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Araştırma Makalesi

GAMIFICATION IN SUSTAINABILITY LEARNING IN BUSINESS EDUCATION

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Abstract[1]

This study was conducted on gamification, sustainability learning, and business education dimensions. The main objective of this study is to synthesize the empirical evidence already available to gain a comprehensive understanding of how gamification can enhance sustainability learning in business education. Since integrating these three dimensions is a new and emerging area in the literature, early work in this field is expected to contribute significantly to future studies. According to the content analysis, the primary finding of the analyzed studies is that they mainly emphasize the cognitive engagement aspect. However, when the sustainability dimension is incorporated into gamification in business education, the games become excessively complex. Moreover, the studies examining cognitive outcomes need to adequately consider students' emotional states, and more attention is given to the behavior change associated with sustainability.

Keywords: *Gamification, Sustainability, Sustainable Development Goals, Business Education.*

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Öz

Bu çalışma, oyunlaştırma, sürdürülebilirlik öğrenimi ve işletme eğitimi boyutlarında yapılmıştır. Bu çalışmanın temel amacı, işletme eğitiminde sürdürülebilirlik

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öğrenimini geliştirmek için oyunlaştırmanın nasıl kullanılabileceğine dair kapsamlı bir anlayış kazanmak için halihazırda mevcut olan ampirik çalışmaları sentezlemektir. Bu üç boyutun entegrasyonu literatürde yeni ve gelişen bir alan olduğu için, bu alanda yapılan bu erken çalışmanın gelecekteki yeni çalışmalara önemli bir katkı sağlayacağı düşünülmektedir. Yapılan içerik analizine göre, analiz edilen çalışmaların temel bulgusu, çoğunlukla bilişsel katılım yönünü vurgulamalarıdır. Bununla birlikte, işletme eğitiminde oyunlaştırmaya sürdürülebilirlik boyutu dahil edildiğinde, oyunlar aşırı derecede karmaşık hale gelmektedir. Dahası, bilişsel çıktıları inceleyen çalışmalar öğrencilerin duygusal durumlarını yeterince dikkate almamakta ve sürdürülebilirlikle ilişkili davranış değişikliğine yeterince önem vermemektedir.

Anahtar Kelimeler: *Oyunlaştırma, Sürdürülebilirlik, Sürdürülebilir Kalkınma Hedefleri, İşletme Eğitimi.*

INTRODUCTION

Implementing innovative educational designs that use unconventional teaching tactics and platforms to convert passive learners into engaged stakeholders might be a positive move. Since the 1970s, there have been ongoing efforts to generate fresh views in education. (Sam et al., 2024; Anderson & Rivera Vargas, 2020). Gamification in education, particularly in higher education, has gained momentum in the last few years (Khaldi et al., 2023). The attention to gamification is mainly due to its ability to stimulate learners in learning, involvement, cooperation, and problem-solving (Saleem et al., 2022). Using gamification in education as a tool for teaching and learning encourages students to engage, learn, and think about more complex problems. This has a long-term impact on the knowledge and behavior of the students, as it is frequently affirmed that learning is related to motivation. (Adams & Du Preez, 2022; Čubela et al., 2023). From a pedagogical perspective, gamification (and serious games) promotes non-formal and informal learning experiences that can lead to motivation and knowledge (Dahalan et al., 2024). Increasing learners' motivation makes the learning experience more meaningful; learners commit to the learning process, and the learning experience becomes more sustainable (Sezgin et al., 2018). In particular, compared to traditional education, gamification enables signaling, permission, and motivation, often facilitating feelings of freedom and competence (Costello, 2020). Finally, from a cognitive approach, the intrinsic properties of games help better memorize, process, and reasoning of educational content (Yu et al., 2021). On the other hand, the most significant challenges of gamification in education include the high costs of the development of the gamified educational activity, the design and the selection of the most appropriate game mechanics, players losing interest in games quickly, and the assessment methods of the success of gamified systems (Ouariachi et al., 2020; Ng & Lo, 2022).

Sustainability is a current concern worldwide. Given the complexity of the concept of sustainability, with its environmental, social, and economic aspects,

researchers in different fields are looking for ways to explore this subject in an interconnected and active way. (Walsh et al., 2021). The development of innovative educational solutions is mainly encouraged by two fundamental objectives: the formation of the broader citizen for critical reflection on the complex implications of sustainability, who understands the complexity of these problems and is able to seek solutions for everyday life, and the training of the professional focused on the necessary skills for including the principles of sustainability in their fields of performance. (Alam, 2022; Gal & Gan, 2020; Caeiro et al., 2020). Numerous benefits and outcomes, both personal and academic, are being directly associated in studies with the gamification methodology put in place to create interest and motivate students while they learn about sustainability (Arufe Giráldez et al., 2022). Furthermore, Mahmud et al. (2020) verify that using gamification elements in sustainability education positively impacts the level of the objectives designed to be achieved by the end of a course or class. To date, studies have recognized the growing importance of the effects of using gamification in the educational context. Still, there is insufficient information on gamification, especially regarding sustainability education (Navarro-Espinosa et al., 2022). It is apparent that recruiting business students who possess the knowledge, values, and judgment specific to sustainability is fundamental in the education of future business leaders. Business students are acknowledged as crucial in furthering sustainability education and sustainability awareness and improving the sustainability operating strategies of businesses and organizations (Tasdemir & Gazo, 2020). In contrast, very little attention is given to addressing the key competencies needed for integrating sustainability at the basic levels of the core business education curriculum (Brundiers et al., 2021; Hermann & Bossle, 2020). Besides, sustainability education is in need of a clear understanding of gamification elements that will yield effective and long-lasting learning results (Tan & Nurul-Asna, 2023). Hence, this research seeks to consolidate existing empirical evidence in order to comprehensively understand how gamification can be applied to sustainability learning in business education. Therefore, the overall objective is to extract and condense concepts pertaining to the gamification of sustainability education as documented in the literature.

To understand the role of gamification in promoting sustainability within business education, this research aims to contribute to the existing knowledge on the gamification of sustainability learning in business education in three keyways. First, this work examines the game dynamics, mechanics, and components used in a teaching strategy with the goal of enhancing students' ability to make conscious decisions in their future careers, enabling them to contribute to a more sustainable society. Secondly, it discloses the main topics and outcomes discussed in the literature about sustainability in business education that adopts gamification. Finally, it reveals the challenges and benefits of deploying gamification in the field of sustainability in business education. The results and implications of this study are deemed valuable for sustainability educators seeking to include games, serious

games, or gamification into their programs, as well as for scholars interested in further investigating this field.

BACKGROUND OF THE RESEARCH

Gamification and Education

The gaming industry continues to grow at a rapid pace, highlighting the increasing appeal of games. At the same time, virtual environments are becoming increasingly relevant in non-entertainment contexts, including education, business, research, and everyday life. Although initially approached cautiously, companies and various organizations realized that gaming elements contributed to engaging activities normally considered boring (Briggs, 2021). This use of games or gaming elements in circumstances unrelated to games is called gamification. Gamification is based on game-like processes and is implemented by using game strategies that are effective in terms of use (Prasad, 2021). Achievement, through game processes, of serious objectives is directed at various aspects of life, such as health, education, economics, environment, social communication, and security (Jääskä et al., 2021; Sharifzadeh et al., 2020; Lamrani & Abdelwahed, 2020). Although gamification elements in the scenarios differ, the general goal is to develop dynamic reading and participation increase and learning in the environment (Luo, 2022). Gamification is a concept that is defined in many ways, with the main emphasis being either on the design elements and mechanics of games or on the act of gaming and the experiences it creates in serious situations (Krath et al., 2021). Lopez and Tucker (2019) define gamification as using game elements to enhance human motivation and achieve personal goals. According to Al-Azawi et al. (2016), gamification is the application of game design principles, mechanics, and mindset to non-game activities in order to inspire and engage people.

Educational gamification advocates for using game-like systems of rules, player experiences, and cultural roles to influence the behavior of learners (Al-Azawi et al., 2016). Gamification is intricately linked to two other concepts: serious games and game-based learning (GBL). Caponetto et al. (2014) and Sezgin et al. (2018) argue that although GBL and Gamification have similarities, they are also sufficiently unique. The first one refers to the use of games for educational objectives, while the second one pertains to the implementation of gaming mechanisms in worldwide educational activities. The distinction between GBL and gamification was often blurred, particularly when both approaches share similar objectives. Both GBL and gamification aim to address a problem, motivate participants, and enhance learning by using game-based concepts and strategies (Dahalan et al., 2024). GBL refers to the use of games as a means to improve the educational process (Saleem et al., 2022). Al-Azawi et al. (2016) claim that for years, educators have been using games as a teaching tool in the classroom. Nevertheless, gamification occurs completely apart from the gaming environment and enhances engagement in the learning process (Saleem et al., 2022; Yıldız & Kahraman, 2024).

Educational gamification advocates for using game-like systems of rules, player experiences, and cultural roles to influence the behavior of learners. It transforms every stage of the learning process into a game. It uses game mechanics and gaming elements to enhance the motivation and engagement of learners by incorporating them into current learning courses and material. Some examples of these elements include achievement badges, points, leaderboards, progress bars, and levels/quests (Al-Azawi et al., 2016; Landers et al., 2018). Although gamification incorporates elements like points, badges, and challenges from games, its objective is not to create a full-fledged game. The concept involves integrating game elements to incentivize learners to interact with the material and progress towards an objective (Kapp et al., 2014).

Games that prioritize educational purposes above amusement or enjoyment are generally referred to as serious games (De Freitas, 2006). Serious games for learning and education refer to games specifically designed to accomplish educational and learning goals in the real world. Players may acquire knowledge while engaging in gameplay and demonstrate their proficiency by successfully accomplishing the game's assignments. That is to say, meaningful games that include real-world concerns are incorporated into gaming platforms. Conversely, the aim of gamification in learning and education is to provide authentic settings that facilitate learning and problem-solving. It is operational in the physical world. However, it is appropriate to include serious games in the gamification of learning and education since serious games encompass a range of activities and processes that utilize game mechanics to address learning and educational challenges (Kim et al., 2018).

Game and Gamification Types

Researchers have categorized games from many perspectives in recent years. Aarseth et al. (2003) proposed five overarching categories and 13 distinct aspects. The five meta-categories are space, time, player structure, control, and rules. The 13 dimensions consist of perspectives, topography, environment, pace, representation, teleology, player structure, mutability, solvability, determinism, topological rules, time-based rules, and objective-based rules. Vossen (2004) outlined three categorization criteria for classifying games: competitive/noncompetitive, interactive/noninteractive, and physical/non-physical. Tang (2019) categorized electronic games into four distinct groups based on the specific skill techniques required to play them. These categories include problem-solving games, decision-making games, multi-task processing games, and management games.

There is currently no universally agreed upon categorization and the categorization of educational games (Zhan et al., 2024). In their study, Xue et al. (2015) categorized educational games into many genres, including role-play, puzzle, strategy, simulation, adventure, and action games. Kim et al. (2018) suggest that within the realm of gamification, there are many game genres that are intimately interconnected, including war games, simulation games, serious games, and alternative reality games.

Kapp et al. (2014) propose two distinct categories of gamification: structural gamification and content gamification. Structural gamification incorporates game design features into educational material to motivate learners without modifying the original learning content. Creating a successful system may be accomplished by implementing defined objectives, incentives for accomplishments, a structured advancement system, recognition of status, stimulating challenges, and constructive feedback (Garone & Nesteriuk, 2019). Content gamification is the application of elements, mechanics, and game thinking to make the content more game-like. This category incorporates game elements such as story, challenge, curiosity, mystery, and characters to captivate the learner, resulting in a partial reorganization of the original educational materials to align with the gamified learning setting (Fernando & Premadasa, 2024).

Frameworks of Gamification for Education

The Mechanics-Dynamics-Aesthetics (MDA) framework proposed by Hunicke et al. (2004) aims to connect game design and development, game criticism, and technical game research. MDA framework involves the following design components:

- The *game's mechanics include the specific components* incorporated into a game. The behaviors that the user is permitted to engage in and the control mechanisms of the game are determined by mechanics through the use of data and algorithms. (i.e., in Monopoly, the mechanics consist of dice, mortgage, title deed, and imprisonment (Kim et al., 2018)).
- *Dynamics* refers to the way in which the mechanics of a system, including player inputs and other outputs, interact. It is the observable behaviors that players exhibit while playing a game. (i.e., Acquiring property ownership may constitute one of the dynamics of Monopoly, Forming an alliance in real-time strategy games (Kim et al., 2018).
- *Aesthetics* refers to the ideal emotional reactions of the player as a response to engaging in the game system.

Järvinen (2008) suggested a threefold categorization of game components, namely systemic (components and environments), compound (ruleset, game mechanic, theme, interface, and information), and behavioral (players and contexts). For example, in Star Wars Chess, components are the Star Wars film characters, and the rule set specifies the arrangement and movement of the components. The game mechanics allow players to control game components. The game environment is the chess board, where the theme is the war between "empire" and "rebel" forces. A mouse or keyboard serves as the interface via which players execute the game mechanics to interact with the intangible virtual characters shown on the screen.

Werbach and Hunter (2012) established a more comprehensive framework that comprises three components:

- *Mechanics*: these are the fundamental processes that generate player action and engagement. An item of mechanics is associated with one or more items of dynamics. (Resource acquisition, chance, competition, cooperation, challenges, feedback, rewards, and victory)
- *Dynamics*: the most abstract level in the pyramid, which pertains to implicit elements that are not directly involved in the game but must be managed and represent the overall landscape of the experience. (Aspects: restrictions, emotions, narrative, progression, and relationships)
- *Components* are the elements that are more practical and specific in a game. The principles are generated by the interaction of components. (points, leaderboards, achievements/badges, levels, story/theme, clear goals, feedback, rewards, progress, challenge, avatar, social interaction, virtual goods, unlockable content, social graph, ranking, teams, real prizes, streak counter)

Kim et al. (2018) propose an integrative gamification framework based on the previous research comprising four dimensions: *story*, *dynamics* (i.e., captivation, challenge, competition, completion, control, relaxation, etc.) Kim et al. (2018) adopt the Playful Experience framework of Korhonen et al. (2009)), *mechanics* (i.e., rewards like points, levels, badges, leaderboards, status, etc.), and *technology* (i.e., hardware like wearable devices and augmented reality; software like gamification platform)

Gamification in Sustainability Learning in Business Education

The transition to a sustainable world is strongly influenced by the abilities of students and the knowledge they have of this dominant field of study (Wamsler, 2020). Business students with a foundation in and capacity for sustainable practice and knowledge are of strategic value to employers and can contribute in practical and intellectual ways to the much-needed transformation of prevailing business models and practices (Rzemieniak & Wawer, 2021). The integration of sustainability concepts into business curricula also offers considerable reputational advantage to business schools that take education for sustainability seriously (Bagley et al., 2020). Integrating gamification in sustainability education draws from various conceptual underpinnings. Gamification has been recognized as an effective educational tool for engaging students by immersing them in complex situations, allowing active decision-making, and providing a safe environment for experimentation and reflection on actions (Despeisse, 2018). This is particularly relevant in sustainability education, where students need to develop skills such as systemic thinking, innovation, and decision-making in uncertain conditions (González-Salamanca et al., 2020).

The use of gamification in sustainability education has several advantages that may greatly increase knowledge acquisition. Research has shown that incorporating game-like elements into educational settings can improve engagement,

motivation, and learning outcomes (Zhang, 2024; Kaya & Özkan, 2024). Gamification has been effectively employed in sustainability education within business schools, offering students an immersive experience in complex decision-making processes. For instance, the board game "Factory Heroes" has been utilized as an educational tool to engage students in addressing the challenges of implementing sustainability in manufacturing. This game provides a stimulating learning environment for students to participate in sustainable manufacturing and experience the associated challenges actively. Additionally, a study on ESG (Environmental, Social, and Governance) education demonstrated a significant improvement in exam scores among students in the gamified group, highlighting the effectiveness of incorporating game-like elements into educational settings. The study also elucidated the psychological processes involved in gamified learning environments, affirming the potential of gamification as an effective pedagogical tool in higher education (Despeisse, 2018). Furthermore, gamification has been linked to the principles of Self-Determination Theory and active learning, indicating its potential to drive behavioral change and application within the context of sustainability education (Botte et al., 2020).

Implementing gamification in sustainability education in business schools comes with several challenges that need to be addressed. Designing effective gamified systems requires careful consideration of the learning objectives, game mechanics, and the integration of sustainability concepts (Hsieh, 2020). This is crucial to ensure that the gamified elements align with the curriculum and effectively engage students in learning about sustainability. Additionally, integrating gamified systems with the assessment processes poses a challenge as educators need to develop methods to evaluate students' performance and understanding within the gamified environment (Despeisse, 2018). Furthermore, resource constraints within the business school environment, such as limited access to technology and time constraints, can hinder the successful implementation of gamification in sustainability education.

METHODOLOGY

In order to provide a comprehensive assessment and compile and synthesize the results of extant empirical research on gamification in sustainability learning in business education, the study used the Systematic Literature Review (SLR) approach. Data were gathered using the SLR methodological steps (planning, conducting, and reporting) of Tranfield et al. (2003), Becheikh et al. (2006), and Karaçam (2013) to provide the best evidence in a repeatable procedure. The PRISMA 2020 expanded checklist is used to ensure the present SLR's methodological rigor. The methodological components of the review were assessed in great depth by using this checklist, which also contributed to the transparent adherence to recognized principles. In the planning phase, the research questions

were formulated, the research protocol and screening criteria were determined, the research protocol was used to extract data, and the content was analyzed in the second methodological step. In the final step of SLR, the findings were reported.

Planning the Review

The paper focused on the following six major research questions in order to establish and drive the course of the systematic review:

RQ1. What are the primary bibliometric attributes of the chosen studies? The objective of this research topic is to determine the number of publications published within a certain timeframe, together with the year of publication and the locations where these studies have been published.

RQ 1.1 What is the frequency distribution of the chosen studies based on their years of publication?

RQ 1.2 What geographic regions are being addressed?

R.Q. 2. What methodological aspects are present in the chosen studies? This research topic seeks to examine the theoretical foundation of the studies, the specific aspects of the methodologies used, such as the types of research and data gathering methods utilized, and the unit of analysis focused on for data extraction.

RQ 2.1 Which theories are mentioned in the studies?

RQ 2.2 Which research design and data collection method are used to conduct the studies?

RQ 2.3 Which unit of analysis is used?

RQ3. Which business fields and sustainable development goals have been discussed in the context of gamification in the literature?

RQ4.Which gamification mechanics, dynamics, and components are used in the field of sustainability in business education?

RQ5. How does gamification change student responses/motivations/emotions in the sustainability field in business education?

RQ6. What are the challenges and benefits of deploying gamification in the field of sustainability in business education?

Conducting the Review

This methodological step initially involved identifying keywords and search terms, which is based on the research questions, literature review, and discussions of the researchers. Four main terms were identified: "Sustainability," "gamification," "education," and "business." In order to guarantee that all relevant studies were included, they were supplemented by a range of related keywords. The identified terms were merged using the Boolean operators 'odds ratio (OR)' and 'AND.' An example of a search word combination is "sustainability" AND "gamification" AND

"education" AND "business". A comprehensive description of the search terms utilized is provided in Table 1.

Table 1: Keywords and Search Strings

Sustainability	**Gamification**	**Education**	**Business**
"sustainable behavior" or "pro-environmental behavior" or "sustainability" or "climate" or "equality" or "energy" or "environmentalism"	"gamified application" or "gamified approach" or "gamified system" or "game-based approach" or "gamification"	"education" or "course" or "sustainability education"	"business" or "management"
Search Strings Example	("sustainable behavior" or "pro-environmental behavior" or "sustainability" or "climate" or "equality" or "energy" or "environmentalism") AND ("gamified application" or "gamified approach" or "gamified system" or "game-based approach" or "gamification") AND ("education" or "course" or "sustainability education") AND ("business" or "management")		

Table 2: Exclusion Criterion

Exclusion Criterion
Conference papers and other non-peer-reviewed publications
Studies focusing on gamification in sustainability learning but not within the framework of higher education in business schools
Non-English papers
Non-empirical studies
Studies with no full-text

Since the ISI Web of Science and Scopus include some of the greatest archives of business research and are often utilized in literature reviews (Lu et al., 2024; Chauhan et al., 2022), they were chosen as the research sources. Three inclusion criteria were specified in an attempt to identify papers that are qualified for further investigation: The papers should (1) address gamification in sustainability learning within the framework of business schools; (2) be published as studies in peer-reviewed journals or published as books and book chapters in English; and (3) be an empirical study using primary and/or secondary data. The search was performed in July 2024. No time limit is defined within the review scope.

The incongruent studies were eliminated, and the pertinent ones were shortlisted using the inclusion and exclusion criteria (see Table 2). The evaluation of the studies that meet the predetermined criteria for inclusion and exclusion in the review is carried out separately by the two authors to minimize subjectivity and increase validity. When the two authors disagreed on the assessment findings, they discussed the discrepancies.

By exhaustively scanning WoS and Scopus databases with all conceivable combinations, a sample of 187 studies was obtained, as seen in Table 3. There were 166 papers left after duplicates were eliminated. Subsequently, the titles and

abstracts of the remaining papers were examined based on the predefined criteria for inclusion. Consequently, 90 papers were removed since they were either review studies, proceeding papers, or early access papers. The full texts of all potentially relevant studies (n=76) were further evaluated to determine their alignment with the research questions. Papers that were irrelevant to gamification in sustainability learning in the context of business schools were removed, yielding a sample of 19 studies.

Table 3: Identification and Screening Process

Identification	**Records identified through database searching**		
	Scopus: 98	**Total: 187**	**WoS: 89**
Screening	Total duplicate records: 21		
	Records to be screened: 166		
	Review study records: 15		
	Proceeding paper records: 70		
	Early access records: 5		
	Studies not within the scope of gamification in sustainability learning in business schools: 57		
	Total records after screening: 19		

Following the process of screening for inclusion, researchers acquired the full texts of papers to be assessed for quality. Hence, a comprehensive evaluation of quality was conducted on the remaining 19 papers. Seven quality evaluation criteria of Kassab et al. (2020) were used. Following the assessment, all 19 papers were found to be eligible for further review, indicating that they satisfied the quality requirements.

Consequently, a database of 19 research studies was established using Microsoft Excel, and the coding protocol was prepared. The database was populated with the title, keywords, institution, year of publication, geographic focus, research method, theoretical background, outcome(s) of the study, business education fields, sustainability education fields, software tools for gamification, game type, gamification elements/components, dynamics of gamification, mechanics of gamification, effects of gamification in the learning environment (Learning engagement, academic achievement, motivation of learners), learners' mood/emotional states, challenges and benefits gathered from each study. Data was analyzed and synthesized using Excel. The authors analyzed and categorized each paper separately. A comprehensive discussion was conducted to address inconsistencies in the codings, and the coding protocol was amended until complete consensus was achieved.

Reporting

The findings are provided after analyzing and synthesizing all the studies. Hence, the next part will outline and present the fundamental aspects of the research as well as the primary concerns pertaining to gamification in sustainability learning within the framework of business schools.

FINDINGS

Research Profiling

This study retrieved 19 studies on gamification in sustainable business education from 10 different journals through Scopus and Web of Science without specifying any timeframe. Studies at the intersection of gamification, business education, and sustainability dimensions started in 2019, and between 2019 and 2024, 1 study was published in 2019, 4 in 2020, 6 in 2021, 3 in 2022, 3 in 2023, and 2 in 2024, respectively. While five studies did not specify where the research was conducted, ten were conducted in European countries, two in Australia, 1 study in Korea, and 1 study in the USA. In addition, most of the studies had a single-country focus, while two studies had a multi-country focus. Additionally, keywords of the studies were analyzed and the term that appears the most frequently is "Gamification", "Serious Game", "Game-based Learning", "Higher Education", "Education", "Sustainability", "Sustainable Development Goals".

In the systematic review, 7 of the studies followed a qualitative research methodology, while 4 followed a quantitative methodology. Eight studies used mixed methods. The most commonly used data collection tools are case studies (n=10), surveys (n=8), and face-to-face interviews (n=5). During this systematic review, it was found that students were the most focused unit of analysis (n=12), and except for 1 study (Master students), all other studies were conducted on undergraduate students. Five studies targeted professionals, while two were conducted on students and professionals. There is only one study focusing on academics.

Theoretical Perspectives

The majority of studies did not go into detail about the theoretical model they were based on, even though a small proportion of them (n=5, 26%) built an underlying theory model to illustrate the rationale behind adopting gamification in sustainable business education.

In this study, when the theoretical models used by the studies are analyzed, it is seen that only five studies used eight different theories. Manshoven and Gillabel (2021) use the ***Self-Determination Theory (SDT)***, which emphasizes that fulfilling basic human needs promotes personal growth. This theory distinguishes between extrinsic and intrinsic motivation. The selection of game features should be chosen

in order to satisfy the psychological needs of autonomy, competence, and relatedness, as stated in SDT, in order to promote learning motives through gamification effectively. The same study also utilizes ***Flow Theory (F.T.)***, focusing on individuals' ability to achieve high concentration in tasks. Constructivist ***Learning Theory (CLT)*** suggests learning occurs through active, experience-based engagement. Ouariachi et al. (2020) apply the ***Octalysis Framework***, which explains human behavior through eight core impulses. Whittaker et al. (2021) explore the ***Hierarchy-of-effects Framework*** and ***Behavioral Learning Hierarchy***, theorizing that serious games follow a "do–learn–feel" process. Gawel, Strykowski, and Madias (2022) differentiate between ***Value Creation*** and ***Value Destruction Approaches***, examining the correlation between sustainability and financial performance. Lastly, Maskeliunas et al. (2020) apply the **T*echnology Acceptance Model (TAM)*** and ***Technology-Enhanced Training Effectiveness Model (TETEM)*** to assess users' acceptance of gamification and its impacts on training effectiveness. The theories used in the systematic review are presented below (See Table 4).

In the "gamification in education" literature, SDT and Cognitive evaluation theory (CET) as a sub-title of self-determination theory (Deci and Ryan, 1985), Self Efficacy Theory (SET) (Bandura, 1977), Goal Setting Theory (GST) (Locke et al., 1968), F.T. (Csikszentmihalyi, 1990) are the most common theories mentioned. Among these theories, SET, which is defined as a person's opinion or conviction regarding their capacity to carry out specific duties (Bandura, 1977), and GST, which claims that people will be motivated to strive towards goals (Locke, 1968), are not mentioned in gamification literature related to sustainability education.

Table 4: The Theories Focused in the Studies

Authors and Year	Theoretical Background	Description of Theory
Manshoven, S. and Gillabel, J. (2021)	**Self Determination Theory (SDT)**	The fulfillment of basic human needs described in the SDT is a source of personal growth and well-being. According to SDT, learners' motivation can also be classified as 1) Extrinsic motivation is the act of engaging in an activity with the intention of achieving a certain outcome, such as obtaining a high grade. 2) Intrinsic motivation pertains to engaging in an activity due to its inherent attractiveness or enjoyment, and it is associated with three factors: autonomy, relationships, and competence.
	Flow Theory (F.T.)	According to F.T., individuals can achieve a high level of focus and delight while playing a game that is demanding enough to keep them from becoming bored but manageable enough to avoid frustration.
	Constructivist Learning Theory (CLT)	Constructivism principally suggests that learning occurs through active learning based on experiences.
Ouariachi T., Li C. Y. and Elving W.J.L. (2020)	**Octalysis Framework**	The Octalysis framework is founded on eight fundamental core impulses that elucidate the underlying purpose behind all human behavior: The concepts of Epic Meaning and Calling, Development and Accomplishment,

		Empowerment of Creativity and Feedback, Ownership and Possession, and Social Influence are being discussed.
Whittaker, L; Russell-Bennett, R; Mulcahy, R (2021)	**Hierarchy-of-effects framework & Behavioral learning hierarchy**	In this study, it is theorized that serious games align with the "do–learn–feel" hierarchy.
Gawel, A., Strykowski, S. and Madias, K. (2022)	**Value Creation Approach and Value Destruction Approach**	Regarding the correlation between sustainability and financial performance, the value-creation approach posits that companies that implement environmental strategies are exposed to lower risks in terms of performance. On the other hand, the value-destruction approach suggests that companies that pursue sustainable strategies, such as reducing production, may overlook profitability.
Maskeliunas, R, et al. (2020)	**Technology Acceptance Model (TAM)**	TAM investigates the factors affecting users' acceptance of gamification using online platforms. These factors are perceived usefulness, perceived ease of use, attitude towards use, intention to use, and perceived enjoyment.
	Technology-Enhanced Training Effectiveness Model (TETEM)	TETEM investigates the use of virtual worlds in corporate training, but subsequently, it is adopted to assess the impacts of gamification. The model assesses individuals' familiarity with games, opinions on learning via games, the positive or negative emotional response to having control, and the positive or negative emotional response to gamification.

Thematic Analysis

An analysis of the business areas considered in the studies reveals that twelve studies are in management, four in marketing, and two in entrepreneurship. Compared to the majority of studies based on a single business area, only three studies provided a perspective focusing on multiple business functions. When the Sustainable Development Goals (SDGs) of the studies are examined, eight studies address SDGs as general sustainability; 7 studies concentrate on SDG13 (Climate Change); 3 studies on SDG 7 (Affordable and Clean Energy). SDGs 5 (Gender Equality), 10 (Reduced Inequalities), 16 (Peace, Justice, and Strong Institutions), and 17 (Partnership for the Goals) were not included in any study.

In the systematic review, it is seen that 15 studies focused on content gamification, and 1 study was conducted within the scope of structural gamification. In addition, 1 of the 15 studies dealt with an outdoor game, and 1 study dealt with a board game. In this context, it can be said that most of the studies focus on content gamification in online settings. Regarding game components implemented in gamified environments in sustainability education of business schools, it is revealed that points (n=6), challenge (n=6), feedback (n=6), rewards (n=5), achievements/badges (n=5), teams (n=4) are the components most frequently used. Analysis of the gamification dynamics shows that the games utilized in the studies mostly employ the dynamics of progression (n=5), narrative (n=4), and emotions

(n=4). Competition (n=6), challenge (n=5), and rewards (n=5) are the most common mechanics of gamification.

When the outcomes of studies were assessed, the main outcomes can be grouped into three categories as follows: (1) outcomes related to game content & context (cognitive and affective learning outcomes, game design, didactic elements of game etc.); (2) outcomes related to the effects of using gamification to teach sustainability in business education/training (attitude toward sustainability, awareness about sustainability, sustainability knowledge, game effectiveness, soft skills, user-engagement, learners' experience, behavior change etc.); (3) outcomes related to using technological advancements (the challenges of using technological tools and techniques in teaching sustainability, attitude toward technology etc.). 14 studies analyze learning engagement and focus on the positive impact of gamification in teaching sustainable business education on learners' engagement. However, though academic achievement is mentioned in the literature as a result of game-based learning (Zeybek & Saygı, 2024), only five studies specifically address academic achievement (Table 5).

Table 5: Outcome(s) of the Studies

AUTHORS and YEAR	**Outcome(s) of the Studies**		
		Learning Engagement	**Academic Achievement**
Shah, Z. et al. (2022)	● Awareness about sustainability in education, ● The difficulties associated with using technical instruments and procedures in the instruction of sustainability.	-	-
McGowan, N., López-Serrano, A. and Burgos, D. (2023)	● Soft skills and technical knowledge in the context of sustainability and gamification	+	-
Gómez-Ruiz, M.L., Morales-Yago, F.J. and de Lázaro-Torres, M.L. (2021)	● Learning outcomes ● Attitude toward the technologies used ● Didactic utility of the gamification	+	-
Santos-Villalba, M.J. et al. (2020)	● Attitude toward sustainability	-	-
Zimmermannova, J. et al. (2021)	● Ability to enhance student´s engagement	+	-
Manshoven, S. and Gillabel, J. (2021)	● Cognitive learning outcomes	+	-
Park, S. and Kim, S. (2023)	● The understanding and motivation for the gamification- ● Learners' intrinsic motivation, self-determination, and self-efficacy	+	-
Ouariachi T., Li C.-Y. and Elving W.J.L. (2020)	● Game design	+	-

Dahdouh-Guebas, F et al. (2022)	• Game design • Feedback about game	-	-
Jääskä, E., Aaltonen, K. and Kujala, J. (2021)	• Learning outcomes • Learning experience • Attitudes toward gamified learning • General satisfaction with the instructional techniques, resources, and acquisition of knowledge.	+	-
Whittaker, L., Russell-Bennett, R. and Mulcahy, R. (2021)	• Sustainability knowledge • Value-in-behavior • Sustainable behavioral intention	+	-
Gawel, A., Strykowski, S. and Madias, K. (2022)	• The dilemma between productivity and • sustainability	+	+
Donath, L., Mircea, G. and Rozman, T. (2020)	• Sustainability knowledge • Sustainability skills (Entrepreneurial skills, Digital competencies, Practical skills in Education for Sustainable Development, • Course design	+	+
Cravinho J. et al. (2023)	• User-engagement experience • Energy literacy • Behavior change	+	+
Fischer, S., Göhlich, M. and Schmitt, J. (2024)	• Didactical elements for a business simulation game (Implementation, game • elements, participation, and consolidation)	+	+
Maskeliunas, R. et al. (2020)	• The effectiveness of the game in teaching	-	-
Garcia, D.A., Groppi, D. and Tavakoli, S. (2021)	• Feedback about game	+	-
Gatti L., Ulrich M. and Seele P. (2019)	• Cognitive and affective learning outcomes	+	+
Runnerstrom M.G., Denaro K. and DiVincenzo J. (2024)	• Students' climate change knowledge, environmental concern, and connection to nature.	-	-

According to the systematic analysis, only 11 of the studies mentioned emotions. While seven studies evaluated only positive emotions, one study analyzed negative emotions. Three studies addressed both positive and negative emotions. Among positive emotions, "like" (n=5) and "joy/fun" (n=5) are the most frequently mentioned, while "frustration" is the most common negative emotion addressed in the studies. Studies have shown that for many people, “cognitive challenge” is the cause of frustration (Fischer et al., 2024; Gatti et al., 2019).

The main challenges and benefits of implementing gamification on sustainability in business education were elaborated and presented in Table 6. According to the analysis, the main benefits can be summarized as improving engagement, both cognitive and emotional, increasing motivation of learners, more favorable user experience which includes fun and inspiration, comprehensive exchange of knowledge and experience in team collaboration, providing opportunity for interdisciplinary learning, generating new way of thinking, rising sustainability awareness, supporting soft skills such as creative intelligence, causing behavioral change on sustainability and finally ensuring students' employability through all these benefits. After discussing the benefits of gamification from the perspective of students, the study on a limited number of instructors identifies promoting teacher competencies and increasing the number of better skilled staff as the main benefits. However, implementing gamification on sustainability in business education also has several challenges. First, game design can be one of the challenges. Especially oversimplified content of the game, which has a lack of real-life connection, game design not being sufficiently inclusive and unbiased, imperfect game appeal and usability, or design which does not reflect real-life sustainability concerns can be main challenges based on game design. On the other hand, balancing students' positive and negative emotions can be a concern since students can live a huge disappointment when the game doesn't turn out the way they want it to, or students' discussions in a team or among teams can have a hectic, stressful learning environment. Applying sustainable logic to business logic makes simulation much more complex. In a way, this means real-world relevance, which is actually desirable. On the other hand, it is also an important challenge because it requires students to have prior knowledge and makes it difficult to understand.

Table 6: Challenges and Benefits of Implementing Gamification on Sustainability in Business Education

AUTHORS and YEAR	**CHALLENGES OF IMPLEMENTING GAMIFICATION ON SUSTAINABILITY IN BUSINESS EDUCATION**	**BENEFITS OF IMPLEMENTING GAMIFICATION ON SUSTAINABILITY IN BUSINESS EDUCATION**
Shah, Z. et al. (2022)	The lack of the necessary training and understanding of basic sustainability principles of instructors	
McGowan, N., López-Serrano, A. and Burgos, D. (2023)	Created an educational game that has the potential to oversimplify intricate ideas and circumstances, leading to false information and a failure to accurately represent the complexity of real-life scenarios. The lack of inclusivity and impartiality in the games	Enhancing an individual's interpersonal abilities, such as effective communication, innovative thinking, and cooperative capabilities. Increasing student engagement. Enhancing the employability of higher-education students while simultaneously increasing knowledge of environmental challenges.

Gómez-Ruiz, M.L., Morales-Yago, F.J. and de Lázaro-Torres, M.L. (2021)		Promoting teaching competencies
Zimmermannova, J. et al. (2021)	Engaged in intense and passionate debates and anxiety-inducing negotiations within or between teams. Great disappointment when the game doesn't turn out the way students want it to	Ability to enhance student´s engagement.
Manshoven, S. and Gillabel, J. (2021)	Seeing the game as intricate, labor-intensive, and lacking the necessary gravitas for academic pursuits. Criticisms of (over) simplifications and the game's lack of real-world connectivity	Creating an engaging learning environment, more specifically, positive cognitive and affective involvement
Park, S. and Kim, S. (2023)		Exceeding the effectiveness of conventional teaching methods in fostering learners' intrinsic motivation, self-determination, and self-efficacy
Ouariachi T., Li C.-Y. and Elving W.J.L. (2020)	The challenge is in achieving equilibrium between favorable and unfavorable emotions, as well as external and internal incentives inside the gameplay.	Delivering engagement that encompasses cognitive, emotional, and behavioral aspects.
Jääskä, E., Aaltonen, K. and Kujala, J. (2021)		The opportunity to use theoretical concepts in practical situations within a humorous, thrilling, and motivating environment. Collaboration among team members
Whittaker, L., Russell-Bennett, R. and Mulcahy, R. (2021)	Difficulty to make a true design that reflects real-life sustainability concerns Difficulty in planning the level of difficulty (low, medium, hard) as well as progressively harder levels and manipulating the magnitude or types of rewards provided	The higher-tiered reward-based game mechanics (badges and trophies) were found to be influential in enhancing sustainability knowledge and value-in-behavior compared to the lower-tier reward of points and meaningful game mechanics of educational messages. Giving rewards to the players is an effective approach to reinforcing knowledge communicated in a serious game.
Gawel, A., Strykowski, S. and Madias, K. (2022)	Integrating sustainable principles into corporate operations increases the complexity of the simulation. This accurately mirrors real-world challenges, but it also presents a greater difficulty for students to comprehend. The task involves the integration of all facets of business and sustainability into a single virtual game. Students must possess a profound comprehension of both sustainability and the business area to effectively apply their	The cross- and interdisciplinary learning of students

	knowledge to their business judgments in the virtual game.	
Cravinho J. et al. (2023)	Design's appeal and usability	Promoting and fostering user engagement Providing an improved user experience Promoting energy literacy and creating sustainability awareness
Fischer, S., Göhlich, M. and Schmitt, J. (2024)	The time and resources required to play the game are required. Triggered negative emotions such as frustration because of cognitive challenge	Promising tools to motivate individuals and promote behavior change in different areas Enables a more comprehensive exchange of knowledge and experience via especially heterogeneous team
Maskeliunas, R. et al. (2020)	It is necessary to use a distinct set of strategies in order to create games for a different academic program, particularly one that is taken by students who are not digitally inclined. There is a potential danger that gamification might have a detrimental psychological effect on behavior, as some students may become too fixated on obtaining rewards rather than engaging with the educational process itself.	Motivating for better understanding and learning
Garcia, D.A., Groppi, D. and Tavakoli, S. (2021)	There is a need for continuous updates to the training content according to new technologies and tools.	More skilled personnel
Gatti L., Ulrich M. and Seele P. (2019)	Triggering negative emotions such as frustration due to the limited group size and cognitive challenge	Generating not only cognitive engagement but also emotional involvement (affective engagement) Influencing the way of thinking about business and management, i.e., thinking in new ways

DISCUSSION AND CONCLUSION

The study achieved its overall objectives with a systematic review methodology and answered specific research questions on the gamification of sustainability learning in business education. In particular, the study has provided several important takeaways. First, studies on the triangle of gamification, business education, and sustainability are centered in Europe. One of the reasons for this is that gamification requires a detailed design and implementation process, so it is usually projected, and the studies published are the outputs of E.U. projects. Although there is a theoretical background of literature related to gamification; unfortunately, theoretical support in the studies analyzed around sustainability in business education is limited. In order to further develop this field, it is recommended

that more projects on gamification in the field of sustainability in business education be conducted and that the projects be designed more comprehensively based on the theoretical background to measure the learning experience within the scope of gamification, some of which will be presented in this study. Particularly geographically, studies could be focused outside the European region and in more developing countries to disseminate the positive outcomes of gamification (i.e., engagement of students), increase sustainability knowledge and awareness, and create socio-economic impact (i.e., better-quality business education and increasing employability) in these developing geographies.

Major studies concentrate on the single business field, mainly management, since multi-business-field concentration complicates the game design. Designing more comprehensive games that reflect real life can be a suggestion in this sense, but it is important not to lose comprehensibility for students. When sustainable development goals are underlined in the studies analyzed; unfortunately, the first thing that comes to mind most often is “the goal of climate change" (SDG 13). However, SDG 5 (Gender Equality) and SDG 10 (Reduced Inequalities), which are important for decent work conditions, were not mentioned in the studies. Therefore, it can be suggested that games can be designed through different SDGs to train managers and leaders, especially those with sustainability priorities.

While components such as competition, rewarding, and giving feedback are used in the selection of game mechanics, design, and components, there are no studies on the effects of these elements individually. In addition, these components may lead to different learning outcomes in different cultures. Therefore, it may be recommended for future studies to investigate how the relationships between game mechanics, design, element selection and learning outcomes change according to different cultural dimensions.

According to the completed systematic review, most of the outcomes are cognitive, such as cognitive learning engagement. Although 11 studies have mentioned emotions, the concepts of affective engagement and types of emotions have not been addressed comprehensively. However, the learning process is an emotional process as well as a cognitive one (Thomas & Baral, 2023). Especially addressing negative emotions such as stress, anger, and shame caused by the consequences of competition or not winning the game can fill an important gap in literature.

The main benefits of studies analyzed can be classified under four groups: Cognitive benefits, such as the exchange of knowledge, generating a new way of thinking, and rising sustainability awareness; affective benefits, such as fun and inspiration; motivational benefits, such as increasing motivation of learners; and finally, behavioral benefits such as causing behavioral change on sustainability. While cognitive and motivational benefits have been heavily emphasized in the literature, affective and behavioral benefits have been relatively less analyzed. From

this perspective, future studies could specifically address the affective and behavioral benefits of using gamification in sustainability learning in business education.

Last but not least, the analyzed challenges of using gamification can open new routes for future studies in sustainability and business education contexts. Game design-related challenges provide an opportunity to design games based on mechanics, design, components, and aesthetic elements and to measure their effectiveness. These game dimensions can be associated with cognitive, affective, motivational, and behavioral outcomes of implementing gamification by future researchers. Additionally, balancing students' positive and negative emotions can be a vital concern, so, during the gameplay, the triggered emotions need to be elaborated. Designed games become significantly more sophisticated when sustainable logic is applied to business logic. Even if games that better reflect the real world are preferred, the complex game design should not exceed students' comprehension and knowledge levels.

The main goal of this study was to comprehend how gamification has been applied to sustainability learning in business education by outlining potential research directions. However, there are limitations to consider. First, it can be said that some studies were excluded because they were written in other languages and indexed in different databases. Gamification in sustainability learning in business education is an emerging field. Moreover, data collection in this domain relies directly on the game's design or the execution of an existing game. These factors pave the way for the scarcity of empirical research in this field. Performing this systematic review within the initial stages of the literature will aid in advancing the field by guiding future research on sustainability, business education, and gamification. Further research may focus on behavioral benefits resulting from gamification strategies. Research should investigate how gamified educational experiences translate into real-world behaviors regarding sustainability and how these behaviors can be effectively evaluated. Moreover, the specific design elements and mechanics contributing to effective learning outcomes in gamified settings could be explored, and best practices for creating comprehensive games that balance complexity and students' comprehension can be identified.

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