per second (frames per second - fps) utilizing an auto-encoder-based neural network to generate game frames directly. This makes it possible to create high-quality graphics even at low resolution and eliminates the need for complex calculations on the graphics engine. As a result, the frame generation rate can be increased directly with DLSS without sacrificing performance. Higher FPS results in smoother graphics, but when anti-aliasing (AA) filters are enabled, this rate drops considerably, negatively affecting the gaming experience. DLSS technology, which also eliminates the need for AA filters, can be used by graphics cards with RTX core GPUs produced by NVIDIA. AMD has responded to this technology with FSR (FidelityFX Super Resolution) technology, which can be used with AMD GPUs.

Auxiliary components define all required data types, message formats, required files, and mathematical calculations according to the game specifications. The Game tool component acts as a bridge between the Game content and the Game engine components. The most crucial auxiliary part is the math library. An intensive calculation from vector operations to graphical transformations is frequently used in games. While these operations were performed entirely on the CPU before the development of graphics cards, with the development of GPUs after the early 2000s, they were moved from the CPU to the GPU side through graphics libraries such as OpenGL and DirectX. On the other hand, it can be said that with artificial intelligence applications in games, mathematical libraries that use the CPU have started to be used again.

Like other computer software, games are software in which a series of operations are repeatedly performed in an infinite loop. Figure 2 shows a typical circle of a game. The first component of the game loop is user input. Examples of user input are direction-critical presses on the keyboard, mouse clicks to fire, or acceleration data from the tablet's acceleration sensor. The flow in the game world is processed by components such as the Physics engine, Collision detection, and Artificial intelligence according to user input and transferred to audio and video output. While GPU is used intensively in the video rendering stage, CPU and main memory (RAM) are used intensively for all other locations. In addition to video and audio output, haptic feedback can be provided to the user through the haptic hardware (Joselli et al., 2014; Mohebali and Chiew, 2014).

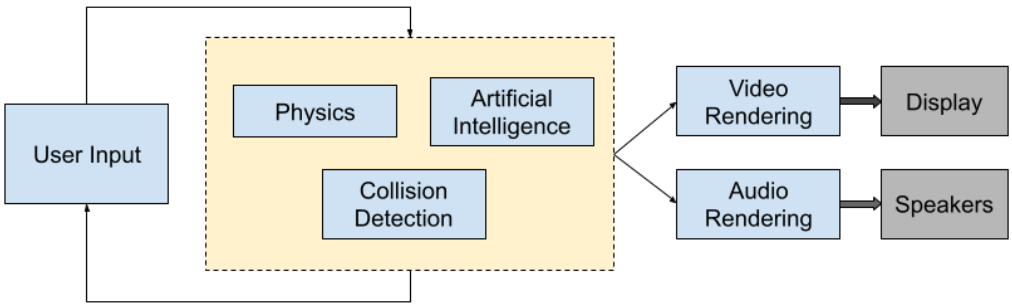


Figure 2. Game Loop (Mohebali and Chiew, 2014).

Designing a game engine solution to suit all game types and purposes is a challenging problem for an engine developer. However, to build successful game engines, there is a need to define basic design principles and specify

requirements. This chapter describes the five principles for a basic game engine proposed by Zarrad, (2018): modularity, usability, library resources, efficiency, rendering effects, and image quality.

Modularity

A game engine should be planned and realized through individual modules. Each component should be independent as a single functional unit. For example, a manager module is needed to handle user input or the management of assets in the game. Engine developers should realize a modular game architecture to reduce system complexity and provide robustness. This will make things easier for programmers working on testing and maintenance. Each component has a unique sub-function in the game engine architecture proposed in Figure 1.

Usability

The usability of a game engine is an important criterion that needs to be carefully considered. Game development is becoming a process in which many team members and different inputs are involved. Since the game engine is a platform where sound, character models, and animation are brought together, good usability facilitates the management of this process. Usability can be defined as the ease of learning and memorability. It applies to all tools integrated into the game engine, such as the GUI editor, animation editor, scene editor, etc. In addition, it should provide an effective debugging mechanism. For example, Visual Studio can provide both programming and debugging functionality for Unity.

Library Resources

Game engine applications are implemented by combining many source libraries. A 3D game engine consists of 3D graphics, physics, collision detection, input/output, sound, artificial intelligence, and a network of libraries. Modern game engines can include more powerful libraries, including laws of physics, collision detection, and special effects. In addition, the resources in the game engine have project examples, user guides, and tutorials; these resources are handy for a game developer.

Efficiency

Game engine efficiency successfully utilizes all inputs and available resources to produce a game output. In this context, efficiency includes memory allocation, CPU utilization, rendering, and other features. We can build an efficient engine, but this does not mean that an efficient game can be made with that game engine. This is because the game workflow is designed by the game creator, which has an impact on game efficiency. Resource managers play an essential role in this criterion. These tools load game data and files from disk into memory that will be used for rendering and game scenario creation. With these tools integrated into game engines, game designers can utilize one resource for multiple games.

Rendering Effects and Image Quality

Rendering can be defined as producing 3D animated graphics using techniques such as rasterization (converting the scene into 2D) and ray tracing. These techniques are valuable for 3D game engines. Unlike 2D graphics, implementing a 3D drawing obtained through rendering requires advanced programming and 3D modeling skills. In addition, the techniques used for the rendering process can also be evaluated in terms of speed. For example, new generation rendering techniques can be accelerated, especially with GPU-based computational algorithms. This process can be defined as GPU-accelerated compression (video encoder) for outputting a finished video for the target platform. Most existing engines render a scene using default settings. This can be good for a quick preview but not ideal for production work. With modern game engines, you can get very sharp, crisp, and high-quality scene outputs, which can come back as increased rendering time.

Game Engine Types

With the tools and new features, they offer, game engines enable the creation of more realistic and attractive games. Especially with high-quality game graphics and artificial intelligence, it continues to carry players one step further into worlds that are difficult to distinguish. In this section, commonly used game engines are mentioned, and evaluations of these game engines are included.

Unity

Unity is a game engine built as an Integrated Development Environment (IDE) that allows users to create video games, 3D animations, and various models. Unity can run on macOS and Linux operating systems as well as Windows. In addition to desktop operating systems (Windows, macOS, Linux), it can output games for Windows Phone, iOS, Android, and different consoles. The user only needs the Software Development Kit (SDK) for Unity on the selected platforms to create applications on the relevant media. Unity is based on the C# programming language as a scripting language, and these scripts can be assigned to game objects in the game with an object-oriented approach. These program codes assigned to the game object can be used to perform animation or real-time transition operations.

Unity includes several advanced components such as NVIDIA's physics engine known as PhysX, Mecanim's animation system, a built-in terrain editor, and MLAPI (Mid-Level API) for multiplayer networking. It also uses an approach that automatically compiles code on the fly and can inject it into the game even after a small change is made to the C# code. Unity can display compilation issues and run-time messages in the console window. The agreement also offers licensing support, ideal for independent developers and small studios. Its enormous user base and incredibly active user community allow everyone, from beginners to professionals, to get answers and exchange information quickly. It also will enable designers to exchange assets online thanks to the asset store. Designers can design their elements, but they can also use assets produced by the community and professionals in their game projects. In addition, assets designed in Unity, Blender, 3DS Max, Cinema 4D, Adobe Photoshop,

and Maya can be imported and used in-game. Famous Unity games include Call of Duty: Mobile, Temple Run Trilogy, Assassin's Creed: Identity and Escape Plan, and Fruit Ninja. Unity can also use all libraries developed for the .net platform thanks to Visual Studio integration (Vohera et al., 2021; Jungherr and Schlarb, 2022).

Unreal Engine

Epic Games, a famous game development company, designed the Unreal Engine (UE). The first version of the Unreal game engine was released in 1998 and continues to be actively developed today. The Unreal game engine stands out for its ability to produce realistic and high-density graphics. This game engine was developed using C++, and this programming language is also supported in the game development phase. It also offers the Blueprints tool, which is a visual programming interface. With a design environment like Unity, Unreal Engine has high portability, supporting a wide range of desktop, mobile, console, and virtual reality platforms. The key advantages of using a game engine like Unreal Engine are reusable code with rich library support and unique integration of object-oriented programming concepts. The engine includes specialized libraries for game creation, which allows you to concentrate on the game without being immersed in the technical details of the game engine. In addition, object-oriented programming allows experienced users to adapt to the game engine quickly. While games are being developed, many technical innovations are also transformed into technology. For example, LoD (Level of Detail), a technology that determines the level of detail based on the camera's distance to the scene and adjusts the number of polygons covered accordingly, was introduced with Unreal Engine. It can be said that the developers of this game engine are mainly focused on real-time rendering of high-quality graphics. Notable games created using Unreal Engine include Unreal, Unreal Tournament, Fortnite, Street Fighter V, Borderlands 3, Dragon Ball Fighter Z, and Ark: Survival Evolved (Gregory and Lemarchand, 2014; Vohera et al., 2021).

GameMaker

The GameMaker game engine was first introduced in 1999 by Mark Overmars under the name Animo and continued under this name until 2011. Since 2007, it has been developed by YoYo Games and is a game engine used to create 2D cross-platform games. Like Unreal Engine, it is set in C++ and offers the Game Maker Programming Language (GML) for game programming. GameMaker is suitable for beginners as it does not require any programming skills or prior knowledge and facilitates game design with functions such as block-based drag-and-drop programming (Visual GML). It allows users to develop games with a single code and publish them to run on multiple platforms, including Android, iOS, PlayStation, Xbox, Windows Desktop, HTML5, Windows UWP, and Nintendo Switch. Some famous games created in GameMaker are Undertale, Hotline Miami, Shovel Knight: Treasure Love, Hyper Light Drifter, and Katana Zero (Christopoulou and Xinogalos, 2018).

CryEngine

CryEngine is a game engine designed by Crytek. CryEngine 1 began with developing the first player shooter, FarCry, and its sequels. Scripting of the game engine is done in C++ and Lua programming languages. It enables game development for multiple platforms, including Xbox One, PlayStation 4, and Windows. The engine manages

real-time asset conversion and optimization, allowing cross-platform changes in all aspects of the game development process. This significantly reduces the risk of developing multi-platform games while increasing development speed and quality. CryEngine provides access to both the source code and the game engine, making flexibility and customization even more accessible. CryEngine is known for creating highly high-quality graphics and game performance. When it was released, Ryse: Son of Rome was awarded the SIGGRAPH award for best real-time graphics game in 2014. CryEngine games are primarily based on the first-player shooting game genre. Some famous CryEngine games include Crysis and its sequels Prey, Kingdom Come, and Ryse: Son of Rome (Vohera et al., 2021).

Godot

It was first developed in 2014 by Argentine software developers Juan Linietsky and Ariel Manzur for various software companies in Latin America and has since been made generally available. Godot is a modern game engine that meets all the requirements of a game engine. It supports C++, C#, and GDScript as scripting languages, and thanks to its cross-platform support, it can run on Windows, MacOS, Linux, and Android operating system environments. In addition to these platforms, Godot can output applications to iOS, HTML5, and virtual reality hardware platforms such as HTC Vive and Oculus Go. It also offers visual coding support thanks to its Visual Script support. In addition, Godot is completely free and open source and is published under the highly comprehensive MIT license. This means your game's revenue has no fees, hidden costs, or royalties. Everything you do with Godot is 100% yours, which is not the case with many commercial game engines that require an ongoing contractual relationship. This makes the Godot game engine attractive to many developers. Examples of games developed with Godot include Kingdoms of The Dump, Romino's Adventure, Bendy Worm, Gravity Ace and Rings of Saturn, Dome Keeper, and Brotato (Bradfield, 2018; Ullmann and Politowski, 2022).

Game engines are just tools for developing game software. The quality of a game is related to the skills of the team that produces that game and the fiction of the game. Unity and Unreal stand out with their features in terms of platform distribution criteria. However, Unreal, Godot, and CryEngine stand out regarding visualization and animation. The high-performance hardware requirements for Unreal Engine and CryEngine should also be considered. A developer with different skills can consider GameMaker and Unreal Engine for their project. When licensing options are considered, the Godot game engine offers complete freedom to the developer (Christopoulou and Xinogalos, 2018; Politowski et al., 2021; Ullmann and Politowski, 2022).

Advantages of Game Engines

Game engines should be able to reduce the need for additional software and resources as much as possible by combining many functions and tools. In these aspects, game engines have made game producers' work easy. The advantages provided by game engines can be listed as follows:

- Reduces costs,
- Reduces the time needed for development and updating,

- Reduces the amount of human labor needed,
- Reusable components facilitate scalability in game projects,
- A single project can output games for multiple different platforms such as game consoles, personal computers, and portable devices,
- Objects simplify the management of overlay elements, such as different fonts and materials,
- It facilitates centralized project management and teamwork.

Modern game engines like Unity support version management tools like Git and SVN (Subversion) for project management. This makes it easier to work on different versions of the project, and it also makes it easier to track who from the team has made which updates. Today, more than 100 game engines are used for commercial and educational purposes, and their licensing, cost, and performance can be evaluated separately. Here, the game engine can be preferred by considering the game to be designed and the user's scale. For example, while Godot is sufficient for a game that can be realized with a 2D scene, Unreal Engine may make the development process difficult for such an application. In addition, the ability to output for multiple platforms may make a game engine preferable. Transferring a developed application to a different medium can become challenging, such as bringing together software and hardware resources with different architectures. For example, the need for a MacOS operating system to output an iOS version of a game or the development of a DirectX version of an OpenGL-based game. Game engines also facilitate the management of the game's assets during the design phase and the loading and unloading of these assets into memory while playing the game. For example, a game's textures are compressed to save disk space. From a coding point of view, reading textures from disk, unpacking them in memory, transferring them to the stage, discarding current surfaces, and fetching new ones during transitions between game levels can be very time-consuming. In addition, separate functions need to be used for an OpenGL- and a DirectX-based workflow, which again means a challenging workload for the designer (Vohera et al., 2021).

Chapter Summary

Today's games can be considered unique software that appeals to people of all ages and has become a means of entertainment and socialization. The gaming industry has become a vast sector, especially with the widespread use of mobile devices. Games, like ordinary computer software, had to be developed through a laborious process. However, game development teams were in dire need of employees who were also experienced in software. However, this situation started to change when ID Software used the term game engine for the game development software they used for the company while developing the game DOOM, which was released in 1993. Epic Games followed ID Software in this regard and licensed the Unreal Game Engine they created for the Unreal tournament to other game development companies, paving the way for new games. Game engines have evolved with the revolutionary developments in computer hardware, especially graphics cards, and have become much easier to use. Today, even users who are not experienced in software can use game engines to create the games of their dreams. Game engines today offer many software libraries to designers under a single roof, especially in terms of graphics engines and physics engines. In addition, outputting a single game project to multiple hardware and software platforms such as personal computers, portable phones, and game consoles has significantly reduced

game design and update times. Considering that even ordinary computer software requires different tools, libraries, hardware, and programming languages for other platforms, it is easy to understand why game engines have become indispensable in the game world. Thanks to game engines, game developers have started to produce high-level games by focusing on the game idea rather than laborious processes. This chapter introduces game engines and explains how game engines emerged. Then, essential game components and how a game loop works are presented. Then, the features of game engines and the advantages they provide are also mentioned, and finally, popular game engines are discussed, and a general evaluation of game engines is made. During the scenario of the game and the type of game, it addresses affect the choice of the game engine, it should not be forgotten that behind the quality of the game is the team that develops it.

References

Bradfield, C. (2018). *Godot Engine Game Development Projects : Build five cross-platform 2D and 3D games with Godot 3.0* (p. 298). Packt Publishing.

Christopoulou, E., & Xinogalos, S. (2017). Overview and Comparative Analysis of Game Engines for Desktop and Mobile Devices. *International Journal of Serious Games*, 4(4), 21–36. doi:10.17083/ijsg.v4i4.194

Gregory, J., & Lemarchand, R. (2014). *Game Engine Architecture*: SECOND EDITION (1st ed., pp. 1–991). doi:10.1201/9781315106946

Joselli, M., Zamith, M., Clua, E., Montenegro, A., Leal-Toledo, R., Conci, A., … Feijó, B. (2009). An adaptative game loop architecture with automatic distribution of tasks between CPU and GPU. *Computers in Entertainment*, 7(4). doi:10.1145/1658866.1658869

Jungherr, A., & Schlarb, D. B. (2022). The Extended Reach of Game Engine Companies: How Companies Like Epic Games and Unity Technologies Provide Platforms for Extended Reality Applications and the Metaverse. *Social Media and Society*, 8(2). doi:10.1177/20563051221107641

Kaban, A. (2023). Artificial intelligence in education: A science mapping approach. International Journal of Education in Mathematics, Science, and Technology (IJEMST), 11(4), 844-861. https://doi.org/10.46328/ijemst.3368

Lowood, Henry, 2014. Game engines and game history. In: Kinephanos: *History of Games International Conference Proceedings*. pp. 179–198.

Mohebali, A., & Chiew, T. K. (2014). Redefining game engine architecture through concurrency. *Frontiers in Artificial Intelligence and Applications*, 265, 767–782. doi:10.3233/978-1-61499-434-3-767

Politowski, C., Petrillo, F., Montandon, J. E., Valente, M. T., & Guéhéneuc, Y. G. (2021). Are game engines software frameworks? A three-perspective study. *Journal of Systems and Software*, 171, 110846. doi:10.1016/j.jss.2020.110846

Sherrod, A., 2007. Ultimate 3D Game Engine Design & Architecture. In: *Charles River Media game development series*, Charles River Media, ISBN: 9781584504733.

Vohera, C., Chheda, H., Chouhan, D., Desai, A., & Jain, V. (2021). *Game Engine Architecture and Comparative Study of Different Game Engines*. 2021 12th International Conference on Computing Communication and Networking Technologies, ICCCNT 2021, 1–6. doi:10.1109/ICCCNT51525.2021.9579618

Ullmann, G.C., Politowski, C., Guéhéneuc, YG., Petrillo, F. (2022). Game Engine Comparative Anatomy. In: Göbl, B., van der Spek, E., Baalsrud Hauge, J., McCall, R. (eds) *Entertainment Computing – ICEC 2022*.

ICEC 2022. Lecture Notes in Computer Science, vol 13477. Springer, Cham. https://doi.org/10.1007/978-3-031-20212-4_8

Zarrad, N. (2018). Game Engine Solutions In D. Cvetkovic (Ed.), *Simulation and Gaming*. doi:10.5772/intechopen.71429

Author Information

Mehmet Gök

https://orcid.org/0000-0003-1656-5770

Kahramanmaraş İstiklal University

Kahramanmaraş

Turkiye

Contact e-mail: *gokmehmet@outlook.com*

Citation

Gök, M. (2023). Game Engines. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp.60-70). ISTES Organization.

Chapter 7 - Analyzing Digital Game Interface Designs in terms of Visual Communication Design[1]

Kemal Köksal, Meryem Geçimli

Chapter Highlights

- This study based on aesthetic and functional aspects of user-friendly interface and visual communication design.
- Visual quality is essential for a game. Because the gameplay of a game bad form or story does not affect its sales as much as visual design. Visual designs always make the first impression on players.
- When creating a mobile game, the process from the game's idea stage to reaching the user In the process, the software developer and the designer must work together.
- Gaming industry is one of the most natural areas of work for a visual communication designer. In order to analyze game design in terms of visual communication, the conceptual framework and technical terms must first be defined correctly.
- Pre-design preparations directly affect the success of the work. Buttons, text, colors, etc., which we can call the designer's toolbox. The use of vehicles is of great importance. As with all products in the design phase, it is a must to be aware of the basic design principles in game interface designs.

[1] This work was supported by Kahramanmaraş İstiklal University Scientific Research Projects Coordination Unit. Project Number: 2022/3-2 BAP. Project Title: Developing Sustainability Knowledge Level Scale and Sustainability Question Bank

Introduction

The purpose of this introductory section is to provide a brief overview of the topic at hand. The advent of technological advancements in previous years has resulted in divergence across several domains of human existence. The internet and digitization have significantly transformed our routines and lifestyles. Significant information access, sharing, and communication advancements have resulted in rapid transitions. The digitalization process commenced with the advent of Web 1.0, characterized by the passive dissemination of information to users. The development of Web 2.0, which facilitated user engagement through feedback provision and digital content creation, came after this. Currently, there is a growing use of Web 3.0 technology, which can reduce the use of robots in comprehending and interpreting data (Alptekin, 2020, p. 140).

The digital game is a social environment structure that has emerged in the technological period. It encompasses online or offline games, utilizing various devices such as tablets, phones, and computers (Binark et al., 2008). When examining the historical progression of digital games, the initial manifestations encountered are console and video games. The initial digital game to arise and progress in this particular domain is recognized as "Tennis for Two," which is a digital simulation of table tennis.

Figure 1. Spacewar game 1962

Communication

Zıllıoğlu asserts the significance of communication in the human experience, positing that individuals have consistently recognized the necessity to engage in various modes of communication throughout their lives. The notion of communication is intricate, expansive, and varied in nature. Communication can take multiple forms, such as engaging in dialogue with another individual, consuming media through television, newspapers, or literary analysis, adopting specific hairstyles or fashion choices, or even observing ancient cave paintings. Sometimes, one may encounter Anouilh's rendition of Antigone in a theatrical setting, while Citizen Kane may grace the silver

screen. Alternatively, the sensory experience may encompass auditory perception, visual observation, and tactile interaction (Zılloğlu, 2003, p. 1).

According to Taylor (2020), communication mainly involves internal dialogue and occurs only within human cognition. Conversely, interpersonal communication refers to the exchange of information and interaction between individuals whose lives are interdependent and often occur in a dyadic context, such as between couples. Group communication is a phenomenon that takes place when a minimum of three individuals engage in communication to attain a shared objective.

Communication can transmit intended emotions, cognitive processes, and conceptual notions to recipients. During the transfer phase, it is essential to establish a common language and utilize compelling pictures to generate specific circumstances. However, it is crucial to prevent harmful situations that hinder effective communication (Erden & Köksal, 2021).

Using appropriate communication tools enables the effective transmission of the intended message with enhanced clarity and efficiency, reducing the required time. The widely accepted definition of communication is proficient and efficient message transmission.

Digital Game Interface Designs in terms of Visual Communication Design

The digital game is a social environment construct that has emerged in the technological period. It encompasses online or offline games, utilizing various devices such as tablets, phones, and computers (Binark et al., 2008). When examining the historical progression of digital games, the predominant focus lies on console and video games. The initial digital game to arise and progress within this domain is recognized as "Tennis for Two," which is a digital simulation of table tennis.

Nowadays, digital games have notably diversified across several platforms, including personal computers, gaming consoles, online media, and mobile devices. The proliferation of mobile games, in particular, has experienced a significant surge in popularity, particularly within the past decade. Furthermore, in addition to the diversification above, several authorities categorize games based on thematic derivatives rather than the devices they are played on. The previous games are classified into several genres, including action, adventure, sports, racing, role-playing, and strategy games. Furthermore, digital games can be categorized based on the level of player involvement into two distinct groups: single-player and multiplayer (Binark & Bayraktutan, 2008, p. 61).

Figure 2. Super Mario Game

The prevalence of computer games has experienced significant domestic and global growth, mainly due to improvements in mobile platforms and internet technologies. Consequently, computer games have become a prevalent form of entertainment, appealing to diverse demographics irrespective of gender and age.

An effective interface design is crucial for a game. The impact of gameplay quality and narrative content on game sales is less significant than visual design's influence. Visual aesthetics consistently serve as the primary determinant in shaping the initial impression of prospective buyers or players, enabling a game to distinguish itself in the market provided its visual designs are visually appealing. Hence, it is imperative to perceive interface design as an integral and enjoyable element that should not be regarded as a distinct lopment (Fox, 2004, p. 2).

Before embarking on a game's interface design, acquiring knowledge about the design elements, dimensional characteristics, menu designs, color palettes employed, and the intended operating system (Android, iOS, Windows) of games within this domain would be advantageous. It is imperative to consider the mobile devices that will be favored and the distinctions that will be acknowledged. Suppose the design is intended for devices adhering to specific standards, such as the iPhone and iPad. In that case, these devices must possess distinct screen resolutions, color schemes, and button designs.

Rhythm

Rhythm in the visual arts is generated through the systematic recurrence of shapes, colors, and lines. When gaps are consistently repeated between lines, a rhythmic atmosphere is generated. In any artistic endeavor, including rhythm, the emergence of concepts such as equilibrium, significance, and emotion is evident. The spatial segmentation into vertical, horizontal, diagonal, and circular movements constitutes the rhythmic pattern inside the intervening space. According to Yolcu (2009, p. 37), the rhythm of things is established by the collective participation of all objects involved in this motion, creating meaning and mood. The notion of rhythm in interactive graphic design apps effectively arranges the elements inside the user interface and guarantees a smooth flow.

Alignment

Alignment is considered to be a fundamental aspect of interface design. Alignment is a basic idea that facilitates the prompt recognition of the interaction between various elements. Within interface design, the significance of many factors, such as the relationship between the background and text, font, and alignment, becomes increasingly prominent.

Typography

When examining the correlation between visual elements and typography, participants express challenges in establishing a cohesive link between visuals and text. They find the relationship between visual elements and typography inadequate, as the visuals must align with the user's proficiency level. Furthermore, there is a need for improvement in the optical elements, and the typography employed should prioritize clarity and legibility. Additionally, it is observed that the visual elements and text size are often rendered in diminutive proportions (Kum, 2022).

Despite its importance in effectively communicating typographic messages through the combination of many features, readability is a concept that designers frequently ignore. According to Köksal (2014), it is expected that the reader should be able to comprehend written content with minimal exertion and challenge.

According to the definitions above, the meticulous design of gaming interface elements should adhere to fundamental design principles. Typography also plays a crucial role in the creation of interfaces. The appropriate typeface and font size selection should be based on the game's overall aesthetic. In a horror-themed setting, it is advisable to refrain from choosing a plain serif font.

Figure 3. Quake Interface Design

Using capital letters in the Quake interface design improves legibility, and having a background that matches the chosen font is ideal. The utilization of colors is executed in a manner that enhances their harmonious interaction. Using contrasting colors enhances the futuristic ambiance and fosters a sense of cohesion. The utilization of

typography in the design played a significant role in shaping the overall design identity of the game, as it effectively merged form and functionality while maintaining a high level of readability and visual appeal.

Figure 4. Devil May Cry 5 Interface Design

The video game Devil May Cry 5 is characterized by its emphasis on spectacle and the presence of unique and unusual characters. Due to this rationale, the aesthetic elements are intentionally crafted distinctively, with a preference for employing contrasting elements and vibrant hues. The writing style used was appropriate for the game.

Colors

Color is a fundamental element in the realm of design. The utilization of design language in the context of integrity involves the establishment of hierarchy and the elicitation of specific emotional responses. According to Gümüştekin (2013), it is widely accepted that colors significantly impact individuals due to their stimulating capabilities and ability to shape perceptions. It is imperative to use caution to verify the compatibility of colors. The theatrical production's chromatic scheme, narrative, genre, and motif likewise impact the color choices and various other aspects of the design process.

Conclusion

Identifying critical considerations for game interface design should be conducted by fundamental visual design principles, considering the industry's specific requirements. It is imperative to ascertain the genre and setting of the game before commencing the design process.

Interface designs incorporate several indicators that characterize the game's distinct elements and functionalities. Moreover, the game's visually captivating digital interface designs have the potential to pique the player's curiosity and generate a desire to engage with the game. Acknowledging that interface designs that effectively eradicate mediocrity will possess a distinct advantage is vital. Interface designs, intended to facilitate efficient visual

communication, influence the user's game choice through colors and typography. Interface designs have a crucial role as a communication medium in advertising games. The interface designs utilized in digital games serve as the primary means of visual communication within the game.

Chapter Summary

Interface designs play a crucial role as a communication tool in the promotion of games. The interface designs in digital games serve as the visual output of the game and function as a visual communication tool that impacts the intended audience. Interface designs encompass various components, including text, color, imagery, and layout. The analysis of these components is crucial to comprehending the design capabilities of the video game business and how interface design is integrated with the game. The visual communication designer is responsible for making vital decisions regarding the positioning and typography of various optical elements to avoid obstructing the primary focal point. The game's design also shapes its visual aesthetics, setting it apart from other games and subtly impacting the player's emotional disposition. The proliferation of mobile gaming has resulted in an increasing number of individuals engaging in this form of entertainment, thereby establishing it as a prominent choice in everyday recreational activities. The practical implementation of designs in emerging media technology within the context of mobile games has resulted in a progressively more user-friendly gaming experience. This study aims to elucidate the correlation between visual communication design and the interface designs of renowned and prosperous video games.

References

Alptekin, Z. M. (2020). Dijitalleşme ve dijital sosyal sorumluluk iletişimi. *Uluslararası Medya ve İletişim Araştırmaları Hakemli Dergisi* (MEDIAJ), 3 (2), 136-155.

Binark, M. ve Bayraktutan-Sütçü (2008).Kültür Endüstrisi Olarak Dijital Oyun. İstanbul: *Kalkedon Yayıncılık.*

Erden N. K., Köksal K. Sanat ve İletişim Örneklemi: Pandemi Sürecinde Sağlık Bakanlığı Tarafından Yapılan Afişlerin Oluşturulma Biçimlerinin İletişimsel Sürece Etkileri, *Ankara Gece Kitaplığı*, Ankara

Ellis K, Kara V, Nore C, et al. (2008). Beyond the aww factor: human interest profiles of paralympian's and the media navigation of physical difference and social stigma. *Asia Pacific Media Educator* 19(2), 23-33.

Fox, B. (2004). Game Interface Design, *Course Technology PTR*, Boston.

Gümüştekin, N. (2013). Rengin Bir Grafik Tasarım Ürünü Olarak Afişe Katkısı: Tarihsel Bir İnceleme . Yedi , (9) 35-50 . Retrieved from *https://dergipark.org.tr*/tr/pub/yedi/issue/21842/234838

Köksal, K. (2014). *Türkiye'deki Kültürel Afişlerin Tipografik Açıdan İncelenmesi* (Master's thesis, İstanbul Arel Üniversitesi Sosyal Bilimler Enstitüsü).

Kum,Ö (2022). "Görsel İletişim Tasarımı Açısından Erbaa Özel Eğitim Uygulama Okulu Sosyal Beceriler 1. Kademe Ders Kitabı'nın İncelenmesi'' 17(4), 611-627. Doi: 10.47356/*TurkishStudies*.

Taylor, S. (2000). Essential communication skills: The ultimate guide to successful business communication. Boston*: Pearson Educational*.

Zıllıoğlu, M. (2003). İletişim Nedir? İstanbul: *Cem Yayınevi*

Author Information

Kemal Köksal

https://orcid.org/0000-0002-1883-4674

Kahramanmaraş İstiklal University

Kahramanmaraş

Turkiye

Contact e-mail: *kemall.koksal86@gmail.com*

Meryem Geçimli

https://orcid.org/0000-0002-1776-1936

Kahramanmaraş İstiklal University

Kahramanmaraş

Turkiye

Contact e-mail: *meryem.gecimli@istiklal.edu.tr*

Citation

Köksal, K. & Geçimli, M. (2023). Analyzing Digital Game Interface Designs in terms of Visual Communication Design. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp.71 -78). ISTES Organization.

Chapter 8 – Gamification in Education

Abdullatif Kaban

Chapter Highlights

- Gamification is the integration of game design elements into educational activities.
- The goal of gamification is to enhance student involvement, motivation, and learning outcomes.
- Gamification tools and platforms have been used in various industries, including healthcare, education, e-commerce, and online content.
- When designing gamified learning experiences, it is crucial to consider learners' psychological needs, ensure the congruence between game design features and educational material, and prioritize attaining learning objectives.
- Digital platforms such as Kahoot, Quizizz, and Socrative are commonly used to foster active student participation and enhance the efficacy of academic endeavors.
- Gamification is expected to play a more critical role in the future and make the student experience more effective.

Introduction

Some limiting aspects of traditional educational methods have led educators and experts researching this field to search for ways to make learning processes more effective, engaging, and participatory. In this context, gamification in education stands out as an approach that has emerged to increase student participation and motivation, convey information more immersive, and make the learning experience more enjoyable. Gamification has attracted much attention, especially in academic and applied fields, and is based on integrating game elements and design principles into learning processes. Research shows how gamification can influence motivational factors and psychological states. Furthermore, according to service marketing theory, gamification can reflect service systems' operant and performative components. Gamification involves applying game elements and game design principles in non-game contexts, such as education, to students' motivation and achievement of learning goals (Chugh & Turnbull, 2023; Huotari & Hamari, 2016).

The concept of gamification encompasses a range of interpretations among scholars, although it predominantly revolves around the augmentation of tasks with game-like elements. According to Huotari and Hamari (2016), gamification is a method that enhances motivation and psychological states. There is likewise a contention that gamification ought to be understood within the framework of service marketing theory. According to Huotari and Hamari (2016), games may be seen as representations of service systems that encompass both performative and non-performative resources. Within the field of education, gamification has been acknowledged as a potent instrument for enhancing student engagement and motivation. According to Aras and Can (2023), educators can enhance student engagement and participation by integrating game components, such as points, badges, leaderboards, and challenges, into the educational setting. Utilizing a game-like structure in educational settings can enhance students' motivation since it is more probable that they will engage actively in the learning process. According to Aras and Can (2023), gamification possesses the capacity to enhance information retention and foster the acquisition of practical skills, including problem-solving, cooperation, and communication.

In addition, gamification has proven to be efficacious across several educational domains. For instance, its efficacy has been demonstrated in several academic disciplines, including mathematics, language acquisition, physical education, and computer programming. Implementing gamification in several fields has been found to enhance educational achievements and foster more student involvement (Chugh & Turnbull, 2023). Furthermore, there is evidence of using gamification in medical education to strengthen information acquisition, clinical abilities, and decision-making (Bigdeli et al., 2023).

The emergence of gamification may be attributed to the early 2010s, a period in which the term "gamification" garnered extensive acknowledgment in mainstream discussions (Dichev & Dicheva, 2017). Gamification integrates game design features and mechanics into situations that are not inherently game-related to enhance user engagement, motivation, and behavior (Huotari & Hamari, 2016). The subject has attracted considerable attention in academic and industrial spheres because it can enable better comprehension, induce changes in behavior, promote friendly competition, and foster collaboration across a wide range of domains (Dichev & Dicheva, 2017).

Within education, there has been extensive scholarly exploration of gamification as a strategy to enhance student motivation and engagement. This approach has been implemented in various educational contexts, spanning higher education and K–12 settings, to enrich the learning experience and achieve positive academic outcomes (Dichev & Dicheva, 2017). According to Moseikina et al. (2022), gamified learning has consistently maintained students' engagement with the subject matter and has yielded favorable results for their overall growth and progress. According to Serrano (2023), there has been an improvement in students' perspectives on art and heritage.

Gamification is a conceptual framework that effortlessly incorporates game components and ideas into non-gaming environments, including education. This phenomenon can promote motivation, engagement, and learning results. Game components like points, badges, and challenges can improve learning. This method has improved information retention and practical skill development across academic fields. Gamification has the potential to improve education and encourage active learning.

The Theoretical Framework of Gamification

The integration of gaming aspects into educational procedures, known as gamification in education, aims to enhance the effectiveness and engagement of the learning experience. This particular methodology can improve student involvement, motivation, and academic achievements. Several theoretical frameworks support the main ideas of gamification. These ideas encompass various topics, including enhancing students' intrinsic desire, facilitating the flow experience, highlighting the significance of defining specific goals, and recognizing the value of social relationships. The Self-Determination Theory (SDT) emphasizes generating motivating experiences by considering individuals' autonomy, competence, and connection requirements. In contrast, flow theory seeks to facilitate profound involvement and attention; the idea of goal-setting posits that explicit and demanding objectives can enhance an individual's level of motivation. Conversely, the Social Influence Theory highlights social interactions' significant role in shaping an individual's behavior and attitudes. Cognitive load theory is centered around optimizing the learning process through minimizing mental effort, whereas narrative theory explores the capacity of tales to offer contextualization. The Pleasurable Experiences (Hedonic) Hypothesis ultimately seeks to enhance participation by promoting good feelings. This paper aims to investigate the theoretical foundations that support the implementation of gamification in educational settings and its potential to improve the overall learning process.

Self-Determination Theory (SDT)

Self-determination theory (SDT) stresses internal motivation. It explores how people's psychological desires for autonomy, competence, and relatedness motivate them. Gamification may meet these needs by providing a variety of alternatives, challenges, and ways to interact that motivate people.

Flow Theory

When people are entirely immersed in an activity, they are in flow. Gamification creates flow by matching work difficulty to skill level. This balance maintains motivation and engagement.

Goal Setting Theory

This theoretical viewpoint suggests that specific and challenging goals might boost motivation and performance. Gamification allows users to set goals, activities, and missions.

Social Interaction Theory

Social relationships and influence motivate people. Gamification uses leaderboards, tournaments, and collaborative activities to capitalize on humans' natural need for social recognition and connection.

Cognitive Load Theory

This idea concerns cognitive effort required for information processing. Gamification reduces cognitive load by presenting information in a clear, organised, and easily understandable manner to increase user engagement.

Narrative Theory

Gamified experiences are contextualized and meaningful by using stories. A fascinating story can boost user relevance and engagement throughout an activity.

Hedonic Motivation Theory

Gamification is a concept rooted in positive psychology, with a primary emphasis on creating pleasurable and entertaining experiences. Factors such as surprise, novelty, and pleasant emotions have been found to enhance levels of engagement.

Figure. 1 Gamification Theories

Elements of Gamification

The concept of gamification entails the utilization of game design features and ideas in situations that are not inherently game-related, aiming to capture and stimulate individuals. Table 1 presents a compilation of essential aspects often utilized in gamification.

Table 1. Key Elements of Gamification

Elements of Gamification	Description
Goals and Objectives	Clearly defined goals and objectives provide direction and purpose for participants.
Points	Accumulating points for completing tasks or reaching milestones can encourage participation.
Badges and Achievements	Rewarding digital badges or achievements acknowledges accomplishments and encourages continued engagement.
Levels	Moving through the levels means progression and mastery, providing a sense of achievement.
Leaderboards	Publicly displayed rankings create competition and increase engagement through comparison.
Challenges	Setting challenges or tasks motivates participants to act and overcome obstacles.
Awards	Tangible or intangible rewards such as discounts, virtual goods, or recognition can increase motivation.
Feedback	Regular feedback keeps participants informed about their progress and encourages improvement.
Narrative or Storytelling	Creating a narrative or story increases engagement by drawing participants into an engaging context.
Competition	Healthy competition increases participation by encouraging participants to outperform others.
Cooperation	Collaborative activities foster a sense of community and teamwork among participants.
Customization	Allowing participants to personalize their experience can increase engagement by giving a sense of ownership.
Progress	Progressing from more straightforward to more complex tasks sustains engagement by offering new challenges.
Instant Satisfaction	Providing quick rewards or acknowledgments for actions encourages continued engagement.
Social Interaction	Integrating social features allows participants to interact, share successes, and collaborate.
Time Pressure	Adding time-based challenges or limited-duration activities can create a sense of urgency and engagement.
Mystery and Surprise	The inclusion of unexpected elements or rewards maintains excitement and curiosity.
Clear Rules and Instructions	Clearly defined rules and instructions ensure clarity and satisfaction.
Feedback Loop	A continuous cycle of action, feedback, and improvement keeps participants engaged.
Progress Tracking	Allowing participants to track their progress visually reinforces their success.
Avatars or Characters	Allowing participants to represent themselves through avatars or characters adds a personal touch.
Virtual Economies	Virtual currencies or economies can encourage behaviors that are desirable to implement.
Real World Impact	Showing how in-game actions translate into real-world impact can motivate participants.
Challenge Scaling	Ensuring that challenges are scaled appropriately to the participant's skill level prevents discouragement.

Benefits of Gamification in Education

Using gamification in education is a novel and progressive strategy that surpasses conventional ways of instruction to enhance student motivation and engagement more effectively. Despite the numerous benefits of this technique, enhancing student engagement is one of the most significant advantages of using gamification in education. According to Barata et al. (2013), the integration of gamification into university-level courses has significantly improved student engagement. This boost allows students to interact more actively with course content, improving learning outcomes and reducing grade disparities among students. The primary advantage of gamification in education lies in its ability to enhance the learning experience by promoting student engagement and collaboration within the educational environment.

Gamification in schools boosts student motivation. According to Barata et al. (2013), game design components like experience points, levels, badges, challenges, and leaderboards encourage student involvement in learning. This excitement boosts effort and perseverance, improving academic success. Gamification tactics also improve knowledge acquisition attitudes and educational satisfaction (Dichev & Dicheva, 2017). Gamification can also improve pupils' cognitive capabilities and critical thinking. Gamification in science education increases students' skills, knowledge, and perception of scientific issues, according to Alahmari et al. (2023). It also improves pupils' critical thinking and problem-solving. Gamification also encourages student collaboration and socialization. Leaderboards and multiplayer challenges in gamification promote student collaboration and friendly rivalry, which improves collaboration and communication skills, according to Dichev and Dicheva (2017).

Gamification in education has shown encouraging outcomes, but more study is needed to prove its advantages. Dichev and Dicheva (2017) emphasize the need for well-structured research and thorough testing to prove gamification's educational benefits. Alahmari et al. (2023) also stress the need for more study on unexplored gamification topics. Gamification improves student engagement, motivation, academic achievement, cognitive capacities, and interpersonal communication. More research is needed to determine the long-term advantages of gamification in education.

Gamified Learning Experience Design

Developing gamified learning experiences entails integrating game design components and principles into educational activities to enhance engagement, motivation, and learning outcomes (Sailer & Sailer, 2020). Using gamification in education has garnered significant interest due to its perceived ability to enhance student engagement and academic achievement. A crucial component in developing gamified learning experiences is carefully selecting and seamlessly integrating game design features. According to Sailer and Sailer (2020), incorporating elements like points, leaderboards, and badges may foster a competitive environment, promote a feeling of accomplishment, and facilitate advancement, enhancing students' motivation to actively engage in the educational journey. Sailer and Sailer (2020) asserted that using gamified classroom activities, such as graded quizzes and team leaderboards, favorably impacts students' intrinsic motivation and social interactions.

In addition, the development of gamified learning experiences must consider students' psychological demands, including but not limited to competence, autonomy, and relatedness. By meeting these needs, gamified learning experiences can create a meaningful and engaging learning environment, emphasizing the importance of integrating gamified learning design with pedagogical principles to achieve a "meaningful gamification" experience (Tsay et al., 2019). This integration can overcome novelty by helping recruit users and sustaining their commitment to the gamified learning system (Tsay et al., 2019).

Another important consideration in designing gamified learning experiences is aligning instructional content with game design elements. Effective instructional content is a prerequisite for successful gamification because gamification should enhance instruction rather than replace it (Sailer & Sailer, 2020). Gamified learning theory suggests that behaviors and attitudes influenced by game design elements can affect learning outcomes. Therefore, the selection and design of game elements should be aligned with learning objectives and content to maximize their effectiveness (Sailer & Sailer, 2020).

In summary, designing gamified learning experiences involves integrating game design elements, considering the psychological needs of learners, aligning instructional content with game elements, and addressing the novelty effect. By carefully designing and implementing gamified learning experiences, educators can create engaging and motivating learning environments that increase student engagement and improve learning outcomes.

Gamification Tools and Platforms

Gamification tools and platforms have attracted much attention in healthcare, education, e-commerce, crowdfunding, and online content platforms. Gamification uses game elements and mechanics in non-game contexts to increase user engagement, motivation, and behavior change (Dithmer et al., 2016). Integrating game dynamics such as rewards, challenges, competition, and feedback into programs and platforms forms the basis of this approach (Kusumawardani et al., 2023). From education to healthcare to software development, gamification tools and platforms are increasingly adopted to increase motivation, engagement, and learning outcomes. Gamification uses game elements and mechanics in non-game contexts to motivate and engage users (Gafni et al., 2018). Especially in education, gamification has positively affected student engagement and learning outcomes. Data from schools in Hong Kong show that multifaceted gamification approaches are more feasible and practical than rigid gamification strategies (Lam & Tse, 2022).

Choosing appropriate resources, such as software-based tools or platforms, is crucial for gamification success. General-purpose gamification platforms provide an off-the-shelf solution for implementing gamification, while self-built solutions offer customization and flexibility to meet specific needs (Trinidad-Fernández et al., 2021). Self-built solutions require a high level of knowledge and understanding of gamification design and technologies but offer greater control and interoperability (Trinidad-Fernández et al., 2021).

Kahoot

Kahoot! one of the popular gamification platforms, is widely used in educational settings. Neureiter et al. (2020) evaluated the applicability of Kahoot! as a real-time assessment tool in (histo-)pathology classroom teaching. They found that gamification elements such as quizzes and leaderboards increased student engagement and motivation. Similarly, Gafni et al. (2018) examined the effects of gamification elements in e-learning platforms and discovered that rewards and hints in a gamified platform increased students' motivation and engagement. In addition, Gafni et al. (2018) have devised an e-learning platform incorporating gamification components and another platform that does not include such features. The researchers discovered that the cohort utilizing the gamified platform exhibited elevated levels of enthusiasm toward the learning process and sustained engagement in learning activities after the completion of the event.

Kahoot is an educational tool that leverages game-based mechanics to promote student engagement and facilitate effective teaching and learning practices in academic environments. This web-based platform is designed to empower educators by creating interactive quizzes, polls, and discussions, all geared toward engaging students who can conveniently participate using their devices. According to a study by Licorish et al. (2018), Kahoot positively impacted several aspects of the classroom environment, including dynamics, engagement, motivation, and the overall learning experience.

Licorish, (2018) et al. examined Kahoot's impact on learning and teaching. Kahoot dramatically boosted classroom instruction, according to their research. The study focused on improvements in classroom dynamics, student involvement, motivation, and learning experience. Educational games like Kahoot! Reduce distractions and improve teaching and learning compared to traditional classroom methods. This study shows that gamification can enhance learning.

In another study, Ismail et al. (2019) examined the benefits of Kahoot for medical education formative evaluation. The research shows that Kahoot sessions boost student interest, subject identification, and knowledge recognition. The study praised Kahoot's interactivity and student involvement. It also highlighted Kahoot's active learning and student engagement elements. According to Ismail et al. (2019) focus group talks, students liked Kahoot because it was inclusive and engaged. This study shows that students regard Kahoot as an interesting instructional tool that supports and motivates medical students.

Kahoot uses game-based aspects to boost student reactions, classroom dynamics, engagement, motivation, and learning. This method promotes active learning, student engagement, and formative assessment. Its interactivity and ability to excite pupils make it useful in mathematics and medical instruction (Ismail et al., 2019; Licorish, 2018).

Quizizz

Quizizz, an extensively utilized web-based educational platform, is efficiently employed for instruction and knowledge acquisition. This gamified platform allows teachers to generate interactive quizzes, surveys, and

student evaluations. It is well recognized for its efficacy, practicality, user-friendliness, and capacity to inspire student engagement. According to Lim and Yunus (2021), Quizizz offers a user-friendly framework suitable for instructors and students, facilitating widespread adoption due to its accessibility and cost-free nature.

The excellent perception of Quizizz is particularly evident among instructors, who recognize its numerous advantages. The reason for this might be attributed to its efficacy in actively involving pupils and assessing their level of comprehension. According to Lim and Yunus (2021), including timed quizzes, leaderboards, and quick feedback in educational settings enhances engagement, fostering a more engaging and enjoyable learning experience. According to Amornchewin (2018), Quizizz offers a platform that enables students to engage in self-directed learning at their own pace.

The tool's adaptability also presents a notable benefit. The internet accessibility of the platform facilitates its utilization by educators since it eliminates the necessity for tangible instructional materials or resources. According to Lim and Yunus (2021), teachers and students must have a reliable internet connection to engage in Quizizz sessions actively. Even with this stipulation, educators in diverse educational environments have extensively embraced Quizizz (Lim & Yunus, 2021).

Recent research has demonstrated the beneficial impact of Quizizz on students' academic achievements. An investigation conducted by Henukh et al. (2022) examined the effects of utilizing Quizizz as a learning tool on the acquisition of fundamental physics concepts amidst the COVID-19 pandemic. The study revealed that the implementation of Quizizz had a beneficial influence on learning outcomes and student engagement.

Quizizz is a frequently utilized web-based platform for creating interactive quizzes and exams. Teachers are widely acknowledged for their significant impact on education, owing to their practicality and ability to inspire pupils. Furthermore, it has been empirically demonstrated that Quizizz positively affects student learning results and engagement across many academic disciplines and educational environments. To effectively include Quizizz in educational practices, it is imperative to ensure the availability of a dependable internet connection.

Quizizz, an extensively utilized web-based educational platform, is efficiently employed for instruction and knowledge acquisition. This gamified platform allows teachers to generate interactive quizzes, surveys, and student evaluations. It is well recognized for its efficacy, practicality, user-friendliness, and capacity to inspire student engagement. According to Lim and Yunus (2021), Quizizz offers a user-friendly framework suitable for instructors and students, facilitating widespread adoption due to its accessibility and cost-free nature.

The excellent perception of Quizizz is particularly evident among instructors, who recognize its numerous advantages. The reason for this might be attributed to its efficacy in actively involving pupils and assessing their level of comprehension. According to Lim and Yunus (2021), including timed quizzes, leaderboards, and quick feedback in educational settings enhances engagement, fostering a more engaging and enjoyable learning experience. According to Amornchewin (2018), Quizizz offers a platform that enables students to engage in self-directed learning at their own pace.

The tool's adaptability also presents a notable benefit. The internet accessibility of the platform facilitates its utilization by educators since it prevents the necessity for tangible instructional materials or resources. According to Lim and Yunus (2021), teachers and students must have a reliable internet connection to engage in Quizizz sessions actively. Even with this stipulation, educators in diverse educational environments have extensively embraced Quizizz (Lim & Yunus, 2021).

Recent research has demonstrated the beneficial impact of Quizizz on students' academic achievements. An investigation conducted by Henukh et al. (2022) examined the effects of utilizing Quizizz as a learning tool on the acquisition of fundamental physics concepts amidst the COVID-19 pandemic. The study revealed that the implementation of Quizizz had a beneficial influence on learning outcomes and student engagement.

Web-based Quizizz is famous for developing interactive quizzes and exams. Teachers significantly affect education due to their pragmatism and ability to motivate pupils. Scientific evidence also shows that Quizlet improves student learning and engagement across academic topics and locations. To integrate Quizizz into educational activities, a good internet connection is essential.

Socrative

Socrative can engage students, test proficiency, and promote active learning. The platform's gamification, user-friendliness, and capacity to engage students make it worthwhile for educators. Socrative is an online platform for educators to generate enjoyable student activities and assessments, according to Christianson (2020). Mohamad et al. (2019) say this web-based platform helps students participate in class. Florenthal (2018) also highlights Socrative's gamification tools, which boost student motivation and engagement. Florenthal (2018) noted that Socrative's gamification function effectively assesses students' ethical, environmental, and professional responsibilities.

According to Ali (2022), empirical evidence suggests that using Socrative positively impacts students' reading comprehension abilities and engagement with online literature. Implementing a gamified interactive learning environment has enhanced students' desire and inclination to participate in reading and varied learning activities. For formative evaluation, online platforms, such as Socrative, are extensively employed in medical education. According to Ali (2022), students prefer Socrative over traditional student response system approaches, which can help improve collaborative learning.

Socrative is widely acknowledged as a powerful instrument for promptly and efficiently evaluating learning outcomes in formative assessment. According to Afrizal et al. (2020), using this tool in classroom instruction facilitates teachers' work by simplifying the comprehension of questions and enhancing student involvement. Students widely regard Socrative as a tool that enhances the validity of assessments and improves academic outcomes. According to Suryani and Fauziati (2022), Socrative is an educational approach that focuses on developing targeted skills and practices based on competency.

In general, gamification technologies and platforms can enhance motivation, engagement, and learning outcomes across several domains. These systems offer an engaging and functional educational experience by integrating gamification components, including incentives, assessments, rankings, and contests.

In summary, gamification tools and platforms have considerable promise across several domains, including healthcare, education, e-commerce, crowdfunding, and online content platforms. This methodology integrates gaming aspects and mechanics to enhance student engagement, motivation, and behavioral modification. The careful selection of suitable resources and the proficient utilization of software-based solutions are imperative for the proper execution of a task or project. Simultaneously, more investigation is required to comprehend how the potential of gamification might be expanded to encompass diverse fields and platforms, including mobile apps.

Gamification and Future Trends

Using gamification in education is a rapidly growing strategy to improve student motivation, engagement, and academic performance by incorporating game elements into the educational experience. Recent research indicates that the implementation of adaptive gamification, customized to meet the unique needs of individual learners, has demonstrated significant advantages in enhancing learning outcomes. Nevertheless, additional empirical research is necessary to quantify and evaluate the impact of gamification elements on the educational process (Alhammad & Moreno, 2018).

The domain of gamification has considerable promise in the context of software engineering education. According to Alhammad and Moreno (2018), this technique facilitates enhanced learning processes and outcomes and provides student support and motivation. Similarly, the implementation of gamification in science education has been found to impact students' motivation to engage in science learning favorably. However, the impact of specific game elements on intrinsic and extrinsic motivation is still controversial and needs further research (Hursen & Bas, 2019).

In language learning, gamification is promising to increase engagement (Thurairasu, 2022). By integrating game elements into language learning environments, gamification can improve academic achievement and make the language learning process more effective. Supporters of gamification emphasize that this approach strengthens critical skills such as problem-solving, collaboration, and communication and encourages active participation in the learning process (Thurairasu, 2022).

The use of gamification in higher education is also rapidly expanding. Research shows that it positively affects students' learning experience and increases their achievement (Naseri et al., 2023). As students' interest in technology increases, implementing innovative educational approaches such as gamification becomes easier. At the same time, gamification can potentially increase students' motivation and learning engagement, which may lead to more gamification of academic education in the future (Dečman & Rep, 2022).

In conclusion, gamification in education and future trends include the continuous research and implementation of adaptive gamification, the evaluation of the impact of gamification elements on the learning process, and the mainstreaming of gamification in different educational disciplines. With the advancement of technology, gamification is expected to play an even more critical role in education, increasing student motivation, engagement, and performance.

Chapter Summary

The concept of gamification in education is the integration of game design aspects into educational activities to enhance the effectiveness and engagement of learning experiences. This strategy aims to enhance student involvement, motivation, and learning results. Gamification tools and platforms have garnered significant attention across several industries, including healthcare, education, e-commerce, and online content platforms. The objective of gamification is to actively involve learners by including game elements such as incentives, obstacles, rivalry, and constructive criticism.

In building gamified learning experiences, it is essential to consider learners' psychological requirements, ensure the congruence between game design features and educational material, and prioritize attaining learning objectives. To foster active participation among students and enhance the efficacy of academic endeavors, digital platforms such as Kahoot and Quizizz are commonly employed. These platforms serve as valuable tools that may augment the educational process by enabling students to generate interactive quizzes, surveys, and conversations. Gamification trends will probably assume a crucial function in the forthcoming years. Further research is required to explore the effects of adaptive gamification on learning outcomes and expand its use across other educational domains. Increased technological advancements have led to a greater possibility for gamification to enhance student motivation, engagement, and academic success. The anticipated proliferation of gamification in domains such as language acquisition is contingent upon the escalation of students' degrees of interest.

Gamification in education involves using game design elements to enhance learning experiences. The effectiveness of gamification in increasing student motivation, engagement, and learning outcomes is supported by many studies. This approach is expected to play a more critical role in the future and make the student experience more effective.

References

Afrizal, J., Ahmad, A., & Safitri, A. (2020). Students' Perception of Using Socrative in Learning Grammar at the English Study Program of FKIP UIR: A Case Study at the Second Year Students. *J-SHMIC: Journal of English for Academic*, *7*(2), 31-40. https://doi.org/10.25299/jshmic.2020.vol7(2).5289

Alahmari, M., Jdaitawi, M. T., Rasheed, A., Abduljawad, R., Hussein, E., Alzahrani, M., & Awad, N. (2023). Trends and Gaps in Empirical Research on Gamification in Science Education: A Systematic Review of the Literature. *Contemporary Educational Technology*, *15*(3), ep431.

https://doi.org/10.30935/cedtech/13177

Alhammad, M. M., & Moreno, A. M. (2018). Gamification in Software Engineering Education: A Systematic Mapping. *Journal of Systems and Software*, 141, 131-150. https://doi.org/10.1016/j.jss.2018.03.065

Ali, H. A. (2022). Using Socrative SRS- Based Assessment to Improve EFL Reading Comprehension Skills of Online Texts for University Students and Their Engagement. *Journal of Reading and Knowledge* 250*(22).* https://doi.org/10.21608/mrk.2022.260486

Amornchewin, R. (2018). The Development of SQL Language Skills in Data Definition and Data Manipulation Languages Using Exercises with Quizizz for Students' Learning Engagement. *Indonesian Journal of Informatics Education*, *2*(2), 85-90. https://doi.org/10.20961/ijie.v2i2.24430

Aras, T., & Can, A. A. (2023). A Study on Educational Software Development Through Gamification in Guitar Education. *Turkish Journal of Education, 12*(1), 1-27. https://doi.org/10.19128/turje.1162940

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2013, October). Improving participation and learning with gamification. In *Proceedings of the First International Conference on gameful design, research, and applications* (pp. 10-17). https://doi.org/10.1145/2583008.2583010

Bigdeli, S., Hosseinzadeh, Z., Dehnad, A., Sohrabi, Z., Aalaa, M., Haghani, F., & Atlasi, R. (2023). Underpinning Learning Theories of Medical Educational Games: A Scoping Review. *Medical Journal of the Islamic Republic of Iran*, 37. https://doi.org/10.47176/mjiri.37.26

Christianson, A. M. (2020). Using socrative online polls for active learning in the remote classroom. *Journal of Chemical Education*, *97*(9), 2701-2705.

Chugh, R., & Turnbull, D. (2023). Gamification in Education: A Citation Network Analysis Using CitNetExplorer. *Contemporary Educational Technology*, *15*(2), ep405. https://doi.org/10.30935/cedtech/12863

Dečman, N., & Rep, A. (2022). Who Is More Eager to Use Gamification in Economic Disciplines? Comparison of Students and Educators. *Business Systems Research Journal, 13*(2), *96-116.* https://doi.org/10.2478/bsrj-2022-0017

Dichev, C., & Dicheva, D. (2017). Gamifying Education: What Is Known, What Is Believed and What Remains Uncertain: A Critical Review. *International Journal of Educational Technology in Higher Education*, *14*(1), *1-36*. https://doi.org/10.1186/s41239-017-0042-5

Dithmer, M., Rasmussen, J. B., Grönvall, E., Dinesen, B., Hansen, J. H. L., Nielsen, G., Sørensen, S. B., & Dinesen, B. (2016). "The Heart Game": Using Gamification as Part of a Telerehabilitation Program for Heart Patients. *Games for Health Journal*, *5*(1), 27-33. https://doi.org/10.1089/g4h.2015.0001

Florenthal, B. (2018). Student perceptions of and satisfaction with mobile polling technology: An exploratory study. *Journal for Advancement of Marketing Education*, *26*(2), 44-57.

Gafni, R., Achituv, D. B., Eidelman, S., & Chatsky, T. (2018). The Effects of Gamification Elements in E-Learning Platforms. *Online Journal of Applied Knowledge Management*, *6*(2),37-53 https://doi.org/10.36965/ojakm.2018.

Henukh, A., Astra, I. M., Reski, A., & Hidayatullah, M. M. S. (2022, July). The Effectiveness of Using Quizizz in Fundamental Physics Learning in the Era of the Covid-19 Pandemic. In *Journal of Physics: Conference Series* (Vol. 2309, No. 1, p. 012054). IOP Publishing. https://doi.org/10.1088/1742-6596/2309/1/012054

Huotari, K., & Hamari, J. (2016). A Definition for Gamification: Anchoring Gamification in the Service

Marketing Literature. *Electronic Markets, 27*(1), 21-31. https://doi.org/10.1007/s12525-015-0212-z

Hursen, C., & Bas, C. (2019). Use of Gamification Applications in Science Education. *International Journal of Emerging Technologies in Learning*, *14*(1), 4. https://doi.org/10.3991/ijet.v14i01.8894

Ismail, M. Z., Ahmad, A., Mohammad, J. A.-M., Fakri, N. M. R. M., Nor, M. R. M., & Pa, M. N. M. (2019). Using Kahoot! As a Formative Assessment Tool in Medical Education: A Phenomenological Study. *BMC Medical Education, 19*(1), *1-8.* https://doi.org/10.1186/s12909-019-1658-z

Kusumawardani, K. A., Widyanto, H. A., & Tambunan, J. E. G. (2023). The Role of Gamification, Social, Hedonic and Utilitarian Values on E-Commerce Adoption. *Spanish Journal of Marketing - ESIC*. https://doi.org/10.1108/sjme-09-2022-0188

Lam, P., & Tse, A. (2022, January). Gamification in everyday classrooms: Observations from schools in Hong Kong. In *Frontiers in Education* (Vol. 6, p. 630666). Frontiers. https://doi.org/10.3389/feduc.2021.630666

Licorish, S. A., Owen, H., Daniel, B. K., & George, J. L. (2018). Students' Perception of Kahoot!'s Influence on Teaching and Learning. *Research and Practice in Technology Enhanced Learning*, *13*(1), 1-23. https://doi.org/10.1186/s41039-018-0078-8

Lim, T. M., & Yunus, M. M. (2021). Teachers' Perception Towards the Use of Quizizz in the Teaching and Learning of English: A Systematic Review. *Sustainability*, *13*(11), 6436. https://doi.org/10.3390/su13116436

Moseikina, M., Toktamysov, S. Zh., & Danshina, S. D. (2022). Modern Technologies and Gamification in Historical Education. *Simulation & Gaming*, *53*(2), 135-156. https://doi.org/10.1177/10468781221075965

Naseri, R. N. N., Abas, N. M., & Abdullah, R. N. R. (2023). Intention Towards Using Gamification Among Students in Higher Education: A Conceptual Framework. *International Journal of Academic Research in Progressive Education and Development*, *12*(1), 1275–1282 https://doi.org/10.6007/ijarped/v12-i1/16506

Neureiter, D., Klieser, E., Neumayer, B., Winkelmann, P., Urbas, R., & Kiesslich, T. (2020). Feasibility of Kahoot! as a real-time assessment tool in (histo-) pathology classroom teaching. *Advances in Medical Education and Practice*, 695-705.

Sailer, M., & Sailer, M. (2020). Gamification of In-class Activities in Flipped Classroom Lectures. *British Journal of Educational Technology*, *52*(1), 75-90. https://doi.org/10.1111/bjet.12948

Serrano, M. C. (2023). Gamification and the History of Art in Secondary Education: A Didactic Intervention. *Education Sciences*, *13*(4), 389. https://doi.org/10.3390/educsci13040389

Suryani, L., & Fauziati, E. (2022, December). The Implementation of Socrative as a Tool for Formative Assessment in Students' Perspective. In *7th Progressive and Fun Education International Conference (PROFUNEDU 2022)* (pp. 92-102). Atlantis Press. https://doi.org/10.2991/978-2-494069-71-8_12

Thurairasu, V. (2022). Gamification-Based Learning as the Future of Language Learning: An Overview. *European Journal of Humanities and Social Sciences*, *2*(6), 62-69. https://doi.org/10.24018/ejsocial.2022.2.6.353

Tsay, C. H.-H., Kofinas, A. D., Trivedi, S. R., & Yang, Y. (2019). Overcoming the Novelty Effect in Online Gamified Learning Systems: An Empirical Evaluation of Student Engagement and Performance. *Journal of Computer Assisted Learning*, *36*(2), 128-146. https://doi.org/10.1111/jcal.12385

Author Information

Abdullatif Kaban

https://orcid.org/0000-0003-4465-3145

Atatürk University

Erzurum

Turkiye

Contact e-mail: *abdullatif.kaban@gmail.com*

Citation

Kaban, A. (2023). Gamification in Education. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp. 79-93). ISTES Organization.

Chapter 9 – Gamification Models

Yusuf İslam Bolat

Chapter Highlights

- In this section, readers will dive into five different Gamification models and why they are important for education.
- Gamification models and models' all phases will be described in detail.
- Readers will explore the key points of Gamification models and relationships between gamification and human motivational psychology.
- Readers will understand which models were developed for practice and which were developed to explain motivations that triggered their behavior.
- Lastly, readers will find that how to use gamification in education in Huang & Soman's model.

Introduction

The interest in games has continued throughout human history by creating economic and cultural values with the transformation from analog to digital. Likewise, gamification, or turning some activities into games, has continued from the past to the present (Chou, 2019). Prensky (2001) defined games as organized play, an activity with specific rules, goals and objectives, outputs and feedback, contention, competition, challenges, interaction, and a story. Contrary to expectations, not only children but also adults spend time playing games. Thus, in the Entertainment Software Association (ESA) 2023 report, it was stated that the average age of players digital games is 32. It is stated that the video game industry generated a revenue of 24 million dollars in 2010 (Ferrera, 2012). According to the current report of ESA (2023), players spend approximately 13 hours a week and a total of 56.6 billion dollars annually (ESA, 2023). This shows that games have become one of the fastest-growing entertainment sectors in the world (Ryan et al., 2006). However, from an educational point of view, it may only be possible to find games suitable for some areas and all learning outcomes and to develop games for these areas. In this respect, the concept of gamification comes to the fore. Gamification uses game elements in non-game environments (Deterding et al., 2011). Huotari and Hamari (2016) defined gamification as using game elements in non-game environments to develop individuals' positive motivation and psychological states. Using gamification in educational environments contributes to students' enjoyment, engagement, motivation, achievement, satisfaction, and attitude (Rahman et al., 2018). In their meta-analysis study, Sailer and Hommer (2020) stated that gamification significantly affects students' behavioral, cognitive, and motivational learning outcomes. However, as in other examples of instructional design, it is important to make clear plans to achieve the desired goal in game-like learning environments (Akıllı & Çağıltay, 2006). For this purpose, different gamification models have been developed in the literature to realize a successful gamification design. These models are developed for the target audience to maintain certain behaviors sustainably. In this section, gamification models in the literature will be discussed. We will look at Werbach & Hunter's D6 gamification model, Yu-kai Chou's Octalysis gamification model, Eyal's (2014) hook model, Zichermann and Cunningham's SAPS model, and Huang and Soman's five-stage model for the use of gamification in education.

Werbach & Hunter D6 Model

To design a successful gamification strategy, some steps need to be planned. For this purpose, Werbach and Hunter (2012) presented a six-step gamification model with the D6 model in Figure 1. Werbach and Hunter's (2012) D6 gamification model has a linear structure that continues sequentially.

Figure 1. D6 Gamification Model

D1: Set Goals

In the first step of the D6 gamification model in Figure 1, we need to identify the goals we want to achieve. Werbach and Hunter (2012) emphasize that having a well-developed understanding of your goals for effective gamification is very important. This refers to specific performance objectives such as increasing student engagement, increasing academic achievement, etc., which are to be achieved through gamification design rather than statements such as the mission and vision statements of the organization in general. If this step is skipped, the gamification design will probably fail. Werbach and Hunter (2012) suggest the following four steps in the process of setting objectives:

1. A list of potential targets,
2. Ranking the objectives according to their importance and eliminating the less important ones
3. Deleting mechanics (Keep truly goals and delete means-tools)
4. Justify objectives (why they are important for gamification design).

As we work through the design and development process of gamification, returning to this list of goals is beneficial to our design. Even if priorities vary, these goals serve as a reminder of what really matters in design.

D2: Delineate Target Behaviors

In the second step, we must describe what behaviors must be developed to achieve these goals. In other words, after determining why we are designing gamification, we should focus on what we want players to do and how to

measure it. Behavior and metrics are best evaluated together. Target behaviors should be concrete and specific. After listing all desired behaviors, criteria for success should be developed. In this way, we will transform behaviors into measurable results. Gamification works on software algorithms that translate the player's activities into numbers and use these numbers to generate feedback.

D3: Describe your players

Since the entertainment elements in gamification designs need to know the target audience well to have the expected effect, in the third step, we should define our players, the audience we want to change behavior for (Lazzaro, 2009). We can use Bartle's (1996) or Marczewski's (2015) player-type theories in the literature at this stage. As player-type theories are discussed separately in the previous chapters of this book, we don't repeat this section. Readers can find detailed information in previous chapters.

D4: Devise Activity Cycles

In the fourth step, we need to identify the activity cycles to help achieve behavioral change in the target audience. Here, the progression and commitment cycles should be used to design the activity cycles. In the engagement loop, we plan how the player will perform the targeted behaviors and how they will be motivated. In this way, the player receives ongoing encouragement after completing their tasks. In the progression cycle, the player is informed about their status after the tasks they perform, what rewards they have achieved, and what level they have reached. As Csikszentmihalyi's flow theory (1990) says, finding the right balance between ability and difficulty is important when setting up activity cycles. This is based on the data gathered during the analysis of the target audience. Since the concept of flow is discussed in detail in the chapter on the theoretical background of games and gamification in our book, it may be useful for readers to review it in this sense.

D5: Don't Forget the Fun

The fifth step is to add fun to the environment. When dealing with the confusions of audience, aims, rules, and motivation, it is easy to lose sight of the fun dimension. However, since motivation is at the heart of games and gamification, meeting the players' need to have fun is crucial. Therefore, it is necessary to take a step back from gamification design and see if it is really fun (Werbach & Hunter, 2012). If users find the gamified system fun, they will likely return. Accordingly, the following questions should be considered when designing gamification: Will players voluntarily participate in your system? Would they still be likely to play if no external rewards were offered? If the answer to these questions is no, it should be reviewed what kind of changes should be made in the gamification design so that it can be perceived as fun.

D6: Deploy the Appropriate Tools

In the sixth and last step, we should use appropriate tools in the gamification design we have prepared in line with the information we have obtained in the previous steps. Although gamification elements are not limited to use

only in digital environments, considering the opportunities provided by digital environments, the use of technology is inevitable. Appropriate gamification elements are selected and coded into your systems in this stage.

Elements of Gamification

Werbach and Hunter (2015) categorize gamification elements into components, mechanics, and dynamics. Each mechanic related with dynamic(s), and each component related with mechanic(s). the game elements are presented in Figure 2.

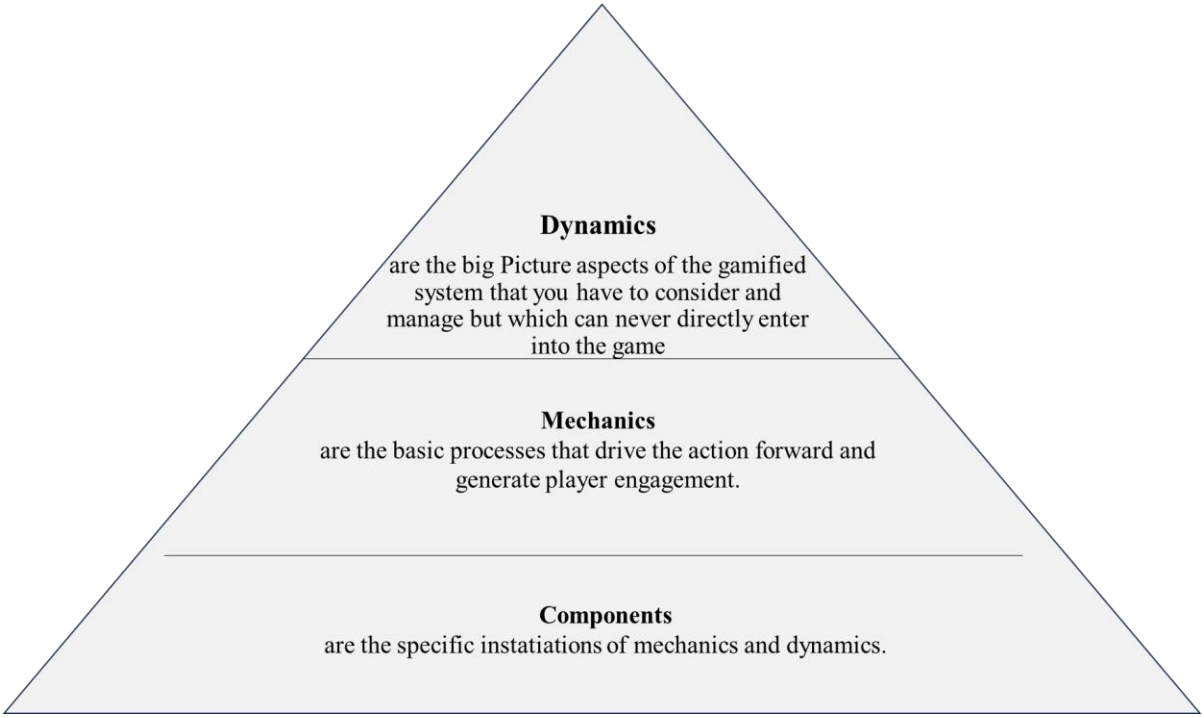


Figure 2. Gamification Elements

Dynamics are at the top level of the game elements hierarchy. The most prominent game dynamics are:

1. Constraints (restriction or forced compromises)
2. Emotions (curiosity, competition, frustration, and happiness)
3. Narrative (a stable, ongoing story)
4. Progression (growth and development of the player)
5. Relationships (social interactions that create feelings of friendship, status, altruism, etc.)

Game mechanics are important for maintaining a sense of fun, interest, and curiosity (Werbach & Hunter, 2012). Werbach and Hunter (2014) list the most important game mechanics as follows:

- Challenges, difficulties (activities requiring effort to complete)
- Chance (objects of randomness)
- Competition (one wins, another loses)

- Cooperation (players must cooperate to accomplish a common goal)
- Feedback (information about how the player is doing)
- Resource Collection (obtaining beneficial items)
- Rewards (gain of some performance or success)
- Transactions (trading among players)
- Turns (sequential participation of alternate players)
- Winning Situations (goals that make one or a team a winner)

Each mechanic is a way to achieve dynamics described. A random event, such as a reward that appears without caution, can trigger players' feeling of fun and curiosity. Components are detailed forms of mechanics or dynamics. Just as each mechanic depends on one or more dynamics, each component depends on one or more higher-level elements. Werbach and Hunter (2014) important game components list as follows:

- Achievements
- Avatars
- Badges
- Boss Fights
- Collections
- War
- Content Unlock
- Gift giving
- Leaderboards
- Levels
- Points
- Tasks
- Social Graphics
- Teams
- Virtual Items

Octalysis Gamification Model

Motivation is a necessary drive to direct the players' behavior. (Chen et al., 2023). The Octalysis gamification model aims to direct users' behavior by increasing their motivation (Chou, 2019). Thus, Chou (2015) developed the Octalysis Model (combines the words "octagon" and "analysis") based on the Eight Core Drives, which seek to maximize the human motivation and participation in the system with a focus on human-oriented design. In his model presented in Figure 2, Chou (2019) bases gamification on eight core drivers: meaning attribution, power (authority) and feedback, achievement, belonging-ownership, social influence, curiosity-unpredictability, avoidance, and scarcity-impatience. The gamification elements that should be presented for each basic motivator are placed next to each other.

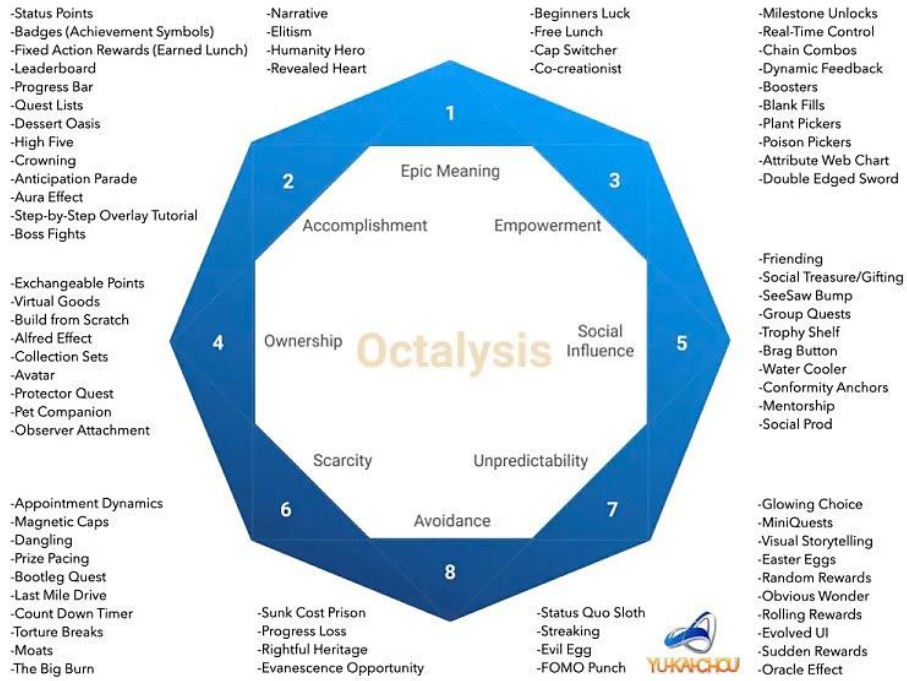


Figure 3. Octalysis Gamification Model (Chou, 2015)

Chou (2019) divided the eight motivators in the Octalysis model into two groups according to their appeal to the left and right brains. Accordingly, the motivators on the model's right-side focus on creativity, self-expression, and social dynamics. The right brain symbolizes more internal tendencies. At the same time, the motivators on the right side contain intrinsic motivational elements. In other words, the elements on the right side of octalysis can be used in systems designed to increase intrinsic motivation. On the other hand, motivations on the left side of Octalysis are associated with logic, analytical thinking, and ownership and are called left-brain motives. Left-side motives are based on extrinsic motivators. It can be expressed as the ability to reach a goal or an object that an individual cannot normally achieve if they perform a behavior. However, eliminating the extrinsic motivation source can dampen the same desired behavior. Chou (2015) classified the eight basic motivators as right-left brain-oriented, black-hat, and white-hat. In this classification, the motivators at the top of the octagon are considered positive motivators, and those at the bottom of the octagon are considered negative motivators. Therefore, he named the positive motivators at the top "White Hat Gamification" and the ones at the bottom "Black Hat Gamification." In this categorization, it is incorrect to think that white is good and black is bad. These are just motivational elements, and many people benefit from black-hat gamification in their daily behaviors, such as living healthier, doing sports, and getting up early (Chou, 2015). According to Chou (2019), one or more of the eight basic motivators in the Octalysis model underlie people's behaviors. Therefore, as educators, if we want to develop behavior in our students, we need to include one or more of these eight basic motivators in our gamified instructional designs. Otherwise, we cannot ensure that students are motivated and show the desired behavior. It is useful to examine these eight basic motivators to understand them better.

Epic Meaning

Epic meaning motive can be explained as the individual's belief that their behavior serves a noble purpose by considering it part of an important job. Here, the individual fulfills the work they have done without interest. The

fact that the individual serves the relevant lofty purpose motivates him sufficiently. We can give an example of people who support Wikipedia. Contributing to Wikipedia has an important motivating effect for its supporters in terms of feeling that they have served a higher purpose much greater than their capacities, such as protecting and preserving the knowledge that humanity has carried from the past to the present. This motivation also comes into play when someone has "beginner's luck". This motivation can be explained by the fact that the people believes that they are lucky because they believe that they have some kind of talent that others do not have.

Achievement

Achievement and development; One of humans' internal motivations is to improve, develop skills, achieve expertise (i.e. overcome a challenge). Challenge is an important term in this point. Using elements such as scoring or badges in designs that do not involve overcoming a challenge will not be motivating.

Empowerment and feedback

When users show their creativity when they create new things, they want to get feedback on the results of their work and learn about their progress. People not only want ways to show their creativity, but they also want feedback the results of their creativity and adapt accordingly. This motivator is also at work in Lego games or art activities where creativity is at the forefront.

Ownership

Ownership and belonging motives arise when an individual has control over something or feels a sense of belonging to a project, organization, process, or object. The individual wants to collect and advance the object they own. Virtual items or virtual money in games serve this motive. At the same time, having their profile or avatar in the game and being able to manage it according to their wishes motivates the individual to stay in the system longer.

Social Impact and Relatedness

This basic motivation comes into play when people are in social situations when they mentor others, gain social acceptance, receive feedback from others, cooperate, or even compete. When a friend has a high-level skill or an item other do not have, you feel motivated to have it. In addition, the same motivation arises with people or objects that people see as close to or related to them. For example, buying a product that reminds us of our childhood can result from this motivation.

Scarcity

Scarcity and impatience are fundamental motives for wanting something since it is scarce, privileged, or not instantly available. For example, limitations in games, such as "come back in 2 hours to claim your prize", that

people cannot get at that moment, motivate them to think about them all day long.

Unpredictability

In designs where unpredictability, unpredictability, and curiosity are the main motives, not knowing what will happen in the next step keeps you engaged (Chou,2019). When something does not fit our schema recognition loops in your mind, our brain pays attention to the unpredicted. This drive also exists in gambling addictions, sweepstakes, and lottery programs. That's the reason to watch movies or read novels.

Avoidance

An avoidance motive is the motivation to prevent something negative from happening. It could be avoiding losing one's previous job or changing one's behavior (Chou, 2014). On a broader scale, avoid admitting that everything you have done up to this point is useless because you are now out of a job. Diminishing opportunities is also a strong beneficiary of this core motive, as people feel that if they do not act now, they will never have the opportunity to act again. Recent campaigns, especially on e-commerce sites, such as "Special offer for a limited time only!" are an example.

Hook Model

Almost half of people's routines are driven by their habits. Our habits are ingrained in our routine as behaviors that are performed with little conscious or unconscious. (Wood et al., 2002). Habits are a mechanism how the brain learns complicated behaviors. (Eyal, 2014). Habits are developed as a result of the brain's tendency to choose for a more efficient route, hence ceasing deliberate cognitive processing when deciding next steps. (Dickinson & Balleine, 2002). Eyal's (2014) four-stage Hook model is a model that aims to help people develop useful habits. The use of the hook analogy in the name of the model has emerged both because it is a cyclical model and because it is thought of as being caught in the habit (being hooked). The hook model is presented in Figure 4.

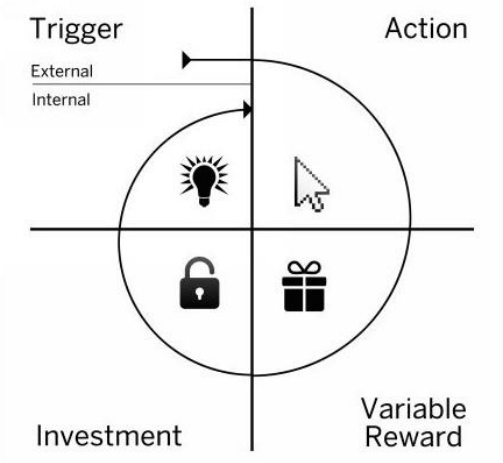


Figure 4. Hook Gamification Model

As seen in Figure 4, the hook model has a cyclical process consisting of four stages: intrinsic and extrinsic trigger, action, variable reward, and investment. While Werbach and Hunter's (2012) D6 model and Huang and Soman's (2013) model, which we will see in the following sections, have a linear structure, this model is cyclical. According to the Hook Model, the more users are exposed to hooks, the more likely they are to develop a habit (Eyal & Hoover, 2015). Triggers are the elements that set the behavior in motion, so we can say that they are like spark plugs in the engine (Eyal, 2014). Triggers can be divided into internal and external triggers. Habit-forming products start with the stimulation of external triggers through several communication tools. Users navigate through successive hooks, connecting with internal triggers associated with current behavior and emotions. When their next behavior becomes automatic and starts to signal their next action, their new habits become routine. Action follows the trigger. It's a behavior in expectation of a reward. At action stage of the Hook, the art and science of usability design is used to uncover how products direct specific user actions. (Eyal, 2014). In this sense, firms leverage the two fundamental drivers of human behavior—the ease of performing an activity and the motivation to perform the behavior—to increase the likelihood of an action occurring. The difference Hook Model from the ordinary feedback loop is that the Hook is developed to create desire. Predictable feedback does not create desire. For example, the fact that the refrigerator lights up as feedback when the door is opened does not create a desire to open the door repeatedly. Instead, variable rewards should be offered. Variable rewards arouse curiosity in individuals because they are unpredictable. This is why companies' most powerful tools for influencing users are variable rewards. The introduction of variability significantly amplifies the impact, resulting in a concentrated cognitive state that inhibits the regions of the brain linked to reasoning and rationality, while concurrently activating the regions involved with desire. (Brevers & Noël, 2013). The final stage of the Hook Model is where the user works more. In the investment phase, factors are repeatedly implemented to re-enter the hook loop. The investment phase is not just about users spending money and returning daily life. Rather, investment here refers to an effort that improves the product for the next cycle. Users invest in improving their experience within the gamification design by inviting others, expressing preferences, creating virtual entities, and learning to use new features. These behaviors can increase the perception of the attractiveness of triggers, the convenience of actions, and the fun of rewards for users each time they enter and exit the hook loop.

SAPS Gamification Model

The term SAPS stands for status, access, power, and stuff. The SAPS model is a reward hierarchy (Zichermann & Cunningham, 2011). However, it can also be examined as a gamification model. According to this model, the cost of the rewarding methods increases as you go downward, while the effect is less. Figure 4 shows the SAPS model.

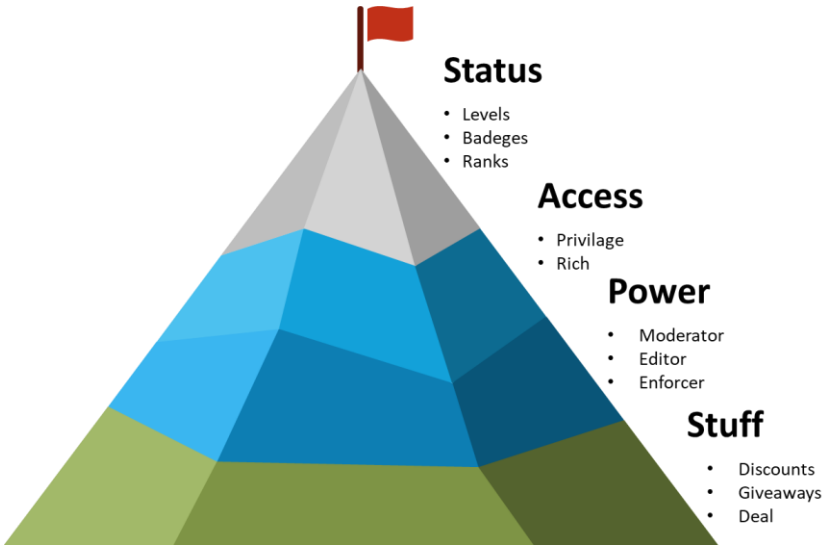


Figure 5. SAPS gamification model

According to Zichermann and Cunningham (2011) in Figure 5, reward methods are less costly and more likely to motivate students to stay in the system as they move up the pyramid. As you move down, the cost increases and the effect on student motivation decreases. Likewise, in the literature, intrinsic motivation comes into play in activities we do without needing an external stimulus, while extrinsic motivation factors are effective in activities we do with the effect of external stimuli (Keller & Deimann, 2012; Malone & Lepper, 1987). This model lists potential rewards that the gamification designer can use as a motivational tool.

Status

Status is based on the relational position of individuals toward others in a social group. Status motivators allow players to get ahead of others in a rules-based ranking system (Zichermann & Cunningham, 2011). One of the three primary causes of intrinsic motivation, according to Ryan and Deci's (2000) self-determination theory, is relatedness, which can account for such motivational elements. As mentioned in the section on the theoretical background, where the relevant theory is examined in detail, one of the psychological needs underlying individuals exhibiting a behavior is based on the interaction between individuals in a social group (Deci & Ryan, 2014). Status-oriented motivational elements also fulfill the needs of players in this sense. Badges, levels, and leaderboards are examples of these. Badges will be meaningful and valuable for the player when visibly designed so that other players can see them. Likewise, levels and leaderboards can show that a player has more or less status or achievements in the game.

Access

Access can be expressed as having certain privileges different from those of normal players and not accessible to everyone in the system (Zichermann & Cunningham, 2011). Examples include seeing some content before other individuals without entering the gamification system and some credit cards reserving lounges at airports and parking lots for their customers. Such rewards are rewards that do not have a direct material value but generally have a high moral value for the user.

Power

In the gamification setup, the fact that some users have powers that other users do not make them feel special (Zichermann & Cunningham, 2011). This situation causes other users to exhibit the behaviors targeted by the gamification system more often to obtain the same power. At the same time, users with power feel more responsibility for the gamification construct and adopt the desired behaviors. In multiplayer games, the fact that some players manage the forums allows them to include the users they want to include and intervene in the messages written in the forums, which can be an example.

Stuff

Although presented as the weakest reward tool, items given as extrinsic reinforcement can also be useful in some cases. However, suppose the user who performs the desired behavior only for the reward does not exhibit the same behavior without a reward. In that case, a useful reward system could not be developed for gamification fiction (Zichermann & Cunningham, 2011). When the reward is achieved, the user's participation in the system should be continued by supporting it with status, access, or power-rewarding methods that can increase intrinsic motivation.

While designing rewards for the gamification design, it will be useful to benefit from SAPS to achieve a more successful fiction. While a correct reward method can increase intrinsic motivation and keep users' interest alive, a wrong reward can cause unnecessary resource expenditure and an inability to achieve the desired behaviors (Berber, 2018).

Huang and Soman's Gamification Model in Education

According to Huang and Soman (2013), who emphasize that implementing gamification in education is challenging, the process consists of five stages. This model has a linear structure similar to Werbach and Hunter's (2012) D6 model. Huang and Soman (2013) argue that the process can be structured more easily with the Gamification in Education Model in Figure 6.

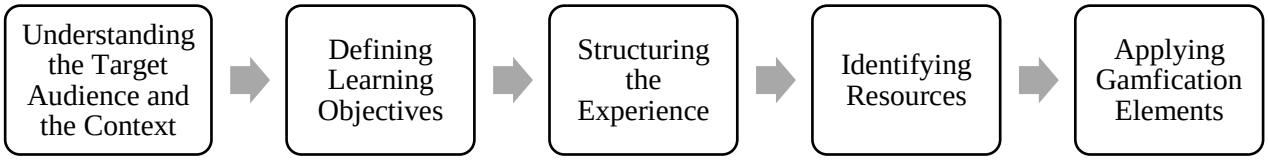


Figure 6. Huang and Soman's Gamification Model in Education

The model emerged as understanding the target audience and context, defining learning objectives, structuring the experience, identifying resources, and implementing gamification elements. The model will be elaborated on in the following sections, according to Huang and Soman (2013).

Identifying the Target Audience and Context

The success of a gamification design depends on a good understanding of who the learner is. This understanding, combined with the context in which education takes place, will help design gamification that will achieve the goal of the curriculum (Huang & Soman, 2013). Here, by analyzing the target audience, factors such as students' age group, learning abilities, current skill set, etc., are identified, while by analyzing the context, details about the size of the student group, the environment, the sequence of skills, and time are obtained.

Defining Learning Objectives

Define what the learner is expected to achieve due to the gamification design. Subject-specific learning objectives may include the learner understanding a concept, being able to perform a task after training, or completing the learning program. While some designs can serve several different objectives at the same time, the success of the design depends on the ability to clearly define the learning objective(s).

Structuring the Experience

The use of course content stages and milestones in gamification design allows instructors to sequence knowledge and measure what learners need to learn and achieve at the end of each stage or milestone, providing a source of engagement for gamification. Milestones and stages also work for learners. This makes the end goal seem more achievable and measurable, making it easier to identify the obstacles within and between each stage. Here, after each stage, the student needs to be motivated to move on to the next stage of completion (Huang & Soman, 2013). For this, two terms are mentioned: completion and push. Here, completion can be explained as trying to understand the concepts in each stage, and pushing can be the motivation to move on to the next stage. To maintain motivation, a balance between the student's skill level and the tasks should be maintained (Csikszentmihalyi, 1990), and the difficulty of the tasks in the stages should be increased as they progress.

Identifying Resources

Once the stages and milestones have been identified in the previous steps, the trainer decides which stages can be gamified and how they can be gamified. When designing the gamification, it is necessary to decide which stage will have a scoring mechanism, the scoring unit, the criteria for the success of a level, the rules that can be applied, and the feedback to the learner and the trainer. The scoring unit can help identify the stage levels when designing the section to be gamified. Also, levels and rules based on scoring allow the trainer to give and receive feedback from the learner. Feedback is an important ally because research shows that students perform better when given more opportunities to complete a task.

Implementation of Gamification Elements

The gamification process in education emerges through the elements applied to the learning program. Huang and Soman (2013) categorized game elements into self and social elements. Self-elements include points, achievement badges, levels, and time constraints. These elements both provide feedback on their personal success and give students the opportunity to compete against themselves. On the other hand, social elements occur in the form of interactive competition or collaboration with other players, such as leaderboards or ranks. Social elements facilitate the integration of students into a community setting, wherein their growth and accomplishments are publicly visible. Self-elements are used in "complete" the stages in structuring experiences, while social elements are used as a "push" to move to the next stage.

Chapter Summary

Gamification has recently become one of the most prominent concepts in educational science research. We can consider gamification as an approach used to reflect the power of the motivational elements of the game in education. It has been stated that gamification significantly affects students' behavioral, cognitive, and motivational learning outcomes. However, as in other examples of instructional design, it is important to make clear plans to achieve the desired goal in game-like learning environments (Akıllı & Çağıltay, 2006). For this purpose, different gamification models have been developed in the literature to realize a successful gamification design. These models are developed for the target audience to maintain certain behaviors sustainably. In this book chapter, gamification models in the literature will be discussed. We will look at Werbach & Hunter's D6 gamification model, Yu-kai Chou's Octalysis gamification model, Eyal's (2014) hook model, Zichermann and Cunningham's SAPS model, and Huang and Soman's five-stage model for the use of gamification in education.

References

Akıllı, G. K., & Çağıltay, K. (2006). An instructional design/development model for the creation of game-like learning environments: The FIDGE model. *Affective and Emotional Aspects of Human-Computer Interaction: Game-Based and Innovative Learning*, *1*(1), 93-112.

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD Research*, 1(1), 19.

Berber, A. (2018). *Oyunlaştırma: Oynayarak başarmak*. Ankara: Seçkin Yayıncılık.

Böckle, M., Micheel, I., Bick, M., & Novak, J. (2018). *A Design Framework for Adaptive Gamification Applications*. http://hdl.handle.net/10125/50038

Brevers, D., & Noël, X. (2013). Pathological gambling and the loss of willpower: A neurocognitive perspective. *Socioaffective neuroscience & psychology*, *3*(1), 21592.

Chen C.-M., Ming-Chaun L. & Kuo C.-P., A game-based learning system based on octalysis gamification framework to promote employees' Japanese learning, *Computers & Education* (2023), doi: https://doi.org/10.1016/j.compedu.2023.104899.

Chou, Y. K. (2015). Octalysis complete gamification framework. URL: http://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework

Chou, Y. K. (2019). *Actionable gamification: Beyond points, badges, and leaderboards*. Packt Publishing Ltd.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. Harper & Row.

Deci, E. L. & Ryan, R. M. (2014). The Importance of Universal Psychological Needs for Understanding Motivation in the Workplace. In M. Gagné (Ed.), *The Oxford Handbook of Work Engagement Motivation, and Self-Determination Theory* (s. 13-32). New York: Oxford University Press.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification." *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, MindTrek 2011*, 9–15. https://doi.org/10.1145/2181037.2181040

Dickinson, A., & Balleine, B. (2002). The role of learning in the operation of motivational systems. *Stevens' handbook of experimental psychology*, *3*, 497-533.

ESA. (2023). *2023 Essential facts about the video game*. https://www.theesa.com/resource/2023-essential-facts-about-the-video-game-industry

Eyal, N. ve Hoover, R. (2015). *Kancaya takılınca: Alışkanlık yaratan ürünler geliştirmenin sırları*. (Akat, B. Çev.). Ankara: Elma Yayınevi.

Ferrera, J. (2012). *Playful design: Creating game experiences in everyday interfaces*. Rosenfeld Media.

Huotari, K., ve Hamari, J. (2016). A Definition for Gamification: Anchoring Gamification in the Service Marketing Literature. *Electronic Markets*. https://doi.org/10.1007/s12525-015-0212-z

Keller, J. M. ve Deimann, M. (2012). Motivation, volition, and performance. R. Reiser ve J. V. In Dempsey (Eds.), *Trends and issues in instructional design and technology* (s. 84-95). Boston: Pearson Education.

Lazzaro, N. (2009). Why we play: affect and the fun of games. In A. Sears & L. A. Jacko (Eds.*), Human-computer interaction: Designing for diverse users and domains* (pp. 156-175). CRC Press, Taylor & Francis Group.

Marczewski, A. (2015). Even Ninja Monkeys like to play. London: *Blurb Inc*, *1*(1), 28.

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivationsfor learning. In R. E. Snow & M. J. Farr (Eds.), *Aptitude, Learning, and Instruction: Conative and affective process analyses* (pp. 223–253).

Prensky, Marc. (2001). *Digital game-based learning*. McGraw-Hill.

Rahman, M. H. A., Ismail, D., Noor, A. Z. B. M., & Salleh, N. S. B. M. (2018). Gamification elements and their impacts on teaching and learning–A review. *The International Journal of Multimedia & Its Applications (IJMA)* 10(6).

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1). https://doi.org/10.1037/0003-066X.55.1.68

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). Th e motivational pull of video games: A self-determination theory approach. *Motivation and Emotion*, 30(4), 344-360. https://doi.org/10.1007/s11031-006-9051-8

Sailer, M., & Homner, L. (2020). The Gamification of Learning: a Meta-analysis. *Educational Psychology Review*, *32*(1), 77–112. https://doi.org/10.1007/S10648-019-09498

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. "O'Reilly Media, Inc."

Wood, W., Quinn, J. M., & Kashy, D. A. (2002). Habits in everyday life: thought, emotion, and action. *Journal of personality and social psychology*, 83(6), 1281.

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business.* Wharton Digital Press.

Werbach, K., & Hunter, D., (2015). *The gamification toolkit: dynamics, mechanics, and components for the win.* Wharton Digital Press.

Author Information

Yusuf İslam Bolat

https://orcid.org/0000-0002-6120-3157

Kahramanmaraş İstiklal University

Kahramanmaraş

Turkiye

Contact e-mail: *y.islambolat@gmail.com*

Citation

Bolat, Y. İ. (2023). Gamification Models. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp. 94 -109). ISTES Organization.

Chapter 10 – Games and Gamification in Online Learning

Hamza Polat

Chapter Highlights

- Games are inherently engaging and can help motivate students to learn because they offer a sense of challenge, competition, and rewards, all of which can help keep students interested and motivated.
- Studies have shown that games can improve learning outcomes in various subjects because they can help students understand concepts better, retain information, and apply their knowledge to real-world situations.
- Games can also help increase students' social interaction because they often require them to work together to achieve a common goal.
- Games can be used to personalize the learning experience for each student because they can be tailored to each student's individual needs and interests.

Introduction

Today, with the rapid development of technology and the widespread use of the internet, great transformations are taking place in the field of education. During the COVID-19 pandemic, many institutions and organizations widely used online teaching opportunities. This situation has been described by many researchers as a paradigm shift in education, and it is predicted that these opportunities will be widely used in the future. Going beyond the traditional classroom environment, online teaching has the potential to make the learning experience more interactive, fun, and personalized. It also offers individuals a learning experience independent of time and space, at their own pace. However, the use of these environments for teaching purposes also brings some challenges. In other words, online teaching is not a silver bullet. Pedagogical solutions need to be produced from the perspective of instructional design by considering the opportunities offered by these environments together with the limitations they bring with them. In this context, one of the elements recommended to make online learning environments more effective, efficient, and participatory is the appropriate use of games and gamification elements in these environments. It is thought that the concepts of games and gamification can attract the attention of educators and students, increase motivation, and provide a more effective learning experience.

The concepts of game and gamification, which initially evoke similar meanings, are different from each other even though they have similar characteristics. A game is an activity that activates people's basic instincts for fun, competition, and reward. The use of games in education can make the learning process more enjoyable while encouraging students to actively participate. Through games, students can develop skills such as problem-solving, strategizing, collaboration, and decision-making. At the same time, games can help present abstract or complex topics in a concrete and understandable way. It is very effective in the learning process of individuals, especially in certain developmental periods.

However, gamification uses game design and mechanics to improve instructional content. Increasing student engagement and learning effectiveness by making learning more appealing is its key goal. Giving pupils responsibility, showcasing their achievements, and rewarding them helps motivate them to study. Students can feel more connected and approach learning more optimistically. Games and gamification in online teaching are successful, especially for digital natives. Technology's interactive tools and platforms let students customize their study time and interests. To improve education, games and gamification must be used wisely. To solve online teaching challenges, it offers several features.

In conclusion, games and gamification in online teaching offer powerful tools to increase student engagement, make learning more fun, and achieve more effective learning outcomes. It is believed that educators and instructional designers should gamify learning materials effectively to provide students with a richer and more motivating learning experience. In this context, this chapter aims to evaluate what games and gamification are, which gamification environments can be used, and what kind of opportunities games and gamification can offer pedagogically, especially in online teaching. It is thought that the chapter will guide educators and researchers who want to get to know games and gamification in online teaching more closely.

Online Learning

Online learning refers to a form of remote education wherein educational materials and instructional guidance are disseminated via digital platforms and the Internet. According to Lee (2017), remote learning enables students to remotely access educational resources, engage in conversations, and fulfill academic tasks without the necessity of being physically present in a conventional classroom setting. Online teaching has gained widespread popularity worldwide due to various factors. These factors include the proliferation of massively open online learning environments, the development of the necessary technical infrastructure to access these environments, and the acceptance of application guidelines for online teaching by educators.

The quick rise and broad adoption of online education can be attributed to its significant accessibility. The concept of transitioning instructional activities to digital platforms is believed to provide students with increased flexibility and convenience. Lee (2017) has posited that within this particular environment, an innovative method has been acknowledged as facilitating enhanced accessibility to higher education. Additionally, it provides several prospects for promoting sustainable learning within the realms of lifelong learning and adult education. According to Boyd (2004), online courses are designed to cater to the requirements of adult learners who need flexibility in terms of scheduling and location. Nevertheless, the utilization of online teaching can effectively tackle educational obstacles and provide adaptable solutions that align with the dynamic nature of the learning process (Simamora et al., 2020).

The field of online education presents a multitude of philosophical and methodological quandaries. There exist divergent discourses on the objectives of remote education, the attributes of distance learners, and the technology that facilitates distance education. The existence of many online education practices and realities presents a challenge to conventional understandings of remote education as a singular discipline. The assessment of the caliber of online higher education and the ongoing discourse around the multifaceted aspects of enhancing its accessibility is of significant importance (Lee, 2017). There are two primary methods by which online teaching may be carried out: synchronously and asynchronously. Students have the freedom to access learning activities in the context of asynchronous online learning at their convenience without being subject to specific time restrictions. For instance, the course material provided on any learning management system or open online course platform may be categorized within this particular group. In the context of synchronous online teaching, there is real-time interaction between students and teachers. One prevalent form of synchronous online learning activities is the utilization of live online courses. Both sorts of approaches are extensively utilized in contemporary times. The COVID-19 epidemic has served to further emphasize the significance of online education. During this particular moment, educational activities were carried out via online platforms on a global scale as a result of implementing emergency measures for distance learning. Amidst the epidemic, educational institutions resorted to the use of online learning as a means to sustain their educational endeavors in response to an unparalleled emergency (Kaban, 2021). Furthermore, the presence of a robust technical infrastructure in contemporary times has played a significant role in facilitating the execution of these tasks, therefore contributing to the development of this solution. Hence, it is important to evaluate the potential and advancement of online learning within the framework of technical capabilities and the demands of a dynamic era (Simamora et al., 2020).

The design and implementation of blended learning, which combines face-to-face teaching with online components, is another aspect of online education. Blended learning has become part of mainstream education, with a continuum between traditional face-to-face teaching and pure online courses. In the design of blended learning, critical factors such as course design, instructional strategies, and technological integration should be considered (Mozelius & Hettiarachchi, 2017). Today, many courses, especially in universities, are conducted in both face-to-face and online learning environments. In this context, several teaching methods and models have been proposed to increase the efficiency of the teaching process. Conducting online teaching in line with a certain teaching model enables more benefits from this process. One of the strategies recommended in this direction and widely preferred today is the flipped classroom teaching model. This model offers an individualized, student-centered, and actively participatory learning experience. In this model, course materials are shared with students in advance in various online learning environments. Before the face-to-face lessons, students are expected to study these materials and come to class. In face-to-face lessons, students, who are assumed to have learned the basic concepts, are taught effectively using various teaching methods such as problem-solving or discussion.

A lot of empirical evidence has been presented that this model facilitates learning as it saves time in face-to-face lessons and includes activities to increase students' higher-order thinking skills. In addition, there are many attempts to adapt this model in line with today's needs (e.g., the pandemic process) and to conduct the flipped classroom model completely online. In this so-called online flipped classroom model, course materials are shared with students asynchronously, while synchronous live lectures are complemented by student-centered activities. Online teaching is an important multiplier in education for several reasons. First, it allows the quality of learning experiences to be enhanced. According to Hung and Jeng (2012), successful online instructors have effective pedagogical practices and technological know-how to enhance the learning process. They are equipped with the necessary competencies to create effective online learning environments and design instruction that improves learning outcomes. Furthermore, online education provides educators, researchers, administrators, and policymakers with a basic understanding of the factors that can influence the introduction of new technology into learning environments. Consequently, online teaching competence also plays an important role in determining the pedagogical competence of educators.

Taking advantage of online teaching methodologies provides learners with increased freedom in their educational pursuits and gives them alternate avenues for accessing valuable learning resources. According to Aydın and Şahin (2023), remote access to educational resources enables students to conveniently and flexibly retrieve a wide range of information, facilitating easier and more extensive access to knowledge. Online education is particularly beneficial for people who encounter limitations, such as employment or family obligations, that pose challenges in attending conventional in-person sessions. According to Hung and Jeng (2012), the utilization of online teaching methods eliminates geographical limitations, enabling students residing in diverse areas to participate in the same courses and engage in collaborative activities with peers from various cultural backgrounds. Online education platforms provide meaningful communication. Online communication may intensify and deepen talks, despite its limitations in portraying emotions and gestures (Bawane & Spector, 2009). Interactive chats and cooperative projects can help online instructors build critical thinking abilities and interest students in learning. It

may improve the communication skills of people who struggle with direct interpersonal contact for various reasons. It is important to acknowledge that the implementation of online instruction presents a multitude of problems. For instance, certain educators may exhibit a preference for in-person interaction and regard online instruction as comparatively less favorable in terms of factors such as attendance, involvement, and the ability to exert control over learning outcomes (Aydn & Şahin, 2023). The potential outcome of this situation might result in a negative view of online courses. Additionally, it is imperative to allocate priority and cultivate the necessary proficiencies essential for proficient online instruction. Online teachers have a multitude of duties and responsibilities, encompassing instructional competency, assessment expertise, technical proficiency, consultation, management, and research. In the present situation, it is imperative to consider these obligations within teacher education programs and place appropriate emphasis on the corresponding duties and competencies (Bawane & Spector, 2009).

In summary, online education encompasses the dissemination of educational materials and guidance via digital platforms and the Internet. It provides enhanced accessibility, more flexibility, and heightened convenience for individuals engaged in the learning process. Nevertheless, the notion of online education exhibits a multifaceted framework, including many discourses and activities. Blended learning, an instructional approach that integrates traditional classroom instruction with online components, is a significant element within the realm of online education. Moreover, it is deemed imperative to carry out instructional endeavors under exceptional circumstances, such as the ongoing COVID-19 pandemic.

Games in Online Learning

The effective use of gamification in the context of online education is highly recommended as a means to effectively engage students and optimize their overall learning experience. According to Li et al. (2023), empirical investigations have indicated that online games exert beneficial impacts on students' growth, motivation, and academic achievement. According to Pintado-Pealoza and Fajardo-Dack (2022), online games offer an enhanced learning environment that promotes interactivity and immersion, enabling students to acquire knowledge in an enjoyable and captivating manner.

Recent studies by Hung et al. (2022) and Li et al. (2023) show that educational interventions can enhance problem-solving and critical-thinking skills. Gamification, incorporating game elements like points and levels, can motivate and engage students (Hung et al., 2022). Wang (2023) emphasizes the importance of designing educational games that teach specific concepts or skills, integrating learning into gameplay for a fun and effective learning experience. According to Fadzil and Sulaiman (2022) and Pintado-Pealoza and Fajardo-Dack (2022), online games can help with language learning by providing interactive ways to improve vocabulary and language skills at one's own pace.

Lim et al. (2023) advise educators and parents to recognize the benefits of online games and help kids utilize them appropriately. Online games can improve students' physical and mental health and foster personal growth and

social engagement. Online games can help teachers enhance students' problem-solving abilities and learning atmosphere. Finally, adding games to online education can boost student engagement, motivation, and learning. Language learning can benefit from interactive and immersive online games that promote problem-solving. Gamification and educational games may make learning more fun and effective for students.

Types of Games in Online Learning

Online platforms with digital instructional resources are replacing traditional learning methods in the present educational environment. Several ways are being investigated to improve instructor-student interaction, making education more pleasurable and effective. This criterion can be met using "educational games". Educational games let students blend game dynamics and interactive features into their learning. The creation of educational games, which successfully aid in the achievement of learning objectives across many academic disciplines, facilitates online learning. The objective of these games is to provide students with practical abilities that go beyond academic knowledge. They facilitate learning within a real-world environment, encourage the assessment of knowledge, and foster peer interaction.

Serious Games

Firstly, the so-called "serious games" provide pupils with the opportunity to master specialized abilities. These educational games facilitate the acquisition of practical skills applicable to both professional and daily contexts through interactive engagement, thereby fostering student motivation. Serious games have garnered recognition as efficacious instruments for fostering skill development across several domains, encompassing education, health professions, and the cultivation of future skills. The aforementioned games include elements of both pleasure and education, offering a captivating and dynamic educational encounter (Gurbuz & Celik, 2022; Ricciardi & Paolis, 2014).

Serious games have been employed within the realm of education to facilitate the advancement of personal and societal learning through an ethical lens. One study analyzed the educational potential of free online serious games that target the development of parasocial skills in students, with a specific focus on combating bullying. According to Wouters et al. (2013), the research discovered that these games incorporate psycho-reflective and interactive elements to actively involve students and facilitate the enhancement of their skills. Serious games are extensively utilized in the health professions for educational and training purposes. Research has demonstrated that these interventions can enhance learning outcomes and foster skill development among healthcare workers. Serious games offer an instructional methodology that prioritizes the learner's needs and preferences, fostering a learner-centered approach. Additionally, serious games have the potential to be more cost-effective when compared to conventional training approaches. Serious games demonstrate potential in the realm of future skill improvement. These games possess the capacity to cultivate talents that are fundamental to the contemporary educational landscape of the 21st century.

Design methodologies for serious games that facilitate the cultivation of future-oriented competencies frequently prioritize problem-solving, cooperation, and teamwork. According to Gurbuz and Celik (2022), game design often includes the use of clear goals and interaction as fundamental features. The validation of serious games has significant importance and warrants careful consideration. Although some studies have examined the efficacy of serious games in enhancing technical abilities within the field of medicine, a significant number of these games have yet to undergo comprehensive validation procedures. The process of validation includes the gathering and analysis of reliable evidence, which encompasses evidence about the game's structure and its influence on the acquisition of practical skills in real-world contexts (Olgers et al., 2021, 2022).

In a broad range of fields, serious games provide a significant instrument for the development of useful skills. Interactive learning experiences have been demonstrated to enhance learning outcomes and skill development across several domains, including education, health professions, and future skill development. Nevertheless, it is crucial to secure the appropriate validation of serious games to ascertain their efficacy in skill development (Amro et al., 2021; Olgers et al., 2021, 2022).

Simulations

Simulation games recreate real-life events for students to learn from (Taş & Gülcü, 2019). These games relate abstract concepts to real-life situations, making learning more meaningful. Simulation games enhance practical learning by combining experiential and theoretical components, providing a secure problem-solving environment. Simulation games benefit from experience-based learning, according to Lean et al. (2020). These educational games encourage experiential learning and active learning. Students can learn practical skills that can be applied in real life by participating in virtual environments.

Experiential learning helps students understand complex topics and solve problems. Simulation games relate theoretical principles to actual applications. These platforms allow students to apply theoretical knowledge in real-world situations and see the instant effects of their activities. The relationship between theory and practice makes education more meaningful and useful (Lean et al., 2020). According to Shaffer et al. (2005), learners can experiment with hypotheses, study different methods, and assess their results.

Consequently, this enables the development of critical thinking abilities and analytical aptitude. Moreover, simulation games provide a safe and controlled setting for individuals to engage in experimentation and learn from their mistakes without having to face any actual repercussions in the real world. According to Lean et al. (2020), individuals engaged in the process of learning have the opportunity to examine various methodologies, get insights from their unsuccessful attempts, and refine their tactics to attain improved outcomes.

The utilization of trial-and-error methodology cultivates a growth-oriented attitude and promotes the inclination of students to engage in risk-taking behavior and employ creative thinking (Faizan et al., 2019). Simulation games provide a sense of autonomy and facilitate self-directed learning by offering a secure environment for experimentation. The degree of accuracy attained in a simulation game is also of significance. High-fidelity

simulations have a striking resemblance to real-world scenarios and have the potential to enhance the transfer of information from the simulated environment to real-life circumstances. Nevertheless, several studies propose that simpler games with decreased complexity may facilitate more efficient learning by minimizing distractions and concentrating on essential learning goals (Lean et al., 2020). Particular educational objectives and intended results should be carefully evaluated to determine the degree of simplicity.

In conclusion, simulation games improve education by providing realistic learning possibilities. They combine academic knowledge with practical application and provide a secure space for problem-solving and decision-making. These games promote critical thinking, analysis, and knowledge application through an engaging educational experience. To improve learning, simulation games should be tailored to specific learning objectives.

Quiz and Trivia Games

Knowledge assessment games let teachers evaluate and test students' knowledge. Educational evaluations include queries, riddles, and exams to evaluate and improve students' knowledge and abilities. Karpicke and Roediger (2008) and Roediger and Butler (2011) emphasize the importance of knowledge evaluation games. These activities encourage recall, which improves learning and long-term retention.

Karpicke and Roediger (2008) found that frequent testing improves memory more than repeated practice. Quizzes and Trivia games help pupils recall material, improving their knowledge. This practice helps learn flexible, transferable information (Roediger & Butler, 2011). Knowledge evaluation games help build metacognition. Students self-assessed performance predictions and actual game performance are seldom correlated, showing a lack of understanding regarding retrieval practice's benefits (Karpicke & Roediger, 2008). Actively participating in these instructional activities helps students understand their learning and memory systems and develop metacognition.

Quiz and Trivia Games boost student engagement and motivation. Agarwal et al. (2008) and Goldey and Espinosa (2020) say that games make learning more fun and interactive than traditional methods. Knowledge evaluation games offer memory experiences like episodic recall, according to Pereverseff and Bodner (2020). These encounters may improve learner engagement and memorability. Knowledge challenge games with kinesthetic learning activities like charades, pictionary, and sculpting improve student engagement and learning (Goldey & Espinosa, 2020). Quiz games may also be used for formative assessment. Teachers can identify areas of weakness and provide targeted feedback and teaching by assessing students' knowledge and understanding during the game. According to Jičínská et al. (2021), these games can help students self-assess their learning and identify areas that need more work.

In summary, Quiz and Trivia Games evaluate knowledge in different ways. They foster retrieval practice, metacognitive processes, student participation and motivation, and formative evaluation. These games help provide an exciting and productive learning environment for educators.

Collaborative Social Games

Cooperative and social games increase interpersonal engagement among students. Collaborative tasks, interactive games, and cooperative exercises facilitate the enhancement of students' aptitude for teamwork and effective communication. Cooperative and social games have the potential to significantly contribute to peer interaction as they facilitate the promotion of collaboration, communication, and the cultivation of social skills. Johnson and Johnson (2009) say cooperative learning, based on social interdependence, is widely used and effective in education. This strategy promotes collaborative efforts among students, cultivates a sense of positive interdependence, and facilitates mutual support and aid among peers.

Cooperative games facilitate the acquisition of effective communication skills, active listening abilities, and the capacity to engage in constructive negotiation and dispute resolution among students. These educational games provide students with a platform to enhance their fundamental social skills, including but not limited to turn-taking, sharing, and empathy. Educators throughout the globe have extensively implemented and put into practice cooperative learning methods, showcasing the practicality and efficacy of these methodologies (Johnson & Johnson, 2009).

Furthermore, cooperative and social games not only facilitate social connection but also contribute to the advancement of cognitive growth. Through participation in collaborative problem-solving activities, students have the opportunity to derive advantages from the many viewpoints and expertise possessed by their peers. Engaging in this process can facilitate more profound comprehension, foster analytical reasoning, and cultivate the advancement of cognitive abilities at an elevated level. In addition, the incorporation of cooperative and social activities has the potential to enhance students' holistic well-being and motivation. When students have a sense of belonging and establish connections with their peers, their level of engagement and motivation toward learning are enhanced.

Collaborative games facilitate the cultivation of a constructive and encouraging educational setting since they allow pupils the chance to collectively achieve accomplishments. It is essential to acknowledge that the efficacy of cooperative and social games in fostering peer interaction is contingent upon their proper design and implementation by educators. Brown and Eisenhardt (1997) emphasize the significance of striking a balance between structure and flexibility within organizational contexts. Likewise, within educational settings, educators must provide a structured framework and set of norms that facilitate collaborative efforts, all while fostering an environment that encourages adaptability and ingenuity.

In summary, cooperative and social games hold significant potential for facilitating peer contact through the promotion of collaboration and communication and the enhancement of social and cognitive abilities. These instructional games allow students to work together to attain a goal, fostering interdependence and cooperation. Kids can improve their social skills, cognitive development, and well-being by playing cooperative and social games.

Gamification in Online Learning

Gamification uses game features in non-game environments like online education to boost student engagement, motivation, and learning (Lim et al., 2023). Gamification in education may improve learning results by encouraging and inspiring students (Alhammad & Moreno, 2018). According to Mahmud et al. (2020), several studies have examined how gamification affects student learning in online education. A sustainability education research study indicated that online gamification improved students' sustainability understanding.

Gamification boosts pupils' sustainability knowledge. Online gamification alone could have improved students' environmental behavior more successfully. Time restrictions, boredom from a lack of social connection, activity repetition, and improper difficulty levels prevent online gamification engagement (Mahmud et al., 2020). Teachers are key to online gamification learning as intermediaries who increase student engagement and learning.

Gamification has been popular in various disciplines, including online learning (Bolat & Taş, 2023; Ilmadi et al., 2023). It boosts student motivation and performance (Rakhmanita et al., 2022). Gamification predicted motivation and performance in an introductory programming course (Imran, 2022). Gamification on educational platforms may motivate and engage students. Gamification can solve online learning problems, including low interest and involvement. Online learning may be gamified to promote student learning (Taş et al., 2023; Wangi et al., 2022).

Gamification may improve online education by enhancing student engagement, motivation, and learning results. However, systematic methods to gamify courses in numerous professions, including software engineering, are needed. Teacher presence is critical in online gamification learning to enhance student engagement and learning. Overcoming engagement hurdles and online gamification issues can improve its efficacy in online education.

The Effect of Games and Gamification on Motivation in Online Learning

Gamification, the use of game elements in non-game circumstances, is gaining popularity in online education. This method may boost student motivation and engagement. Gamification features, including points, leaderboards, badges, levels, narratives, targets, feedback, incentives, progress, and challenges, boost motivation, according to Khalil et al. (2018). Imran et al. (2019) propose that badges, points, and scores in educational environments may motivate students extrinsically. Incentives can motivate students to work hard and succeed, improving learning productivity. Scoring systems, leaderboards, and badges have been used in online education to motivate and engage students.

Gamification in online education includes higher education, training, and tutorials for lower-level students. Gamification tactics in online learning have been shown to increase student engagement and motivation, especially while studying for higher education admission exams. Gamification in online education benefits instructors. According to Rahardja (2019), the utilization of this application offers educators a means to stimulate and include pupils while also serving as an alternate method for tracking and acknowledging their advancements.

The introduction of game-based teaching can also enhance the motivation of lecturers since they are incentivized through incentives for their efforts.

In general, games and gamification have the potential to enhance motivation and engagement within the context of online education. The use of gamification components, such as points, leaderboards, badges, and awards, can function as extrinsic incentives for students, fostering their engagement and pursuit of achievement. Nevertheless, further investigation is required to comprehensively comprehend the impacts of gamification in the realm of online education and to delve into its possibilities within various educational settings.

The Effect of Games and Gamification on Participation in Online Learning

Research studies conducted by Bovermann and Bastiaens (2020) as well as Rincon-Flores and Santos-Guevara (2021) have demonstrated the beneficial effects of games and gamification on students' levels of engagement within the context of online education. The concept of gamification involves the integration of game components and mechanisms into situations that are not inherently game-related, with the purpose of captivating and incentivizing individuals (Bovermann & Bastiaens, 2020).

Gamification can improve online students' motivation, engagement, and learning experiences. Bovermann and Bastiaens (2020) believe that one-way games and gamification can motivate students and improve engagement. Gamification tactics use specific game mechanics and components to motivate students, which is crucial to learning behavior.

Gamification user categories and game mechanics can help classify students' interests and learning preferences, which can stimulate learning. Gamification can make learning inspiring and interesting. This is done by matching online learning activities to student interests and needs. Games and gamification can improve active learning and engagement, according to Rincon-Flores and Santos-Guevara (2021). Research during the COVID-19 pandemic found that gamification tactics boost student interest and participation in online courses, improving academic performance.

Gamification, which uses a reward system, has been shown to improve student engagement and academic performance during the transition from in-person to virtual education. Gamification strategies like systemic recognition and incentive systems can boost students' engagement with educational content and classmates. Gamification can also boost student engagement by fostering teacher-student and student-student interactions. Games and gamification can also humanize virtual learning environments. Gamification can improve students' mental health, reduce anxiety, and reduce pandemic-related isolation. Gamification and a reward system in higher education can motivate and engage students in online learning, especially in difficult situations.

Gamification in online learning can boost student engagement and community belonging, according to Rincon-Flores & Santos-Guevara (2021). This is done through making school more fun and interactive. Overall, games and gamification improve student engagement in online education. Gamification can improve online learning by

increasing engagement and effectiveness. This can be done through amplifying motivation, encouraging active learning and engagement, and creating a more human virtual learning environment. Online educators should consider using games and gamification to boost student engagement and learning.

The Effect of Games and Gamification on Interaction in Online Education

Research has demonstrated that the utilization of games and gamification strategies may have a notable effect on enhancing student engagement within the context of online education. Multiple research studies have demonstrated that the implementation of gamification strategies may significantly enhance students' motivation to actively engage in online learning environments and therefore enhance their academic achievements (Rincon-Flores & Santos-Guevara, 2021).

The implementation of gamification in educational settings promotes increased levels of active participation and engagement among students. This is achieved via the utilization of a reward-based system, which serves to mitigate the negative emotions associated with fear and isolation. The implementation of gamification strategies in educational settings has been found to contribute to the humanization of virtual environments, fostering a sense of community among students. The COVID-19 pandemic has exerted a substantial influence on students across many educational levels, prompting the implementation of gamification as a tactic to mitigate academic setbacks resulting from the pandemic.

According to Rincon-Flores, and Santos-Guevara (2021), students during the lockdown period reported seeing gamification as a motivational element that stimulated their attendance in class, engagement in activities, and successful completion of tasks. Mahmud et al. (2021) suggest that the perpetuation of involvement in online gamification encounters several obstacles, including temporal limitations, a dearth of interpersonal communication, and the presence of monotonous or unsuitable tasks. The involvement of teachers in online gamified education is of utmost importance, as they fulfill a critical function in fostering student engagement and facilitating the learning process.

The presence of a teacher fosters social presence among students, enhancing their involvement and facilitating the learning process. The utilization of gamification in the context of online education has been seen to have a favorable influence on students' comprehension and awareness of sustainability-related concepts. The utilization of this approach significantly augments students' comprehension of sustainability principles and environmental education. Nevertheless, the utilization of gamification as a standalone approach may have diminished efficacy in fostering pro-environmental behaviors among student populations.

In summary, it has been demonstrated that the utilization of games and gamification techniques may effectively enhance student engagement within the context of online education. One of the key benefits of these activities is their ability to inspire and encourage pupils, leading to enhanced academic achievement. Additionally, they have been found to alleviate feelings of fear and foster a sense of belonging and active participation within the

community. Nevertheless, it is crucial to consider the obstacles that impede the maintenance of active involvement as well as the significance of educators in aiding the implementation of online gamified educational approaches. Furthermore, although the implementation of gamification in educational settings has demonstrated the potential to enhance students' information acquisition and comprehension, its efficacy in fostering pro-environmental behaviors may be limited.

Chapter Summary

Games and gamification are innovative methods that can be used to overcome some of the problems inherent in online learning. The use of games and gamification elements in online learning with certain standards in mind is thought to positively affect students' academic achievement, motivation, active participation, and engagement. Even though numerous empirical studies support this, more research is necessary to determine how games and gamification will affect learning in various contexts. Online training has grown due to technical advances, modern needs, and pedagogical developments. It has many potentials but also limits. In particular, these educational settings must contain certain methods to motivate students, engage them, and encourage active participation. In this context, gamification in online educational courses has gained popularity in recent years. Gamification and games are used to engage pupils and improve learning. Game types include serious games, simulations, knowledge evaluation games, and collaborative social games. Online education uses points, leaderboards, badges, levels, narratives, objectives, feedback, rewards, progress, and obstacles. Games and gamification in online classes, under certain conditions, may improve academic progress, motivation, engagement, and interaction. In this case, online pedagogical techniques should be evaluated, with an emphasis on combining game elements and gamification concepts into instructional design.

References

Agarwal, P. K., Karpicke, J. D., Kang, S. H., Roediger III, H. L., & McDermott, K. B. (2008). Examining the Testing Effect with Open-and Closed-book Tests. *Applied Cognitive Psychology: The Official Journal of the Society for Applied Research in Memory and Cognition*, *22*(7), 861-876. https://doi.org/10.1002/acp.1391

Alhammad, M. M., & Moreno, A. M. (2018). Gamification in Software Engineering Education: A Systematic Mapping. *Journal of Systems and Software*, *141*, 131-150. https://doi.org/10.1016/j.jss.2018.03.065

Amro, M., VicunaPolo, S., Jayousi, R., & Qasrawi, R. (2021). Personalized Serious Games for Improving Attention Skills Among Palestinian Adolescents. *Advances in Science Technology and Engineering Systems Journal, 6*(4), 368-375. https://doi.org/10.25046/aj060441

Aydın, T., & Şahin, A. B. (2023). Perspectives of the Dental Educators with Regard to Online Education. *Cumhuriyet Dental Journal, 26*(1). https://doi.org/10.7126/cumudj.1228802

Bawane, J., & Spector, J. M. (2009). Prioritization of Online Instructor Roles: Implications for Competency-Based Teacher Education Programs. *Distance Education*, *30*(3), 383-397. https://doi.org/10.1080/01587910903236536

Bolat, Y. İ., & Taş, N. (2023). A meta-analysis on the effect of gamified-assessment tools on academic

achievement in formal educational settings. *Education and Information Technologies*, 28(5), 5011–5039. https://doi.org/10.1007/s10639-022-11411-y

Bovermann, K., & Bastiaens, T. J. (2020). Towards a Motivational Design? Connecting Gamification User Types and Online Learning Activities. *Research and Practice in Technology Enhanced Learning*, *15*(1), 1-18. https://doi.org/10.1186/s41039-019-0121-4

Boyd, D. (2004). The Characteristics of Successful Online Students. *New Horizons in Adult Education and Human Resource Development*, *18*(2), 31-39. https://doi.org/10.1002/nha3.10184

Brown, S. L., & Eisenhardt, K. M. (1997). The Art of Continuous Change: Linking Complexity Theory and Time-paced Evolution in Relentlessly Shifting Organizations. *Administrative Science Quarterly*, 1-34. https://doi.org/10.2307/2393807

Fadzil, N. I. M., & Sulaiman, N. A. (2022). Online Game-Based Learning Enhance ESL Learners' Vocabulary Learning: Benefits and Challenges. *International Journal of Academic Research in Progressive Education and Development, 11*(4), 833–843. https://doi.org/10.6007/ijarped/v11-i4/15634

Faizan, N. D., Löffler, A., Heininger, R., Utesch, M., & Krcmar, H. (2019). Classification of Evaluation Methods for the Effective Assessment of Simulation Games: Results from a Literature Review. *International Journal of Engineering Pedagogy, 9*(1), 19–33. https://doi.org/10.3991/ijep.v9i1.9948

Goldey, K. L., & Espinosa, A. (2021). Sculptorades, Cloodles, and Cameos, Oh my! A Cranium Game for General Psychology. *Teaching of Psychology*, *48*(4), 308-315. https://doi.org/10.1177/0098628320979877

Gurbuz, S. C., & Celik, M. (2022). Serious Games in Future Skills Development: A Systematic Review of the Design Approaches. *Computer Applications in Engineering Education*, *30*(5), 1591-1612. https://doi.org/10.1002/cae.22557

Hung, L., Mann, J., Battersby, L., Parappilly, B., Butcher, C., & Vicic, A. (2022). Gamification of Dementia Education in Hospitals: A Knowledge Translation project. *Dementia*, *21*(8), 2619-2630.https://doi.org/10.1177/14713012221127773

Hung, W. C., & Jeng, I. (2013). Factors Influencing Future Educational Technologists' Intentions to Participate in Online Teaching. *British Journal of Educational Technology*, *44*(2), 255-272.https://doi.org/10.1111/j.1467-8535.2012.01294.x

Ilmadi, N., Gea, A. F., Sadewo, N. J. D., Hasanah, N. U., Prasetyawan, N. E., Saputro, N. T. V. D., Rahmawati, N. S., Nurazizah, N. M., Nurfebrianti, N. A., Wini, N. T., & Suprapti, N. S. (2023). Application of Gamification with" SIKMA" to Increase Motivation and Learning Independence Attitudes. *Asian Journal of Community Services*, *2*(1), 145-152. https://doi.org/10.55927/ajcs.v2i1.2361

Imran, H. (2022). An Empirical Investigation of the Different Levels of Gamification in an Introductory Programming Course. *Journal of Educational Computing Research*, *61*(4), 847-874. https://doi.org/10.1177/07356331221144074

Jičínská, L., Sedláčková, P., Kolek, L., Tetourová, T., Volná, K., Lukavský, J., & Brom, C. (2021). Extrinsically Integrated Instructional Quizzes in Learning Games: An Educational Disaster or Not? *Frontiers in Psychology*, *12*, 678380. https://doi.org/10.3389/fpsyg.2021.678380

Johnson, D. W., & Johnson, R. T. (2009). An Educational Psychology Success Story: Social Interdependence Theory and Cooperative Learning. *Educational Researcher*, *38*(5), 365-379. https://doi.org/10.3102/0013189x09339057

Kaban, A., (2021). University students' attitudes towards distance education. *International Journal of Technology in Education and Science (IJTES)* , vol.5, no.3, 311-322.Karpicke, J. D., & Roediger, H. L. (2008). The Critical Importance of Retrieval for Learning. *Science*, *319*(5865), 966-968. https://doi.org/10.1126/science.1152408

Khalil, M., Wong, J., de Koning, B., Ebner, M., & Paas, F. (2018, April). Gamification in MOOCs: A Review of the State of the Art. In *2018 IEEE Global Engineering Education Conference (educon)* (pp. 1629-1638). IEEE. https://doi.org/10.1109/educon.2018.8363430

Lean, J., Moizer, J., Derham, C., Strachan, L., & Bhuiyan, Z. A. (2020). Real World Learning: Simulation and Gaming. *Applied Pedagogies for Higher Education: Real World Learning and Innovation across the Curriculum*, 187-214. https://doi.org/10.1007/978-3-030-46951-1_9

Lee, K. (2017). Rethinking the Accessibility of Online Higher Education: A Historical Review. *The Internet and Higher Education*, *33*, 15-23. https://doi.org/10.1016/j.iheduc.2017.01.001

Li, F., Zhang, D., Wu, S., Zhou, R., Dong, C., & Zhang, J. (2023). Positive Effects of Online Games on the Growth of College Students: A Qualitative Study from China. *Frontiers in Psychology*, *14*, 1008211. https://doi.org/10.3389/fpsyg.2023.1008211

Lim, D., Sanmugam, M., & Yahaya, W. A. J. W. (2023). Addressing the Dilemma of Online Gamification with Subgame Perfect Equilibria. International Journal of Information and Education Technology, 13(4). https://doi.org/10.18178/ijiet.2023.13.4.1864

Mahmud, S. N. D., Husnin, H., & Soh, T. M. T. (2020). Teaching Presence in Online Gamified Education for Sustainability Learning. *Sustainability*, *12*(9), 3801. https://doi.org/10.3390/su12093801

Mozelius, P., & Hettiarachchi, E. (2017). Critical Factors for Implementing Blended Learning in Higher Education. *International Journal of Information and Communication Technologies in Education*, *6*(2), 37-51. https://doi.org/10.1515/ijicte-2017-0010

Olgers, T. J., Os, J. M. van, Bouma, H. R., & Maaten, J. C. Ter. (2022). The Validation of a Serious Game for Teaching Ultrasound Skills. The Ultrasound Journal. https://doi.org/10.1186/s13089-022-00280-8

Olgers, T. J., Weg, A. A. B. de, & Maaten, J. C. ter. (2021). Serious Games for Improving Technical Skills in Medicine: Scoping Review. *JMIR Serious Games*, *9*(1), e24093. https://doi.org/10.2196/24093

Oo, A., & Vallabhajosyula, R. (2022). Perceived Effectiveness of an Innovative Mobile-based Serious Game on the Improvement of Soft Skills in Minimally Invasive Surgical Training. *Asian Journal of Endoscopic Surgery*, *16*(1), 41-49. https://doi.org/10.1111/ases.13115

Pereverseff, R. S., & Bodner, G. E. (2020). Comparing Recollection and Nonrecollection Memory States for Recall of General Knowledge: A Nontrivial Pursuit. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *46*(11), 2207. https://doi.org/10.1037/xlm0000941

Pintado-Peñaloza, K. J., & Fajardo-Dack, T. (2022). Teaching English Vocabulary to Students Through Online Games. *Revista Arbitrada Interdisciplinaria Koinonía*, *7*(1), 4–22. https://doi.org/10.35381/r.k.v7i1.1676

Rahardja, U. (2019). Understanding How Gamification Influences Behaviour in Education. *International Journal of Advanced Trends in Computer Science and Engineering*, *8*(1), 269-274. https://doi.org/10.30534/ijatcse/2019/4781.52019

Rakhmanita, A., Kusumawardhani, P., & Anggarini, D. T. (2022). Gamification in Teaching Innovation: Perception of Teacher Adaptation with the Organism-Response Stimulus Paradigm. *Jurnal Education and Development*, *11*(1), 221-224. https://doi.org/10.37081/ed.v11i1.4330

Ricciardi, F., & Paolis, L. T. De. (2014). A Comprehensive Review of Serious Games in Health Professions. *International Journal of Computer Games Technology*, *2014*, 9-9. https://doi.org/10.1155/2014/787968

Rincon-Flores, E. G., & Santos-Guevara, B. N. (2021). Gamification during Covid-19: Promoting active learning and motivation in higher education. *Australasian Journal of Educational Technology*, *37*(5), 43-60. https://doi.org/10.14742/ajet.7157

Roediger, H. L., & Butler, A. J. (2011). The Critical Role of Retrieval Practice in Long-Term Retention. *Trends in Cognitive Sciences*, *15*(1), 20-27. https://doi.org/10.1016/j.tics.2010.09.003

Shaffer, D. W., Squire, K., Halverson, R., & Gee, J. P. (2005). Video Games and the Future of Learning. *Phi Delta Kappan*, *87*(2), 105-111. https://doi.org/10.1177/003172170508700205

Simamora, R. F., Fretes, D. de, Purba, E. A., & Pasaribu, D. A. U. (2020). Practices, Challenges, and Prospects of Online Learning During Covid-19 Pandemic in Higher Education: Lecturer Perspectives. *Studies in Learning and Teaching*, *1*(3), 185-208. https://doi.org/10.46627/silet.v1i3.45

Taş, N., Coşkun, M.R., Ayverdi, G. & Bolat, Y.İ. (2023). Matematik Eğitiminde Dijital Oyunlaştırma Etkinlikleri Kullanımının Ortaokul Öğrencilerinin Akademik Başarılarına ve Tutumlarına Etkisi. *International Journal of Eurasia Social Sciences*, 53, p. 1066-1081. Doi: 10.35826/ijoess.3347.

Taş, N., & Gülcü, A. (2019). *Bilgisayar Destekli Öğretimin Temelleri.* Erzurum: Ertual Akademi.

Wangi, N. B. S., Chandra, N. E., & Ali, A. (2022). Application of Gamification-Based Online Learning on Student Learning Outcomes During the Covid-19 Pandemic. *International Journal of Research and Review*, *9*(11), 554-561. https://doi.org/10.52403/ijrr.20221172

Wouters, P., Van Nimwegen, C., Van Oostendorp, H., & Van Der Spek, E. D. (2013). A Meta-analysis of the Cognitive and Motivational Effects of Serious Games. *Journal of Educational Psychology*, *105*(2), 249. https://doi.org/10.1037/a0031311

Author Information

Hamza Polat

https://orcid.org/0000-0002-9646-7507

Atatürk University, Faculty of Applied Sciences, Information Systems and Technologies

Erzurum

Türkiye

Contact e-mail: *hamzapolat@atauni.edu.tr*

Citation

Polat, H. (2023). Games and Gamification in Online Learning. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp. 110-125). ISTES Organization.

Chapter 11 – Assessment Based Games and Gamification

Önder Yıldırım

Chapter Highlights

- Games and gamification enhance learning and motivation in assessment.
- Gamification can be used in fields such as education, health, and human resource management.
- Gamification can effectively assess motor skills in children.
- Quantitative metrics include participation rate, completion rate, time spent, scoring, success rate, conversion rate, and repeat participation rate.
- Qualitative evaluation tools encompass interviews, focus groups, observation, diaries, participant observation, textual analysis, thematic analysis, and ethnographic approaches.
- Gamification motivates behavior tracking, improving participation and precision.
- Serious games and gamification support social and collaborative learning, focusing on performance, progress, and feedback.
- Gamification's future holds potential in various domains, with the need for further research.
- Learning analytics integrate with game-based assessments, aiding progress tracking and personalized learning.
- Gamification enhances engagement, motivation, and learning but requires clear objectives and ongoing improvement efforts.

Introduction

Games and gamification make learning more participatory and entertaining in tedious and demotivating measuring and evaluation circumstances. Measurement- and assessment-based games and gamification use game features and methods. This method can boost learning, motivation, and involvement in schooling (Lister et al., 2014). Gamification has been studied in education and learning. Gamification and serious games can improve learning (Gentry et al., 2019). The game or gamification must match the learning objectives. Learning quality should be prioritized over technology. Assessment-based games and gamification can boost engagement, motivation, and learning in many professions. However, comprehensive studies and professional recommendations are needed to ensure the efficacy and quality of these therapies (Gentry et al., 2019; Lister, 2014). Successful implementation requires interdisciplinary teamwork.

The Importance of Game and Gamification-Based Assessment

Several variables make games and gamification-based evaluation and intervention important. Gamification may increase task appeal and enjoyment, which can help modify behavior and increase intervention adherence. Gamification also engages shy or easily distracted people, increasing engagement and conversation (Song et al., 2017). Education, health sciences, and other fields use gamification. Gamification tactics can help students learn by making learning fun, increasing engagement, and improving results. Gamification in human resource management may improve work satisfaction, engagement, and performance (Taş et al., 2023). It may also improve corporate culture, solve internal concerns, and improve sales processes. Gamification in assessment can boost engagement and involvement.

One such instance involves effectively implementing gamified assessments within cognitive evaluations. According to Brons et al. (2021), using gamification can provide a viable approach for evaluating the fine motor abilities of youngsters through sensor-assisted toys and machine-learning methodologies. By incorporating gamification into the assessment process, individuals may have heightened motivation to engage in the evaluation and have the chance to demonstrate their talents effectively.

The significance of games and gamification for evaluation and intervention may be attributed to their ability to enhance motivation, engagement, and outcomes across several domains, including health, education, and human resource management. Including gamification components in examinations creates a heightened potential for actively motivating individuals to engage and get improved results. Nevertheless, it is imperative to acknowledge that in addition to the offered data about the advantages of gamification, several research have shown inconclusive or neutral outcomes. Furthermore, it is crucial to consider the methodological constraints associated with these studies (Johnson et al., 2016). Additional investigation is necessary to enhance comprehension of gamification's efficacy and possible hazards across various settings (Bolat & Taş, 2023; Murawski, 2020).

How Games, Gamification, and Evaluation Intersect?

The interplay between games, gamification, and assessment can manifest in several ways. The primary objective of gamification in assessment is to enhance results by integrating game aspects into pre-existing evaluation processes. Using game design concepts in this method enhances the assessment process, improving applicant answers and ensuring higher measurement quality (Landers et al., 2020). Assessment gamification aims to enhance applicants' impressions of institutional technology via immersive and regulated games (Landers et al., 2020). Nevertheless, it is important to note that the impact of gamification on several aspects of applicant responses, including attitudes toward exams, perceptions of procedural fairness, and institutional attractiveness, may exhibit variability.

Quantitative Metrics in Game and Gamification-Based Assessment

Games and gamification are interactive and dynamic methodologies that have been shown to promote learning, engagement, and motivation across many domains. The success of these initiatives is evaluated using quantitative measures. Quantitative metrics offer impartial evaluations derived from quantifiable facts. Several quantitative criteria often employed for evaluations of games and gamification include:

The participation rate statistic measures the frequency with which individuals who are the intended audience engage in games or activities incorporating gamification elements. The participation rate serves as a metric to gauge the level of attraction and appeal associated with a certain activity (Zichermann & Cunningham, 2011).
The completion rate measure pertains to the extent to which players successfully finish the game or gamified activities. The completion rate is a metric that measures the degree of success with which users can finish a certain activity (Haldar & Saha, 2022).

Time Spent: Haldar and Saha (2022) define time spent as the entire time users spend playing games or engaging in gamified activities. This indicates the efficacy and involvement of these initiatives. Scoring systems are popular in games. This measure helps evaluate learning or activity results by incorporating user scores and performance (Zichermann & Cunningham, 2011).

The success rate is the percentage of people who achieve a goal. According to Tlili and Chang (2019), games or gamified activities achieve their goals. Feedback assessments analyze user input on games or gamified activities, offering full user experience insights.

The conversion rate is the percentage of people who complete a training module in a certain activity (Zichermann & Cunningham, 2011). The repeat participation rate is a statistic that measures the frequency at which users engage in an activity many times. It indicates the activity's sustainability and impact (Haldar & Saha, 2022).

The metrics above serve as a limited selection of examples that may be employed to assess the efficacy of games

and activities based on gamification. However, several measures may be employed based on the particular circumstances or objectives.

Qualitative Evaluation Tools in Game and Gamification-Based Evaluation

Games and gamification are effective strategies for augmenting the process of learning, fostering engagement, and promoting motivation. Qualitative assessment methods are extensively employed to comprehend the effects of these approaches and the user experience. Qualitative assessment is a research approach that aims to get comprehensive knowledge of a phenomenon, such as users' experiences and learning processes, via in-depth exploration and analysis. Several qualitative assessment approaches are often employed to evaluate games and gamification. These methods include the following:

Semi-structured interviews include researchers or evaluators engaging in user interviews, wherein a lack of rigid framework characterizes the interviews but encompasses certain themes of interest. The approach above is employed to comprehensively comprehend users' experiences and extract their perspectives (Creswell & Creswell, 2017).

Focus group talks refer to interactive sessions conducted with a limited number of participants, typically organized in small groups. The approach above is employed to discern diverse perspectives and experiences and comprehend the impacts of educational procedures (Ragin, 2014).

The observation process entails people engaging in real-time gameplay or gamified activities. The approach above is employed to comprehend user behavior and engagement (Bal, 2012).

Diaries for User Documentation: Users can document their experiences using diaries or diary-like notes. The approach above entails capturing and analyzing the user experience throughout the process (Lallemand, 2012). Participant observation involves researchers observing real-world contexts in which individuals actively engage in games or gamified activities. The approach above is employed to comprehend interactions and experiences (Creswell & Creswell, 2017).

Textual analysis is used to gain insights into individuals' experiences and perspectives by examining written materials, such as comments and forum postings (Schreibman et al., 2008).

Thematic analysis is a qualitative research approach that systematically examining and interprets data to identify and understand recurring themes or patterns. The approach described in this study classifies user experiences and discerns significant concerns (Braun & Clarke, 2012).

The ethnographic approach involves comprehensive research to understand the social and cultural milieu in which users reside and their daily behaviors. Skinner (2013) uses this approach to comprehend the social and cultural

aspects of activities.

The aforementioned qualitative assessment methodologies serve as illustrative instances for comprehending the user experience, effects, and learning processes associated with games and activities, including gamification. The selection of an appropriate approach is contingent upon the specific objectives and circumstances of the study.

Behavior Tracking with Gaming and Gamification

Behavior monitoring may be accomplished using various approaches and components, such as using games and implementing gamification strategies. Gamification aims to enhance user motivation and involvement by incorporating game-like themes and mechanics into environments not traditionally associated with games (Morschheuser et al., 2017).

The implementation of gamification in the behavior monitoring process can serve as a motivating factor for individuals to engage in a more enjoyable and participatory approach to tracking their behavior. One of the techniques employed in monitoring behavior through games and gamification is the utilization of crowdsourcing platforms. Crowdsourcing platforms sometimes incorporate motivating design elements inspired by gaming, a phenomenon called "gamified crowdsourcing" (Morschheuser et al., 2017).

Integrating gamification components, such as scoring systems, leaderboards, and awards, can effectively motivate individuals to engage in crowdsourcing activities and produce precise and superior contributions using games and their implementation. This methodology can effectively observe and enhance the execution of tasks or the dissemination of information.

In summary, implementing gamification features inside crowdsourcing platforms, health and fitness applications, and electronic lifestyle activity monitors enables behavior monitoring through games and gamification. These features can motivate individuals to display desirable behaviors, monitor progress, and effectuate good transformations. However, further study is required to comprehensively understand gamification's efficacy in behavior monitoring and determine the most optimal gamification tactics for various situations and behaviors.

Behavior Tracking with Gaming and Gamification

Behavior monitoring may be accomplished using various approaches and components, such as using games and implementing gamification strategies. Gamification aims to enhance user motivation and involvement by incorporating game-like themes and mechanics into environments not traditionally associated with games (Morschheuser et al., 2017).

Assessing Social and Collaborative Learning with Games and Gamification

Social and collaborative learning can be evaluated using games and gamification in various ways and approaches. In evaluating serious games, it is important to assess user performance as part of gamified learning experiences (Bellotti et al., 2013). This evaluation involves assessing players' learning progress and outcomes and providing feedback to improve their learning experiences (Bellotti et al., 2013). Gamified learning experiences may be customized and adapted using assessments of performance. Styles, presentation speed, feedback types, etc., may be changed.

Effective serious game evaluation helps educators and creators understand how serious games affect learning and maximize learning results. However, serious games' abstract and non-measurable criteria are difficult to evaluate. To build and assess serious games, a systematic method and strategy based on known principles should be used (Bellotti et al., 2013). Through social interactions, gamification promotes collaborative and behavioral learning (Sailer & Homner, 2019). Combining cooperative and competitive games has improved behavioral learning outcomes. Collective games improve learning (Sailer & Homner, 2019). Adding social connections to gamified learning can improve its efficacy (An, 2020).

Gamification may motivate and engage students in learning settings. Gamifying learning can motivate students using game dynamics and strategies (Felszeghy et al., 2019). Gamification may improve learning by fostering interest, cooperation, and instant feedback. Gamified learning experiences that contain social features, including meeting obstacles, completing tasks, and celebrating successes, can improve social interaction and learning performance (An, 2020). Thus, assessing social and collaborative learning using games and gamification requires monitoring user performance, addressing individual requirements, adding social interaction, and enhancing engagement and motivation. Educators and designers may improve gamified learning experiences using a systematic approach and following recognized concepts and rules.

The Future of Gaming and Gamification-Based Assessment

The potential of games and gamification-based evaluation in many domains, such as education, health, business, and sustainability, has significant prospects for the future. Game-based learning has gained significant attention as a novel technique, particularly in medical education, and presents different instructional methodologies (Taş & Gülcü, 2019; Xu et al., 2023). Various gaming platforms have the potential to enhance player engagement, foster competitive dynamics, and fortify social connections (Taş et al., 2023b). According to Oyelere et al. (2022), within the realm of physical activity in educational institutions, multiplayer cooperative games have demonstrated efficacy in fostering physical activity engagement and enhancing children's enjoyment.

In order to ascertain psychological and behavioral consequences and investigate the subjective encounters of employees with gamification, it is important to direct attention toward various attributes inherent in games (Thomas et al., 2022). Nevertheless, gamification exhibits the potential to mold customer behavior due to its

ability to affect consumer behavior and foster heightened loyalty (Shahid & Arshad, 2021).

Gamification may be efficiently employed in the domain of sustainability. According to Mulcahy et al. (2021), integrating gamification techniques into sustainable initiatives can foster sustainable habits and modify customers' perceptions of sustainability by employing game design components based on rewards. To fully utilize the potential of games and gamification-based evaluation, it is imperative to identify and prioritize key topics for future study. According to Oyelere et al. (2022), it is imperative to incorporate gaming user interfaces, gamification components, and physical activity challenges to enhance the overall user experience. To create effective gamification strategies (Thomas et al., 2022), it is also important to understand how different game elements work together and how they affect psychological and cognitive factors.

In addition, researching the impacts of social interactions, such as collaborative teamwork and competitive leaderboards, might yield significant findings about the efficacy of gamification (Mulcahy et al., 2021). In summary, the outlook for games and gamification-based evaluation appears optimistic, exhibiting potential applications across several domains. Further investigation is necessary to enhance the conceptualization and execution of gamification tactics, delve into game elements' psychological and behavioral ramifications, and scrutinize the impacts of social interactions. Games and gamification can significantly transform several domains, including education, health, business, and sustainability.

Learning Analytics with Games and Gamification-Based Learning

The convergence of game- and gamification-based assessment and learning analytics occurs at several junctures. Learning analytics can gather and examine data derived from evaluations that are based on games. This methodology encompasses the utilization of game-based examinations, which employ games to evaluate students' knowledge and aptitude. Learning analytics can offer suggestions on learning progress and results by monitoring students' activities inside the game, including their choices, actions, and performance.

Kim et al. (2022) suggest using this data to identify problem areas, provide personalized feedback, and improve pedagogy. Another approach is to utilize learning analytics to evaluate game-based learning interventions. Researchers and educators can assess game-based learning interventions' effects on learning outcomes by measuring students' engagement, progress, and performance. Game-based learning methods can help determine their pros and cons, guiding future intervention strategies (Li et al., 2023). Learning analytics may also help develop game-based learning experiences. Students' interactions with game elements like points, badges, and leaderboard advancement help designers understand their motivation and engagement (Arsarkij & Laohajaratsang, 2021). Rasco et al. (2020) found insights that can improve game-based learning experiences and their efficacy. Additionally, learning analytics may help create adaptive game-based learning experiences. Tenório et al. (2020) say learning analytics can track students' progress in game-based learning. This lets the system adjust difficulty, teaching materials, and student feedback. A personalized technique can improve learning results and student engagement and motivation, according to Wangi et al. (2022).

In summary, there are several points of intersection between gaming, gamification-based learning, and learning analytics. Learning analytics can collect and analyze data from game-based assessments, measure the effectiveness of game-based learning interventions, help create and improve game-based learning experiences, and help make learning more adaptive. These intersections have a role in boosting assessment procedures and increasing learning outcomes within educational settings.

Conclusion

Games and gamification-based evaluation have possibilities in education, health, business, and sustainability. This strategy boosts engagement, motivation, and learning outcomes by making assessment and evaluation more interactive and engaging. Traditional approaches can be monotonous and demotivating. Gamification may improve learning outcomes in school by transferring information and skills. This method can encourage and improve student performance by encouraging involvement and making learning interesting. Gamification can improve health-related physical activity and lifestyle behaviors. Gamification improves corporate performance, training, and work happiness. Game elements and tournaments can boost workplace cooperation and engagement. Gamification can also boost evaluation findings. Gamification may change consumer behavior and promote sustainability. Reward systems and games can improve customers' sustainability attitudes and boost eco-friendly behavior. Careful reviews and professional criteria are needed to ensure gamification's efficacy and quality. This field supports gaming and gamification-based evaluation, although methodological constraints and hazards must be acknowledged. Quantitative and qualitative measures assess game and gamification efficacy. Measurable indicators like participation rate, completion rate, time spent, etc., objectively assess user behavior. In-depth qualitative metrics like semi-structured interviews and focus group discussions provide more extensive user experience research. Games and gamification promote and track desirable behaviors on crowdsourcing platforms and health apps. Game features like incentives and leaderboards on crowdsourcing platforms might motivate users to complete jobs. Health applications can use gamification to boost exercise and treatment compliance. In conclusion, game- and gamification-based evaluation works in education, business, health, and sustainability. As with any application, it should be created to meet objectives, address user demands, be reviewed with effective metrics, and be constantly enhanced. More areas and industries will employ gamification and assessment to boost creativity and engagement.

Chapter Summary

This chapter discusses how games and gamification improve learning, motivation, and engagement compared to traditional assessment and evaluation methods. Gamification is employed in education, business, and other industries, and assessment quality and efficacy are crucial to its success. In this chapter, this technique is used and assessed in education, health, and human resource management. Games and gamification boost engagement, motivation, and learning and offer exciting career options. However, extensive examinations and professional norms are needed to ensure this approach's efficacy. Games and gamification boost engagement, motivation, and

learning and offer exciting career options. However, extensive examinations and professional norms are needed to ensure this approach's efficacy. Gamification indicators, both quantitative and qualitative, are also provided. Quantitative indicators, including participation, completion, time spent, scoring, and scores, can quantify learning benefits. Instead, qualitative measurements like interviews, focus groups, and observation can help understand the user experience. It discusses how gaming and gamification affect social and collaborative learning. Social interaction and gamification improve collaborative learning. In conclusion, this chapter examines evaluation using games and gamification, their effects, hazards, and future studies.

References

An, Y.-J. (2020). Designing Effective Gamified Learning Experiences. *International Journal of Technology in Education*, *3*(2), 62-69. https://doi.org/10.46328/ijte.v3i2.27

Arsarkij, J., & Laohajaratsang, T. (2021). A Design of Personal Learning Network on Social Networking Tools with Gamification for Professional Experience. *International Journal of Emerging Technologies in Learning*, *16*(18), 53-68. https://doi.org/10.3991/ijet.v16i18.25159

Bal, H. (2012). *Bilimsel Araştırma Yöntemleri: Nicel Araştırma Yöntemi*. Fakülte Kitabevi.

Bellotti, F., Kapralos, B., Lee, K., Moreno-Ger, P., & Berta, R. (2013). Assessment in and of Serious Games: An Overview. *Advances in Human-Computer Interaction*, *2013*, 1-1. https://doi.org/10.1155/2013/136864

Braun, V., & Clarke, V. (2012). *Thematic analysis*. American Psychological Association.

Bolat, Y. İ., & Taş, N. (2023). A meta-analysis on the effect of gamified-assessment tools on academic achievement in formal educational settings. *Education and Information Technologies*, 28(5), 5011–5039. https://doi.org/10.1007/s10639-022-11411-y

Brons, A., Schipper, A. W. de, Mironcika, S., Toussaint, H. M., Schouten, B., Bakkes, S., & Kröse, B. (2021). Assessing Children's Fine Motor Skills with Sensor-Augmented Toys: Machine Learning Approach. *Journal of Medical Internet Research*, *23*(4), e24237. https://doi.org/10.2196/24237

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Felszeghy, S., Pasonen-Seppänen, S., Koskela, A., Nieminen, P., Härkönen, K., Paldanius, K. M. A., Gabbouj, S., Ketola, K., Hiltunen, M., Lundin, M., Haapaniemi, T., Sointu, E., Bauman, E. B., Gilbert, G. E., Morton, D. A., & Mahonen, A. (2019). Using Online Game-Based Platforms to Improve Student Performance and Engagement in Histology Teaching. *BMC Medical Education*, *19*, 1-11. https://doi.org/10.1186/s12909-019-1701-0

Gentry, S., Gauthier, A., Ehrstrom, B. L., Wortley, D., Lilienthal, A., Car, L. T., Dauwels-Okutsu, S., Nikolaou, C. K., Zary, N., Campbell, J., & Car, J. (2019). Serious Gaming and Gamification Education in Health Professions: Systematic Review. *Journal of Medical Internet Research*, *21*(3), e12994. https://doi.org/10.2196/12994

Haldar, S., & Saha, S. (2022). *The routledge handbook of education technology*. Routledge India.

Johnson, D., Deterding, S., Kuhn, K. L., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for Health and Wellbeing: A Systematic Review of the Literature. *nternet interventions*, *6*, 89-106. https://doi.org/10.1016/j.invent.2016.10.002

Kim, Y. J., Ruipérez-Valiente, J. A., Ifenthaler, D., Harpstead, E., & Rowe, E. (2022). Analytics for Game-Based Learning. *Journal of Learning Analytics*, *9*(3), 8-10. https://doi.org/10.18608/jla.2022.7929

Lallemand, C. (2012). Dear Diary: Using Diaries to Study User experience. *User Experience Magazine*, *11*(3). https://orbilu.uni.lu/handle/10993/37705

Landers, R. N., Auer, E. M., & Abraham, J. R. (2020). Gamifying a Situational Judgment Test with Immersion and Control Game Elements. *Journal of Managerial Psychology*, *35*(4), 225-239. https://doi.org/10.1108/jmp-10-2018-0446

Li, Q., Yin, X., Yin, W., & Dong, X. (2023). Evaluation of Gamification Techniques in Learning Abilities for Higher School Students Using FAHP and EDAS Methods. *Soft Computing*, 1-19. https://doi.org/10.1007/s00500-023-08179-9

Lister, C., West, J. H., Cannon, B., Sax, T., & Brodegard, D. (2014). Just a Fad? Gamification in Health and Fitness Apps. *JMIR Serious Games*, *2*(2), e3413. https://doi.org/10.2196/games.3413

Montag, C., Schivinski, B., Sariyska, R., Kannen, C., Demetrovics, Z., & Pontes, H. M. (2019). Psychopathological Symptoms and Gaming Motives in Disordered Gaming—A Psychometric Comparison Between the WHO and APA Diagnostic Frameworks. *Journal of Clinical Medicine*, *8*(10), 1691. https://doi.org/10.3390/jcm8101691

Morschheuser, B., Hamari, J., Koivisto, J., & Maedche, A. (2017). Gamified Crowdsourcing: Conceptualization, Literature Review, and Future Agenda. *International Journal of Human-Computer Studies*, *106*, 26-43. https://doi.org/10.1016/j.ijhcs.2017.04.005

Mulcahy, R., McAndrew, R., Russell-Bennett, R., & Iacobucci, D. (2021). "Game On!" Pushing Consumer Buttons to Change Sustainable Behavior: A Gamification Field Study. *European Journal of Marketing*, *55*(10), 2593-2619. https://doi.org/10.1108/ejm-05-2020-0341

Murawski, L. (2020). Gamification in Human Resource Management—Status Quo and Quo Vadis. *German Journal of Human Resource Management*, *35*(3), 337-355. https://doi.org/10.1177/2397002220961796

Oyelere, S. S., Berghem, S. M., Brännström, R., Rutberg, S., Laine, T. H., & Lindqvist, A.-K. (2022). Initial Design and Testing of Multiplayer Cooperative Game to Support Physical Activity in Schools. *Education Sciences*, *12*(2), 100. https://doi.org/10.3390/educsci12020100

Ragin, C. C. (2014). *The comparative method: Moving beyond qualitative and quantitative strategies*. Univ of California Press.

Rasco, A., Chan, J., Peko, G., & Sundaram, D. (2020). Fincraft: Immersive personalised persuasive serious games for financial literacy among young decision-makers. In *Proceedings of the 53rd Hawaii international conference on system sciences* (pp. 32-41). https://doi.org/10.24251/hicss.2020.006

Sailer, M., & Homner, L. (2019). The Gamification of Learning: A Meta-Analysis. *Educational Psychology Review*, *32*(1), 77-112. https://doi.org/10.1007/s10648-019-09498-w

Schreibman, S., Siemens, R., & Unsworth, J. (Eds.). (2008). *A companion to digital humanities*. John Wiley & Sons.

Shahid, A., & Arshad, S. (2021). Gamification and Consumer Loyalty: The Role of Utilitarian and Hedonic Benefit. *Lahore Journal of Business*, *10*(1). https://doi.org/10.35536/ljb.2021.i1.v10.a2

Skinner, J. (Ed.). (2013). *The interview: An ethnographic approach* (Vol. 49). A&C Black.

Song, D., Ju, P., & Xu, H. (2017). Engaged Cohorts: Can Gamification Engage All College Students in Class?

Eurasia Journal of Mathematics, Science and Technology Education, *13*(7), 3723-3734. https://doi.org/10.12973/eurasia.2017.00755a

Taş, N., Bolat, Y. İ. & Savaş Başkara, Ö. (2023). Blok Tabanli Oyunlaştırılmış Öğretimin Bilgi-Işlemsel Düşünme ve Kodlamaya Yönelik Tutuma Etkisi. *EKEV Akademi Dergisi, 0* (95), 238-255. DOI: 10.17753/sosekev.1268523

Taş, N., Coşkun, M.R., Ayverdi, G. & Bolat, Y.İ. (2023)[b.] Matematik Eğitiminde Dijital Oyunlaştırma Etkinlikleri Kullanımının Ortaokul Öğrencilerinin Akademik Başarılarına ve Tutumlarına Etkisi. *International Journal of Eurasia Social Sciences*, 53, p. 1066-1081. Doi: 10.35826/ijoess.3347.

Taş, N., & Gülcü, A. (2019). *Bilgisayar Destekli Öğretimin Temelleri.* Erzurum: Ertual Akademi.

Tenório, K., Dermeval, D., Challco, G. C., Lemos, B., Nascimento, P., Santos, R., & da Silva, A. P. (2020, November). An Evaluation of the GamAnalytics Tool: Is the Gamification Analytics Model Ready for Teachers? In *Anais do XXXI Simpósio Brasileiro de Informática na Educação* (pp. 562-571). SBC. https://doi.org/10.5753/cbie.sbie.2020.562

Tlili, A., & Chang, M. (2019). *Data analytics approaches in educational games and gamification systems*. Springer Singapore.

Thomas, N., Baral, R., & Crocco, O. S. (2022). Gamification for HRD: Systematic Review and Future Research Directions. *Human Resource Development Review*, *21*(2), 198-224. https://doi.org/10.1177/15344843221074859

Wangi, N. B. S., Chandra, N. E., & Ali, A. (2022). Application of Gamification-Based Online Learning on Student Learning Outcomes During the Covid-19 Pandemic. *International Journal of Research and Review*, *9*(11), 554-561. https://doi.org/10.52403/ijrr.20221172

Xu, M., Luo, Y., Zhang, Y., Xia, R., Qian, H., & Zou, X. (2023). Game-Based Learning in Medical Education. *Frontiers in Public Health*, *11*, 1113682. https://doi.org/10.3389/fpubh.2023.1113682

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. " O'Reilly Media, Inc.".

Author Information

Önder Yıldırım

https://orcid.org/0000-0003-4333-2323

Erzincan Binali Yıldırım University

Erzincan

Turkiye

Contact e-mail: *oyildirim@erzincan.edu.tr*

Citation

Yıldırım, Ö. (2023). Assessment Based Games and Gamification. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp.126 -136). ISTES Organization.

Chapter 12 – Smart Toys

Abdulkerim Aydın

Chapter Highlights

- Explains the importance of smart toys in education and the pedagogical value of play-based learning.
- Information about the definition, characteristics, context, benefits, development process, types, and categories of smart toys used in education is given.
- The contributions of smart toys to learning processes and their potential to support cognitive, physical, social, and affective development are discussed.
- Smart toys' potential for use in special education, language education, coding, mathematics, and digital storytelling was emphasized.
- Positive aspects and gains of smart toys in education, potential risks, and considerations for students' safety are discussed.
- What should be considered when choosing smart toys for parents, and teachers was explained.
- Explanations are made to express the future potential of smart toys, and important questions are raised. It discusses how smart toys can be used more effectively in education and how they can transform educational processes.
- The role and importance of smart toys in education are again emphasized, and important recommendations and implications for policymakers, technology developers, educators, parents, students, and researchers are presented.

Introduction

Playing with toys is one of the most critical moments people experience at every stage of life. These moments are remembered as lasting learning experiences and contribute significantly to one's development. Playing with toys can be considered a fun activity and one of the cornerstones of learning and development. It is, therefore, essential to examine how this play process affects people's lives and contributes to their learning process. Play and toys play a vital role in the development of students. Play is an element that contributes positively to students' cognitive, physical, social, and affective development. It also allows them to move freely, express their emotions, communicate, and explore the world around them according to their age group. Toys support students' ability to learn in a fun way and have interactive experiences.

The use of technology brings a new dimension to the world of toys. While traditional electronic or digital toys often use technology to enhance the toy's appeal, smart toys integrate technology meaningfully so that students can perform interactive and purposeful tasks (Cagiltay et al., 2014). Technology toys are not all smart toy. Smart toys and technological toys should be distinguished. Smart toys provide rich, engaging, and novel learning experiences, especially in education. In this environment, toy technology has become increasingly significant.

Smart toys may help youngsters learn and grow. To start, these toys are instructive. They assist students in learning math, language, and science. They encourage early skill acquisition and make learning more pleasant and participatory. Also, smart toys help kids learn to solve problems. Such toys can teach students problem-solving and creativity. Smart toys' voice recognition and speech capabilities help youngsters learn new words and enhance their language skills. Smart toys' entertaining and engaging character might motivate students to study. Through multiplayer games, certain smart devices can help children improve social skills by fostering interaction with friends and family. Smart toys accelerate technological familiarization for young kids. Today's technology-driven environment makes this crucial to students' success. It also benefits parents. Parents can track their children's progress and help them learn using smart toys. This allows students to enjoy learning experiences that fit their speed and style.

Finally, smart toys provide preparation for the skills of the future. They allow students to learn about digital technology, programming, and other vital subjects. This helps them be better prepared for the age of technology and step into a competitive world of work. Smart toys contribute positively to the education and development of students and better prepare them for the future. Why smart toys are educationally meaningful can be summarized in the following five features:

1. They can provide essential activities that lead to memorable learning experiences in people's lives.
2. They can contribute to the development of students' cognitive, physical, social, and affective skills by increasing the role of technology in the world of education.
3. Provide parents with the opportunity to observe and understand their children better.
4. It can help students have experiences that match their learning pace and style.
5. Provide an environment for teaching future skills (problem-solving, creative thinking, computational thinking, etc.).

Definition of Smart Toys

Classic toys may arouse curiosity in students and cause them to spend more time with them. Innovative technologies used in toys (augmented reality, virtual reality, sensors, etc.) can engage students in the long-term or short-term. Moreover, students' various skills may improve. For example, in a lesson with toys, students may listen to the class more attentively. In this case, it can be assumed that there is an improvement in students' attention. However, what is essential in education and training processes is that permanent behavioral changes occur in students. For this reason, it is not enough for a toy to have various technologies and for students to interact with it for a long time. A toy must have pedagogical value and a purpose to be considered smart. Classical toys and smart toys are different from each other. Smart toys provide a technologically rich environment for individuals to interactively complete purposeful educational tasks (Nikolopoulou, 2021).

The most critical issue in defining a smart toy is that it serves a specific task and purpose. This purpose can provide cognitive, physical, social, or affective gains. From this point of view, smart toys play games and support mutual interaction and purposeful tasks. Cagiltay et al. (2014) defined smart toys as types used to perform tasks for a specific purpose, increase student-material interaction, and include physical and electronic components. Purpose, interactivity, physical and electrical components compose smart toys.

1. *Purpose*: Smart toys are designed to make learning entertaining. Smart toys are highly important for their purpose. A smart toy can teach letters, numbers, math, or problem-solving. Smart toys should be designed with educational ideas in mind.
2. *Interaction*: Smart toys respond to and interact with learners. The toys respond to pupils' voices, touches, and motions. A smart toy can answer children's inquiries, follow their orders, and react during games. Interactivity helps pupils learn from toys.
3. *Physical and Electronic Components*: Smart toys include physical and electronic components. Material components are the things that make up the external appearance and texture of toys. They can be made of plastic, fabric, or wood. Electronic components are items in the toy, such as electronic circuits, sensors, microphones, speakers, and displays. These components help the toys record sounds, detect movement, and interact with learners. It may have a microprocessor, a microcontroller, a memory storage device, and many input and output units.

The three elements (purpose, interactivity, and physical and electronic components) shape smart toys' functionality, interactivity levels, and educational goals. The design and function of smart toys can be customized according to students' ages and educational needs. A unique educational environment is created when smart toys are used in educational processes. This environment can be called a smart toy environment. The components in the smart toy environment can be listed as follows:

1. *Physical Object:* The physical object is the primary carrier of smart toys. This can be a toy, gaming board, robot, or play element. This item interacts directly with the toy.
2. *Software*: Software controls and directs smart gadgets. The program has speech recognition, motion

detection, and narrative from the toys.

3. *Interface*: This part describes how the smart toy may be used. Touch screens, buttons, and voice instructions make smart toys usable.
4. *Interaction*: The interaction component controls smart toys' user responses. It includes the ability of the toys to detect and respond to the user's voice or touch.
5. *Individual*: This component represents the person using the smart toys. Smart toys recognize individual users and provide functionality based on this information to deliver experiences appropriate to their age, interests, learning levels, and personal preferences.
6. *Environment*: Smart toys consider the physical or digital environment in which they are used. This includes the ability of toys to sense their environment and provide an appropriate experience for the user. An example is the ability of characters within a game to adapt to the environment. The context created by the previous five components can be called the environment.

Benefits of Smart Toys

The use of smart toys in education and training processes provides various benefits. These benefits include supporting students' motivation, increasing student-content interaction, enabling creative thinking skills, offering individual activities, and creating learning environments everywhere.

Motivation

Toys are tools that have the potential to motivate students to achieve a certain goal. Smart toys can be considered toys that can support students' motivation. Motivation is provided by a driving force originating from outside (extrinsic motivation) or inside (intrinsic motivation). Malone and Lepper (1987) emphasize that learning processes should be intrinsically motivated, and toys are objects that can trigger inherent goals. A smart toy must have motivational elements to be motivating. Malone and Lepper (1987) say motivation comprises four aspects. These include challenge, curiosity, control, and fantasy.

Challenge: Smart toys offer mental and physical activities and puzzles to challenge students. This can increase students' self-confidence and problem-solving skills. Smart toys with arithmetic challenges or science experiments can challenge students.

Curiosity: Smart toys boost students' interest via interactive and exploratory activities. Asking questions or giving them intriguing assignments might engage them. Students' learning enthusiasm may increase. Students may use chemistry sets to experiment with power color changes and chemical reactions.

Control: Smart toys motivate students by giving them control. Choices and decisions may customize learning for kids. This can help students flow and focus in the game. Programming toys let kids make games and projects. Students program characters, build gaming worlds, and monitor results.

Fantasy: Students may engage their imagination with smart toys. Storytelling and role-playing may spark students' imaginations. This fosters creativity and makes learning fun. An interactive storytelling toy can help students write and listen to stories.

The examples described illustrate how smart toys target key components of motivation. Using challenge, curiosity, control, and fantasy, smart toys encourage learning and make the learning experience more motivating and enjoyable. In this way, it is possible to encourage students to be more eager to learn and to learn deeply.

Interaction

One of the most important components of the material development process is interaction. When a material offers a high level of interactivity, it enables students to acquire the targeted outcomes more easily. The interaction element in most materials and content is handled separately and planned sensitively. Smart toys differ from other materials in terms of interaction. Because there is tactile interaction in smart toys, students can physically play with the toys, give commands, and watch and listen to the results. Resnick (1998) emphasizes that maintaining toy interaction positively affects learning processes. Smart toys encourage students to learn by touching and experiencing.

Concretization of abstract concepts and students' learning through experience play a fundamental role in the effectiveness of educational activities (Evripidou et al., 2021). Therefore, students need to be provided with concrete materials, and their active participation in learning processes should be encouraged. Piaget (1955) emphasized the importance of students making sense of information from their perspectives by interacting with educational materials. Bruner (1966) explains that learning is a process of touching, feeling, interacting, and using sense organs. Students who learn through tactile interaction may be able to concretize abstract concepts with physical objects (Merkouris et al., 2019). As a result, using tangible materials in educational processes and conducting research on these materials can enable students to have more in-depth learning experiences. This approach supports lasting learning by encouraging students to involve more sensory organs in the learning process. For example, in the material named IoTES (Internet of Things-Based Electrical Experiment Set), it is seen that students try to interact with touch (Aydin, 2023). Through this material, the serial and parallel connection topics in the seventh-grade science subject of Electrical Circuits are learned interactively (Figure 1).

Figure 1. IoTES (Internet of Things-Based Electricity Experiment Set)

Creative Thinking Skills

The fact that students not only play with toys but also produce original content using the modules, parts, and equipment in toys can trigger their creative thinking skills to a great extent. This shows that smart toys function as a platform that enables the development of imagination and creative thinking skills. Moreover, the open-ended features of smart toys can further enhance students' creative thinking potential by providing an experience that does not limit their activities. Smart toys allow students to discover new things and create games instead of just playing certain games (Kara & Cagiltay, 2020). In Kara et al. (2014), StoryTech is an example. Students construct digital stories using this toy. Smart toys let kids play predefined games and create material, fostering creativity.

Individuality

A smart toy can collect and store data about a student's interactions and preferences, enabling it to provide tailored responses and reactions to that student (Kucirkova & Flewitt, 2020). This personalization may benefit education. Smart toys can assess student learning styles, pace, and requirements. This allows teachers and parents to track students' progress and customize education. Math testing software can track students' strengths and shortcomings. This data can identify student needs and inform learning tactics. A language learning app may measure a student's vocabulary improvement and provide customized lists. Therefore, smart toys' data collection capabilities boost education and help every kid succeed.

Ubiquitous Learning Environment

Smart toys have portability benefits. Due to their lightweight and portable design, students may use them at home, school, the park, or while traveling. This mobility lets kids study in different places. In addition, smart toys may be used offline. These toys provide offline learning for students without internet access. This is a major benefit in areas with poor internet connectivity. Smart toys enable learning anywhere.

Types of Smart Toys

Smart toys have evolved to offer more than just entertainment; they can now seamlessly integrate with other hardware and software components to expand their features and capabilities. For instance, a smart toy component can be linked with additional hardware to enhance its processing power or connect to online cloud-based gaming and computing services. This adaptability makes smart toys highly customizable, enriching the user experience, particularly in educational contexts. However, categorizing smart toys based solely on the devices they interact with, such as computers or tablets, can be overly restrictive. Smart toys are diverse and multifaceted, warranting a more comprehensive classification approach.

Considering several criteria to provide a more nuanced classification system is essential. First, technology-type categorization involves classifying smart toys based on the technology they employ. Some smart toys, like robots or programmable toys, are designed to interact with physical devices. In contrast, others are fully integrated with

digital platforms, such as mobile apps or web-based games. Second, assessing the function of smart toys is crucial, as it determines their purpose. Some are geared towards educational and training objectives, while others focus on fostering creative thinking skills or physical activity. Third, communication capabilities are vital, encompassing how smart toys interact with users or other toys through Wi-Fi, Bluetooth, or other communication protocols.

Additionally, considering the educational and training purposes of smart toys is paramount. They can be tailored for specific academic goals, such as math learning, language development, science discovery, or coding skills. Finally, age groups can be used as a classification criterion, acknowledging that smart toys can appeal to different demographics, including children, teenagers, and adults. By employing these criteria, we can classify smart toys more comprehensively and specifically, accounting for their technology type, function, communication capabilities, educational objectives, and target age groups. This approach facilitates a better understanding of smart toys' diverse landscape and potential applications.

Development Process of Smart Toys

The smart toy development process focuses on several fundamental steps. These steps involve identifying components, addressing data security and energy efficiency concerns, and following a structured approach to ensure successful development. According to de Albuquerque Wheler et al. (2020) outline, a few crucial steps exist in developing smart toys.

First, it begins with determining the educational purpose of the smart toy. This purpose sets the stage for defining the learning experience it aims to provide to its intended audience. Next, the hardware and software components necessary for the toy are identified. These components range from sensors and processors to displays, speakers, and software applications. The choice of boards for programming or operating systems comes next. Common options include boards like the Arduino or Raspberry Pi, depending on the specific requirements of the toy. Determining the communication paths is crucial. This involves deciding how the smart toy will interact with users or other devices, including Wi-Fi, Bluetooth, or other wireless protocols. Data security measures are a top priority, especially for children's toys. Robust data security protocols and encryption methods are applied to protect user data. Efforts to optimize energy consumption follow. These measures aim to efficiently use batteries or rechargeable energy sources, extending battery life while minimizing environmental impact.

User interface (UI) and user experience (UX) design are important aspects of the process. Creating an intuitive and enjoyable interaction with the toy is a key consideration. A pilot trial tests the toy prototype, gathers valuable user feedback, and identifies and addresses bugs or issues. Deficiencies discovered during the pilot trials are rectified, and the development process may be repeated. Finally, the smart toy is deemed ready for end users, marking the start of the production phase, during which the final product is made available to consumers.

These steps are critical for completing the smart toy development process successfully. Each step should be

meticulously planned and adjusted as needed, with a strong focus on security, data privacy, and the well-being of the intended users. These steps can be executed sequentially or iteratively until the smart toy is ready for deployment (Figure 2).

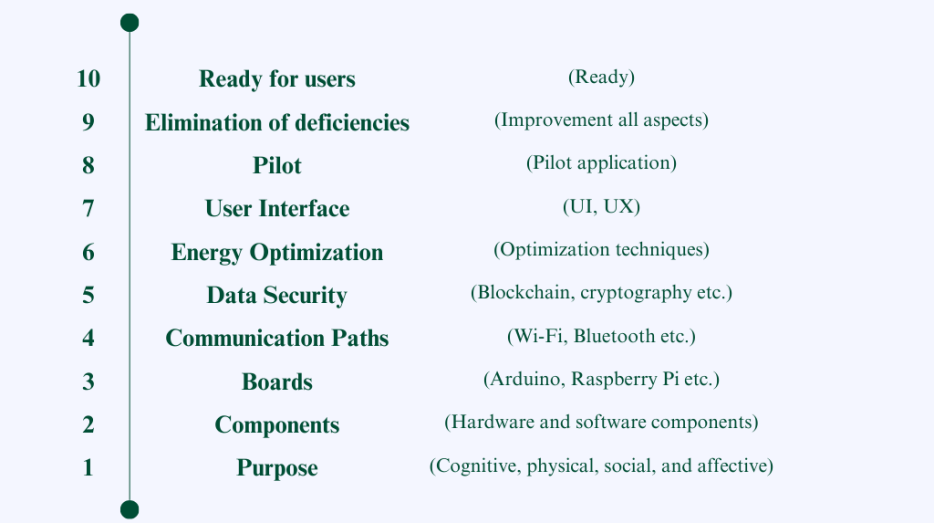


Figure 2. Development Process of Smart Toys

Usage Areas of Smart Toys

Smart toys are used in various fields. It can be stated that they are more widely used in special education, language education, coding, mathematics, and digital story creation. The following sections provide examples and clarify their application in these areas:

Special Education

Smart toys have a critical function in education. First, these toys enable personalized learning. They can be customized for special education students. This allows toys to be tailored to the student's learning style and speed (Ekin et al., 2016). This customization helps each kid reach their potential and improves learning. However, smart devices can help special education children communicate. Autism spectrum disorder toys can help youngsters learn language and communication. By improving communication and social skills, these toys can help children in special education connect with their surroundings. A language therapy student's smart toy can use customized exercises to develop speech and language abilities. The learner can play with the toy to improve sound recognition and pronunciation. It might involve mimicking emotions or social situations.

Language Education

Smart toys assist in building language and communication abilities in numerous aspects. These toys assist language skills via voice recognition. Voice recognition helps students learn vocabulary and pronunciation.

Digital storytelling is also possible with smart toys. Storytelling talents may be developed using this function. Creative thinking and language development require storytelling. Smart toys make learning these abilities entertaining and informative. Thus, smart toys boost language and creativity. A smart device can teach English words through an interactive game. The smart toy may utter a comment and ask the student to show or utilize its meaning.

Coding

Smart toys are good at teaching coding, which is crucial for future abilities. These devices make learning programming enjoyable and engaging. These toys teach fundamental coding concepts through games and puzzles. This dramatically improves their reasoning and problem-solving skills. Students may utilize their ideas to develop projects while studying programming. This helps students build technical and creative thinking capabilities. An elementary school smart toy may teach coding. The toy lets you provide commands and see the outcomes. Smart toys like Dash Robot (https://www.makewonder.com/robots/dash/) teach coding principles (Figure 3). In conclusion, smart toys offer a fun and informative approach for youngsters to prepare for the digital age.

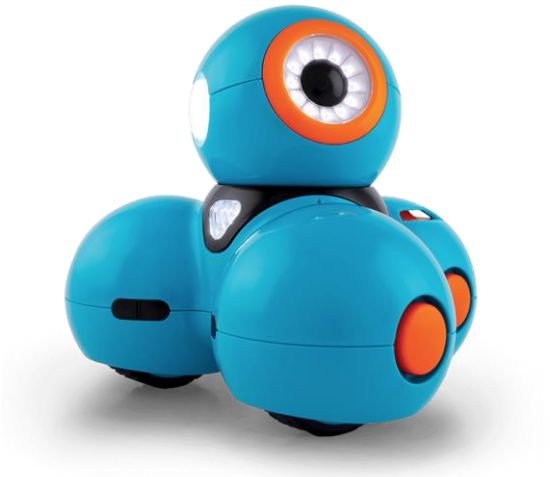


Figure 3. Dash Robot

Mathematics

Smart toys may help kids learn math, numbers, and problem-solving. These toys make arithmetic entertaining for kids. Math games improve numerical comprehension and fundamental math operations. Mathematically challenged kids benefit from them. Smart devices make ideas more tangible for students. Problem-solving abilities may be developed using smart toys. The toys teach students to tackle complicated issues logically. These games improve students' critical thinking and problem-solving skills. Smart devices may make arithmetic and problem-solving fun and engaging for students.

Digital Storytelling

Smart toys can improve students' storytelling. These digital storytelling tools allow students to create stories, characters, and sequences. Through these toys, students learn to tell tales. Creative thinking increases when character traits, story world design, and event preparation are considered. These smart devices also let students tell tales. This boosts students' self-esteem and communication abilities. Students can also learn empathy and emotional intelligence via storytelling. Students can grasp others' viewpoints since stories depict diverse characters' experiences. Smart toys like Story Tech are utilized for digital storytelling (Kara et al., 2014). In conclusion, smart toys provide a creative learning experience for kids who wish to improve their storytelling, communication, and empathy abilities.

Potential Barriers and Possible Enablers

While smart toys make valuable contributions to education and training processes, they also pose some risks in terms of security and privacy (Nikolopoulou, 2021). These toys can communicate with different devices; data flow and storage processes occur during this communication. The security of this data is extremely important. Smart toys that can connect to the internet have the potential to collect active or passive information about users. For example, a student can interact with a toy robot, and in the process, the toy can record the student's data (name, date of birth, location, etc.). This data can then be used and shared. Furthermore, sensors or cameras in internet-connected toys can be intercepted by malicious actors, raising serious concerns about the right to privacy of young children and their families.

IoToys (Internet of Toys) systems, in particular, pose potential risks, such as the leakage of students' personal information, and the consequences of such threats can be potentially devastating for young users. Some smart toys may solicit personal information, while others may passively collect it to infer usage patterns or improve personalization. It is therefore important to increase safeguards around smart toys' privacy and security measures and encourage users to be more aware of protecting their information. The security of smart toys is of paramount importance for the protection of users' data. Therefore, the types of attacks and defenses against data collected from smart toys must be analyzed in detail. Rivera et al. (2019) examined these types of attacks and addressed vulnerabilities.

Regarding data security, the classification of vulnerabilities is of great importance, and Shasha et al. (2018) have made an important contribution in this regard. In addition, legal regulations such as the Children's Online Privacy Protection Act (COPPA) in the US, the General Data Protection Regulation (GDPR) in Europe, and the Personal Data Protection Law (KVKK) in Turkey are important steps towards protecting users' data. Measures that can be taken for data security include two-step authentication, storing data with technologies such as blockchain and encryption, taking security measures in cases where data flow is used, and properly managing cookie policies. In addition, developing algorithms and interfaces that parents can use to keep their children safe can play an

important role in completing data security measures (de Paula Albuquerque et al., 2022).

Technology developers must collaborate with educators in the design of smart toys. When smart toys are used as tools for educational purposes, the age range to which they will appeal should be carefully determined. This means correctly adjusting the toy's content, difficulty levels, and learning objectives. By considering students' cognitive and affective developmental levels, educators can assess how appropriate smart toys are for specific age groups. Parents must also consider these age groups and their children's growth. The demands of each child vary; therefore, a smart toy may not work for another child of the same age. Parents should examine their children's educational and entertainment needs when deciding if the item suits its content and purpose. This way, children can play safely and get the best learning experience.

The success and effectiveness of smart toys depend on the quality and necessity of their content. Therefore, content design should be carefully considered when developing smart toys. The quality of the content should engage learners, be relevant to educational goals, and consider age and developmental levels. Smart toys with an educational purpose should provide students with useful information and support their learning process. The toys' content should be relevant to the needs and objectives of the students' academic lives. Only necessary or adequate content can reduce the impact of toys and positively affect learning experiences. For this reason, a range of smart toys should be designed and continuously evaluated in collaboration with experts in the field. In this way, smart toys can contribute more to educational processes.

Another important issue in smart toy design is affective stickiness. Affective stickiness refers to a strong emotional state that students may develop towards smart toys and is especially important at preschool, primary, and secondary school levels (Berriman & Mascheroni, 2019). It is of great importance for parents to be careful in this context. Smart toys can affect children's affective stickiness; as children become attached to these toys, these devices may be perceived as friends or trusted figures. This requires parents to watch how children use these toys and how they affect their emotional development. Smart toys' impact on preschool, primary, and secondary students' emotional and social development must be understood. Parents should restrict their children's use of these toys. This helps youngsters build affective stickiness while allowing them to participate in other social activities.

For example, a kid has a cuddly stuffed bear, a smart toy. The kid plays and sleeps with this plush bear. The kid might bond with the bear due to its emotional relationship. It protects and comforts the youngster. However, the youngster can take it when their grandma comes on weekends. This shows smart toy material portability. The kid can play with this cuddly companion at his grandmother's place, which can calm him. This example indicates that toys may be emotionally meaningful and that mobility helps youngsters retain affective stickiness. However, children connected to toys may have trouble developing friends. Thus, educators and parents must supervise youngsters' affective stickiness to smart toys. In summary, policymakers, technology developers, parents, and students should take note of the following dangers and precautions:

Policymakers should establish strict rules and safety standards for companies producing and selling smart toys.

Informational campaigns should also be organized for parents and educators to raise awareness about the potential risks associated with smart toys.

Technology developers need to prioritize data security and privacy, particularly regarding personal data collected from students. Using blockchain and encryption techniques can help protect this data. Smart toy content should be educationally enriching and skill-building, emphasizing necessity and competence.

Parents should stay informed about the advantages and risks of smart toys, closely monitoring their children's interactions with these devices. Limiting time and content access can help maintain a healthy balance.

Students should use smart toys cautiously, avoiding sharing personal information and learning to use technology responsibly. These toys should primarily serve educational purposes, with a balanced approach that includes physical activities, reading, and other important developmental activities.

The Future of Smart Toys

Smart toys improve learners' education and fun. These toys' interactive elements need to be enhanced for educational value. AI-based toys can measure and personalize learners learning. Meanwhile, data privacy and security may need further attention. However, human-machine interaction improves smart toys. More studies might examine how this connection influences students' emotional development. Smart toys blend classroom and home learning with teacher-parent collaboration. However, sustainability needs greater attention. The materials used in producing smart toys must be environmentally friendly and reduce waste production. The energy efficiency and durability of toys should also be considered. Combining all these factors will ensure that smart toys will continue positively contributing to students' future development. To inform research on the future of smart toys, several important questions can be explored:

- The ubiquity of gaming in individuals' lives, especially among students and children, raises questions about how smart toys influence this phenomenon and how they are impacted by it.
- Considerations regarding the guidance and recommendations for parents and educators using smart toys should be made.
- Smart toys currently leverage technologies like IoT and RFID cameras, but what alternative technologies might be employed in the future? How can these emerging technologies enhance the educational value of smart toys?
- Is there a necessity for a specialized field, such as toy or smart toy literacy, as suggested by Heljakka and Ihamäki in 2018?
- Can innovative smart toys be designed to align with specific educational curriculum outcomes, and if so, how effective would they be? In what ways can these toys be optimized for educational purposes?
- Given that smart toys are typically designed with a specific purpose, they may provide limited opportunities for interaction. Could this constraint potentially hinder students' development of creative

thinking skills, and what measures can be taken to mitigate such limitations?

- What research methodologies and approaches should be devised to ensure users' data security and privacy when it comes to smart toys?

Chapter Summary

This chapter explains the importance of smart toys in education and the pedagogical value of play-based learning. The role of smart toys in education and how they can enrich the learning experience are described. Information about the definition, characteristics, context, benefits, development process, types, and categories of smart toys used in education is given. Examples of smart toys, such as interactives, coding, and digital stories, are included. The contributions of smart toys to learning processes and their potential to support social, cognitive, and affective development are discussed. In addition, smart toys encourage problem-solving skills and contribute to developing imagination and creative thinking. Their potential for use in special education, language education, coding, mathematics, and digital storytelling was emphasized. In addition to the positive aspects and gains of smart toys in education, potential risks and considerations for students' safety are discussed. In addition, what should be considered when choosing smart toys for parents and teachers was explained. Explanations are made to express the future potential of smart toys, and important questions are raised. It discusses how smart toys can be used more effectively in education and how they can transform educational processes. In summary, the role and importance of smart toys in education are again emphasized, and important recommendations and implications for policymakers, technology developers, educators, parents, students, and researchers are presented.

References

Amâncio, F. M. P., Souza, A. P., Fantinato, M., Peres, S. M., Hung, P. C., do Rêgo, L. G. C., & Roa, J. (2023). Parental perception of children's privacy in smart toys in countries of different economic levels. *Technology in Society*, *72*, 102180. https://doi.org/10.1016/j.techsoc.2022.102180

Aydin, A. (2023). *Determination of the design principles of the internet of things-based electrical experiment set (IoTES) and investigation of its effectiveness* [Unpublished doctoral dissertation]. Atatürk University.

Berriman, L., & Mascheroni, G. (2019). Exploring the affordances of smart toys and connected play in practice. *New Media & Society*, *21*(4), 797-814. https://doi.org/10.1177/1461444818807119

Bruner, J. S. (1966). *Toward a theory of instruction*. Harvard University Press.

Cagiltay, K., Kara, N., Aydin, C.C. (2014). Smart toy based learning. In: Spector, J., Merrill, M., Elen, J., Bishop, M. (Eds.), *Handbook of research on educational communications and technology* (pp. 703-711). Springer. https://doi.org/10.1007/978-1-4614-3185-5_56

de Albuquerque Wheler, A. P., Kelner, J., Junior, R. S. R., & Nogueira, T. D. (2020). IoT4Fun rapid prototyping tools for toy user interfaces. *Electronic Commerce Research and Applications*, *44*, 101009. https://doi.org/10.1016/j.elerap.2020.101009

de Paula Albuquerque, O., Fantinato, M., Hung, P. C., Peres, S. M., Iqbal, F., Rehman, U., & Shah, M. U. (2022).

Recommendations for a smart toy parental control tool. *The Journal of Supercomputing*, *78*(8), 11156-11194. https://doi.org/10.1007/s11227-022-04319-4

Dujić Rodić, L., Stančić, I., Čoko, D., Perković, T., & Granić, A. (2023). Towards a machine learning smart toy design for early childhood geometry education: Usability and performance. *Electronics*, *12*(8), 1951. https://doi.org/10.3390/electronics12081951

Ekin, C. C., Cagiltay, K., & Karasu, N. (2018). Effectiveness of smart toy applications in teaching children with intellectual disability. *Journal of Systems Architecture*, *89*, 41-48. https://doi.org/10.1016/j.sysarc.2018.07.001

Evripidou, S., Amanatiadis, A., Christodoulou, K., & Chatzichristofis, S. A. (2021). Introducing algorithmic thinking and sequencing using tangible robots. *IEEE Transactions on Learning Technologies*, *14*(1), 93-105. https://doi.org/10.1109/TLT.2021.3058060

Heljakka, K., & Ihamäki, P. (2018). Preschoolers learning with the Internet of Toys: From toy-based edutainment to transmedia literacy. *Seminar.net*, *14*(1), 85–102. https://doi.org/10.7577/seminar.2835

Kara, N., & Cagiltay, K. (2020). Smart toys for preschool children: A design and development research. *Electronic Commerce Research and Applications*, *39*, 100909. https://doi.org/10.1016/j.elerap.2019.100909

Kara, N., Aydin, C. C., & Cagiltay, K. (2014). Design and development of a smart storytelling toy. *Interactive Learning Environments*, *22*(3), 288-297. https://doi.org/10.1080/10494820.2011.649767

Komis, V., Karachristos, C., Mourta, D., Sgoura, K., Misirli, A., & Jaillet, A. (2021). Smart toys in early childhood and primary education: A systematic review of technological and educational affordances. *Applied Sciences*, *11*(18), 8653. https://doi.org/10.3390/app11188653

Kucirkova, N., & Flewitt, R. (2020). The future-gazing potential of digital personalization in young children's reading: views from education professionals and app designers. *Early Child Development and Care*, *190*(2), 135-149. https://doi.org/10.1080/03004430.2018.1458718

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (Eds.), *Aptitude learning and instruction: Volume 3: Cognitive and affective process analyses* (pp. 223–253). Routledge. https://doi.org/10.4324/9781003163244

Merkouris, A., Chorianopoulou, B., Chorianopoulos, K., & Chrissikopoulos, V. (2019). Understanding the notion of friction through gestural interaction with a remotely controlled robot. *Journal of Science Education and Technology*, *28*(3), 209-221. https://doi.org/10.1007/s10956-018-9760-2

Nikolopoulou, K. (2021). Internet of Toys for young children: Educational value or threat?. In S. Papadakis & M. Kalogiannakis (Eds.), *Handbook of research on using educational robotics to facilitate student learning* (pp. 424-439). IGI Global. https://doi.org/10.4018/978-1-6684-7468-6.ch005

Piaget, J. (1955). *The construction of reality in the child*. Routledge.

Price, S., & Rogers, Y. (2004). Let's get physical: The learning benefits of interacting in digitally augmented physical spaces. *Computers & Education*, *43*(1-2), 137-151. https://doi.org/10.1016/j.compedu.2003.12.009

Resnick, M. (1998). Technologies for lifelong kindergarten. *Educational Technology Research and Development*, *46*(4), 43-55. https://doi.org/10.1007/BF02299672

Rivera, D., García, A., Martín-Ruiz, M. L., Alarcos, B., Velasco, J. R., & Oliva, A. G. (2019). Secure communications and protected data for a Internet of Things smart toy platform. *IEEE Internet of Things*

Journal, *6*(2), 3785-3795. https://doi.org/10.1109/JIOT.2019.2891103

Shasha, S., Mahmoud, M., Mannan, M., & Youssef, A. (2018). Playing with danger: A taxonomy and evaluation of threats to smart toys. *IEEE Internet of Things Journal*, *6*(2), 2986-3002. https://doi.org/10.1109/JIOT.2018.2877749

Yu, J., & Roque, R. (2019). A review of computational toys and kits for young children. *International Journal of Child-Computer Interaction*, *21*, 17-36. https://doi.org/10.1016/j.ijcci.2019.04.001

Author Information

Abdulkerim Aydın

https://orcid.org/0000-0003-4657-3683

Atatürk University

Erzurum

Turkiye

Contact e-mail: *abdulkerimaydn@gmail.com*

Citation

Aydın, A. (2023). Smart Toys. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp. 137-151). ISTES Organization.

Chapter 13 – Gamification in Educational Mobile Apps

Ömer Arpacık

Chapter Highlights

- In this section, the concept of mobile learning, definitions, and advantages of mobile learning are given.
- The features of mobile devices and what they can add to learning are emphasized,
- Mobile learning and gamification, the features of mobile devices that support gamification elements, and
- The elements of gamification and the use of these elements in mobile applications are explained.
- Finally, the development process of educational mobile applications and the place of gamification in this process were mentioned.

Introduction

Mobile learning can be defined as the ability to learn anywhere and at any time using a portable electronic device. There are different definitions of mobile learning in the literature. According to Crompton (2013), in the early 2000s, mobile learning was defined as the use of palm devices in educational processes (Quinn, 2001). Later on, a more in-depth discussion started, and it came to the point that the definition of mobile learning was based on four key elements: pedagogy, technology, context, and social interaction. O'Malley et al. (2003) defined mobile learning as learning when the learner is not in a fixed, predetermined location or when mobile technologies offer learning opportunities. Crompton, Muilenburg, and Berge defined it as learning in multiple contexts through social and content interactions with personal electronic devices, considering these four essential elements (Crompton, 2013).

Additionally, because mobile learning can be spontaneous, informal, contextual, portable, anywhere, and anytime (Kukulska-Hulme, 2005), these characteristics can support the definition of mobile learning. Individuals can learn with their portable device anytime and suddenly upon a learning need. Because of these features, mobile learning has expanded with the increase in accessibility of mobile learning devices. Looking at 2022 data, it is stated that there will be 6.4 billion smartphones (statista.com, 2023) This is an excellent opportunity for mobile learning.

Mobile learning offers various advantages and supports a range of strategies, including social learning, task-based learning, flexible learning, adaptive learning, individual learning, collaborative learning, microlearning, scenario-based learning, and project-based learning. Additionally, various elements, such as interaction, monitoring, participation, motivation, and feedback, can bolster learning across all of these strategies. Besides the pedagogical features mentioned earlier, mobile devices offer an array of technological capabilities, including multimedia support, touch and hand gestures, location services, cameras, vibrations, high-resolution screens, notifications, messaging, and the potential to enhance mobile applications with these attributes.. Considering all these learning strategies and technological competencies, how many alternatives an instructional designer has in supporting learning in a mobile environment with games or gamification can be easily seen. The variety of touch and hand gestures in mobile applications adds richness to the applications in games and gamification (Table 1).

Table 1. Touch and hand gestures on mobile devices

Tap
Double Tap
Tap with two fingers.
Double tap with two-finger
Pinch and spread
Press
Long press
Scroll and pan
Swipe
Rotate
Drag and drop
Flick
Multi-touch
Tilt
Shake

As the table shows, these devices support many touch and hand gestures. Players send commands by pressing buttons when playing a game on a computer with a keyboard and mouse or on a game console with a joystick. The joysticks of game consoles have recently added vibration, allowing them to experience more different sensations. The phone can be advantageous in this respect. Instead of pressing a button, it can sometimes add more realism to a movement in the game, such as dragging, swiping, or turning the phone left and right.

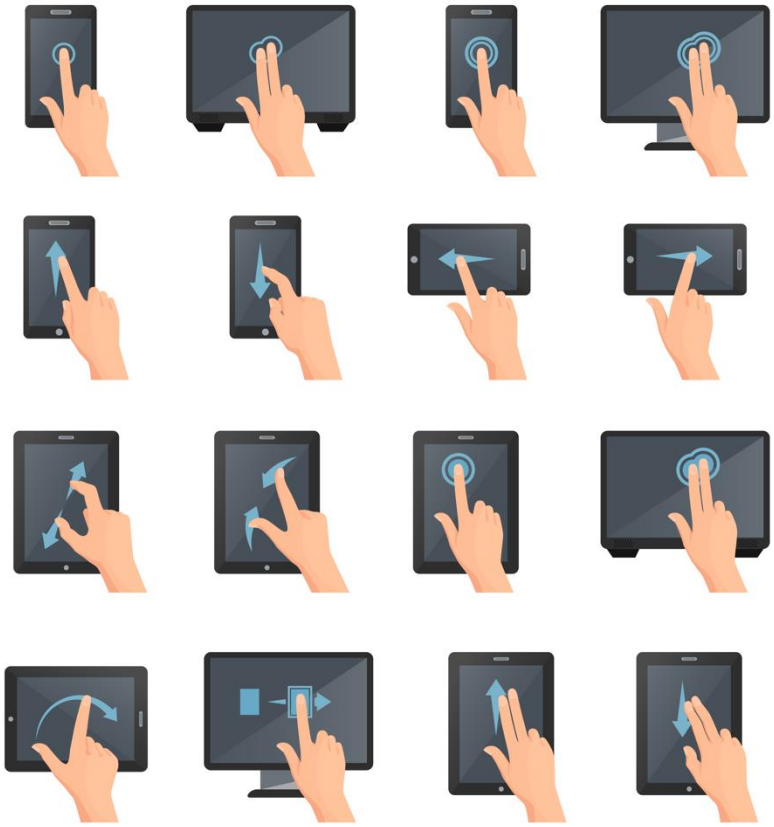


Figure 1. Tapping movements of mobile devices

When a task, question, content, etc., is presented to the learner and interaction is expected, the learner can fulfill the task by using gestures such as swiping, rotating, tilting, shaking, etc., not just touching. For example, a task that can be answered with drag and drop in a classical material can be completed by tilting the device left and right on mobile devices. When moving a concept on the screen, the learner can perform the task by moving the device. This adds variety to the application. Considering the elements of feature-based gamification, using different gestures will increase the excitement and motivation of learners. The visual represents the hand gestures that can be done (Figure 1. "Designed by macrovector/Freepik").

Gamification in Mobile Learning

In recent years, mobile games have seen a surge in popularity as forms of entertainment (Su & Cheng, 2015). As mentioned earlier, some of the most frequently downloaded applications belong to the gaming category. Gamification involves incorporating elements from games into content that is not originally designed for gaming purposes (Deterding et al., 2011). In essence, it leverages game elements and mechanics to enhance people's engagement (Su & Cheng, 2015). Games have the potential to boost learners' motivation and engagement significantly (Domínguez et al., 2013). When thoughtfully designed, motivation and engagement can increase, especially when students are confronted with challenging tasks (Boyinbode, 2018).

In this context, mobile gamification is the inclusion of game elements in applications that are not designed for game purposes. These elements include tasks, rules, scoring, levels, ranking, process tracking, rewards, leaderboards, collections, and feedback (Battal et al., 2023). Werbach & Hunter (2015) classify these elements under three main elements: dynamics, mechanics, and gamification components. Dynamics represent the aspects of the gamified system that you need to consider and manage but can never directly enter the game; mechanics represent the core processes that drive the action and enable player engagement; and components represent the reflections of mechanics and dynamics in the interface. The main and sub-elements are given in Table 1.

Table 1. Elements of gamification (Werbach & Hunter, 2015)

Main Elements	**Sub-elements**
Dynamics	Constraints, emotions, narrative, progress, relationships
Mechanics	Challenge, chance, cooperation, contest, competition, feedback, resource acquisition, reward, processes, turn, no-win situation.
Components	Achievements, avatars, badges, boss fights, collectibles, combat, content unlocks, gifts, leaderboards, levels, points, quests, social charts, teams, virtual items

With the technological development of mobile devices, mobile applications can be designed flexibly and with more features. It is possible to use many of the gamification elements mentioned above in mobile applications. This chapter will give examples of what can be done in the mobile environment within the framework of the elements specified by Werbach & Hunter (2015).

Dynamics

Constraints

Emotions indicate the feelings experienced by learners during and after the application. Mobile applications can leave positive traces on learners by supporting multimedia, including the learner, and supporting interaction with different features. This will increase the motivation for the material.

Emotions

One of the essential elements of gamification is narrative. Narrative in mobile applications increases engagement and satisfaction (Sánchez-Rivas et al., 2023) and can be easily applied in mobile applications and other environments.

Narrative

One of the essential elements of gamification is narrative. Narrative in mobile applications increases engagement and satisfaction (Sánchez-Rivas et al., 2023) and can be easily applied in mobile applications and other environments.

Progression

In mobile applications, a variety of visual toolscan be used to display the progress of the material, allowing to learners to follow their progress and continue where they left off. For instance, these progress indicators can be shared within the group they are collaborating with, enabling them to observe everyone's progress as well as their own relative position. Moreover, learners can be reminded of their progress from time to time or at the specified time with notifications, thus their participation can be ensured. For example, an application with a weekly goal of memorizing ten foreign words can be reminded in the last few days, and notifications such as "You have two days left; there are eight more words to memorize!" can be made.

Storytelling

One of the essential elements of gamification is storytelling. Storytelling in mobile applications increases engagement and satisfaction (Sánchez-Rivas et al., 2023). Storytelling can be easily applied in mobile applications and other environments.

Relationships

Mobile applications are very suitable for communication and relationships with others. By making some design changes to an individual application, you can quickly turn it into an application that is associated with others. In the example above, let us imagine that the word memorization task is given on a group basis. Then the notification

could go like this: "You have two days left, your friends have memorized an average of 6 words, and you are on word 5. Come on, you can get ahead with a few more words!". (These messages can be enhanced with various emojis.)

Mechanics

Mechanics are essential to increase engagement (Werbach & Hunter, 2015). Let us try to give examples of mechanics within the framework of mobile applications.

Challenge

Challenges are tasks to be solved, like puzzles. This could be completing the steps needed to complete an incomplete experiment in a chemistry lesson. The learner starts the task with a notification and can do a group study on relationships.

Chance

Chance or randomness, as an element within gamification, is used to make players' experiences more exciting and unpredictable, which refers to the unpredictability and unexpectedness of a particular outcome. In games or gamified experiences, the element of chance is often used in ways such as the random winning of prizes, the unpredictability of developments, and the random selection of winners of competitions. This keeps players constantly motivated, makes their experience more exciting, and encourages users to participate more.

Collaboration

Let us turn our example of collaboration into a competition. Learners who receive a notification simultaneously are given a time limit to complete the experiment successfully. Whichever learner finishes, their score is immediately increased on the leaderboard, and the other learners are notified. Add more excitement. Let us imagine five people fulfilling the requirements in the same experimental environment. At the bottom of the screen is a circle graph of five people, and the completion percentage is given in the center. The circle graph's coloring will excite the learners as each opponent's percentage increases.

Competition

Let us turn our example of collaboration into a competition. Learners who receive a notification simultaneously are given a time limit to complete the experiment successfully. Whichever learner finishes, their score is immediately increased on the leaderboard, and the other learners are notified. Add more excitement. Let us imagine five people fulfilling the requirements in the same experimental environment. At the bottom of the screen is a circle graph of five people, and the completion percentage is given in the center. The circle graph's coloring will excite the learners as each opponent's percentage increases.

Feedback

Feedback serves as an indicator of the learner's current stage of learning progress.The graphic in the competition example is an excellent example of feedback. Both individual feedback and collaborative feedback can be easily given in mobile environments.

Resource acquisition

Let us continue with the chemistry experiment. Within the framework of the tasks given to the learners, the work can be made fun by having the learners collect the chemicals and glass materials they will use in the experiment

Rewards

Rewards are one of the most frequently used elements in games. It is an element that can be easily used in mobile applications. Successful completion of the chemistry experiment on mobile can be awarded.

Trades

Trades are realized by buying and selling various items in games. In the chemistry example given in this section, learners can be asked to earn money for completing each piece of content and to design an experimental environment in the relevant part of the content with this money.

Turn

Here again, group interaction can be mentioned. Learners can perform the group task assigned to them in turn. Each learner waits for his or her turn and performs the task when his or her turn comes. Those who accomplish the task are rewarded.

Winning Status

According to Werbach & Hunter (2015), this element is used more frequently in games than in gamified environments.

Components

Achievements

Achievements are defined goals. As learners reach their goals, they are rewarded with points and badges. When we go through the chemistry application, tasks with different interaction types and goals can be defined in the content and rewarded for successful completion.

Avatars

Using avatars is an important feature that allows players to represent themselves in virtual worlds. An avatar can be a character or icon of the player's choice and represents the player's presence in the game world. Avatars allow players to personalize their in-game experience, express themselves, and become more connected to the game's story. Players can often customize their avatars, choosing their clothes, hairstyles, skin tones, and other features; this makes the gaming experience more fun and personal. It also provides an opportunity to communicate and compete through avatars when interacting with other players in multiplayer games. Avatars are a critical element that makes game worlds more attractive and interactive.

Badges

Badges are visual representations of achievements. Badges can be added to the user's avatar by accomplishing a task. In the chemistry application, each goal overcome can bring a new badge.

Boss fight

In games, this can be characterized as the most challenging task; e.g., the game ends when it is completed. In gamification, it is possible to use this as the most challenging task. In the chemistry application, an interactive gamification can be designed to summarize the whole subject after learning many concepts. As a result of this application, it can meet all the learner's achievements.

Teams

Mobile applications can be very convenient for team building. Online interaction can be used as an essential advantage, where every single move of each player on the team is instantly reflected to everyone and goes with a notification.

Collections, virtual items, and gifts

These elements are also elements that can be easily used in mobile applications within the framework of gamification. When you look at mobile games, you can see that many games include elements such as collections and virtual items.

Leaderboards, challenges, and social charts

These are essential gamification elements that increase motivation and engagement. Especially in crowded groups, interaction increases with these elements, and learners follow the leaderboard and social schedules and compete with other learners to better themselves.

Tasks, content unlocking

Task fulfillment and content unlocking stages involve rewarding users or providing access to more content when they perform a specific action or complete a specific stage. These stages incentivize users to complete certain tasks or actions to access more content or features in an app, website, education platform, or other digital experience. It helps the user enhance the experience or learn more.

Levels, Points

An essential element that motivates learners is to see their level and compare it with other learners. The mobile application, mainly by providing social interaction, can drive people to see and compare their scores.

Development Process

In developing a gamified educational mobile application, the steps of analysis, design, development, testing, implementation, and evaluation can be followed. The pedagogical and technological content and how it will be transferred are decided in the analysis phase. At this phase, topic selection, whether there is a need for a mobile application on this topic, whether it is an original idea, goals, and objectives are determined. Whether the application is an application that provides a subject from beginning to end or an application that supports an existing lesson, whether it will be used during or outside the lesson, user roles (teacher, student, family, school administrator, etc.), communication channels (sms, e-mail, notification, in-app correspondence, etc.), and content types (text, image, video, animation, graphics, etc.) are determined. The target audience is also essential. Primary school, middle school, high school, university, or even a company's in-service training or lifelong learning are essential for how the content will be delivered and which elements will be selected for gamification. Healthily analyzing these issues during the analysis phase will support the design phase and increase the quality of the application.

The design phase is essential in gamification, as in every application. Because the gamification elements will be decided here, using gamification elements will especially require experience. Because although these elements are effective in increasing motivation and participation, using them more than necessary can be a disadvantage (Nicholson, 2015). In the design phase, the dynamics, mechanics, and components should be chosen, and experts in the field should be consulted if necessary. After this point, each application screen should be designed, a story board should be prepared, and all events on that screen should be specified under the story board. McQuiggan et al. (2015) stated that the following headings should be considered for mobile application designs: If we take these principles for gamification elements in this section:

Simplicity: Each element on the screen has a purpose and is not overused. This principle also applies to gamification elements. In gamification, the learner should be able to use that element simply and quickly, according to their level.

Smart Position of Elements on the Screen: The position of each element to be placed on the screen is expressed here. Likewise, gamification elements should be used in the appropriate places.
Instant Feedback: Feedback is already an element of gamification.
Co-location of Feature and Function: Here, the action and the objects related to the action should be positioned together to avoid cognitive load. If gamification is to be initiated by the visual on the screen, the relevant button should be together with the visual.
Smart Icon Usage and Traditional Routing: Certain icons and routing tools are characterized by the same visual. For example, a badge-related interaction should use an icon similar to the xxx icon, or a leaderboard should use one similar to the xxx icon. The same is true for cross-screen redirects.
Segmentation: The division of content into small parts with meaning. Game elements can also be appropriately placed in small chunks within this framework. Segmentation enables users to use the app more effectively and personally. This can increase user loyalty and support the success of the app.
User Age and Experience: As in all design processes, user age and experience are crucial for gamification. While leaderboards are essential for a certain age, getting badges may be more important for a different group. Collaboration can be complex in primary school, while it can be more comfortable in middle school.
Direct Manipulation: We have given the hand gestures used in mobile applications above. A large number of these provide direct manipulation. For example, when filling a bottle with liquid from another bottle, instead of touching a button, it can carry the bottle and pour it into the new bottle after turning it with two fingers. This will provide a more realistic environment and take the learner into the application.
Forgiveness: If the learner touches the wrong place while using the application, it should be reversible. But for gamification, this may have the opposite reaction. In other words, being unable to go back when they make a mistake about the game will increase the excitement. Nevertheless, this can also be provided according to the age level.

During the development and testing process, developers should explain the application with the story boards and specify what is desired. After the development is done, the tests are started, and the development process continues again according to the feedback from the tests. In tests, new-old devices, big-small screens, phone-tablet resolution, processing speed, load test, camera, and microphone angles are tested if necessary. It is also important to conduct usability tests. After the development and testing processes, implementation and evaluation processes are carried out.

Chapter Summary

Mobile learning, defined as learning using portable electronic devices anytime and anywhere, has evolved over the years with varying definitions. Initially, it involved the use of palm devices in education. Later, it encompassed four key elements: pedagogy, technology, context, and social interaction. Mobile learning is characterized by its spontaneity, informality, portability, and accessibility.
Mobile learning supports various strategies, such as social learning, task-based learning, flexible learning, adaptive learning, individual learning, collaborative learning, microlearning, scenario-based learning, and project-

based learning. It also enhances learning by providing interaction, monitoring, participation, motivation, and feedback. Mobile devices offer diverse technological capabilities, including multimedia support, touch and hand gestures, location services, cameras, vibrations, high-resolution screens, notifications, messaging, and the potential for enhancing mobile applications. Touch and hand gestures, in particular, add richness to mobile applications, enhancing the gamification potential.

Gamification, incorporating game elements into non-gaming content, has gained popularity in mobile learning. Mobile gamification includes elements like tasks, rules, scoring, levels, ranking, process tracking, rewards, leaderboards, collections, and feedback. These elements fall under dynamics, mechanics, and gamification components. Mobile gamification offers numerous advantages, increasing learner motivation and engagement. Dynamics involve constraints, emotions, narrative, progression, and relationships. Mechanics include challenges, chance, collaboration, competition, and feedback. Gamification components consist of achievements, avatars, badges, boss fights, collectibles, combat, content unlocks, gifts, leaderboards, levels, points, quests, social charts, teams, and virtual items.

Mobile applications can flexibly incorporate gamification elements, enhancing the learning experience. The development process involves analysis, design, development, testing, implementation, and evaluation. The analysis phase involves topic selection, determining the need for a mobile app, defining goals, and identifying user roles, communication channels, content types, and target audience. The design phase requires careful selection and placement of gamification elements, ensuring simplicity, smart positioning, instant feedback, co-location, smart icon usage, segmentation, consideration of user age and experience, direct manipulation, and forgiveness. Development and testing involve translating the design into an application and conducting usability tests. The implementation and evaluation phases follow, ensuring the app meets its educational objectives effectively. Mobile learning and gamification offer a dynamic and engaging approach to education, harnessing the capabilities of modern technology to enhance the learning experience.

References

Battal, A., Kayaduman, H., & Polat, H. (2023). The Use of Gamification Elements in an Online Introduction to Programming Course. In G. Durak & S. Cankaya (Eds.), *Shaping the Future of Online Learning: Education in the Metaverse* (pp. 284-300). IGI Global. https://doi.org/10.4018/978-1-6684-6513-4.ch015

Boyinbode, O. (2018). Development of a gamification based English vocabulary mobile learning system. *International Journal of Computer Science and Mobile Computing*, *7*(8).

Crompton, H. (2013). A Historical Overview Of M-Learning Toward Learner-Centered Education. Içinde Z. L. Berge & L. Y. Muilenburg (Ed.), *Handbook of Mobile Learning*. Routledge.

Deterding, S., Dixon, D., Khaled, R. & Nacke, L. (2011). From game design elements to gamefulness. *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, 9-15. https://doi.org/10.1145/2181037.2181040

Kukulska-Hulme, A. (2005). Introduction. Içinde A. Kukulska-Hulme & J. Traxler (Ed.), *Mobile Learning: A handbook for educators and traimers*. Routledge.

McQuiggan, S., Kosturko, L., McQuiggan, J. & Sabourin, J. (2015). Design and User Experience. Içinde *Mobile Learning: A Handbook for Developers, Educators, and Learners* (ss. 179-194). John Wiley & Sons, Inc.

Nicholson, S. (2015). A RECIPE for Meaningful Gamification. Içinde *Gamification in Education and Business* (ss. 1-20). Springer International Publishing. https://doi.org/10.1007/978-3-319-10208-5_1

Sánchez-Rivas, E., Ramos Núñez, M. F., Ramos Navas-Parejo, M. & De La Cruz-Campos, J. C. (2023). Narrative-based learning using mobile devices. *Education + Training*, *65*(2), 284-297. https://doi.org/10.1108/ET-06-2022-0244

Su, C.-H. & Cheng, C.-H. (2015). A mobile gamification learning system for improving the learning motivation and achievements. *Journal of Computer Assisted Learning*, *31*(3), 268-286. https://doi.org/10.1111/jcal.12088

Werbach, K. & Hunter, D. (2015). *The Gamification Toolkit: Dynamics, Mechanics and Components for the Win*. Wharton Digital Press.

Author Information

Ömer Arpacık

https://orcid.org/ 0000-0002-4400-9299

Atatürk University

Erzurum

Turkiye

Contact e-mail: *omerarpacik@gmail.com*

Citation

Aydın, A. (2023). Gamification in Educational Mobile Apps. In N. Taş, & Y.İ. Bolat (Eds.), *Digital Games and Gamification in Education* (pp. 152- 163). ISTES Organization.

Games have always captivated individuals for hours, sometimes leading to addiction. Games' motivating and engaging qualities have been extensively explored and utilized to improve education. Educational games and gamification have increased in popularity. In 13 chapters, we address fundamental game principles, technological game production, and instructional applica-.tions

Chapter 1 covers game and gamification basics. Chapter 2 covers theory. Chapter 3 discusses game motivation and applications. Gamification in design education is covered in Chapter 4. Game Development Design Patterns are covered in Chapter 5. Chapter 6 covers game engine architecture and developer basics. User-friendly digital gaming interfaces are examined in Chapter 7. Gamified learning experience design is covered in Chapter 8. Chapter 9 provides examples of significant gamification models. In Chapter 10, games and gamification are examined in online education. Their importance in educational measurement is covered in Chapter 11. Chapter 12 stresses smart toys in schooling and gives suggestions. Finally, Chapter 13 examines mobile learning and gamification. This comprehensive book assists educators in implementing gamification strategies inside their classrooms, utilizing game-based applications, and .developing educational games

International Society for Technology, Education and Science
istes
www.istes.org

9 781952 092589
ISBN: 978-1-952092-58-9