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Gamification for sustainable consumption: A state-of-the-art overview and future agenda

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Abstract

Unsustainable consumption is a pressing issue requiring innovative solutions. Gamification is a promising approach with the potential to drive a shift toward sustainable consumption. This study delivers a state-of-the-art overview of gamification as a strategy for sustainable consumption, shedding light on its role at the intersection of *environmental sustainability*, *sustainability education*, *sustainable behavioral changes*, *sustainable living*, *sustainable tourism*, and *workplace sustainability*, underscoring that sustainable consumption (e.g., energy) is not only personal but also professional. This study also offers a rich organizer of *antecedents* (game mechanics, incentives and mechanisms, social dynamics, sustainability focus, and user experience), *mediators* and *moderators* (psychographic and socio-cultural), *controls* (demographic and contextual), and *outcomes* (behavioral changes, consumption patterns, and psychographic shifts), alongside relevant *theories* and *methods*, to provide a finer-grained, toolbox-like understanding of gamification for sustainable consumption. This study concludes with avenues for future research to drive new frontiers where gamification can contribute to sustainable consumption, and by extension, the United Nations Sustainable Development Goal (SDG) 12 on Responsible Consumption and Production.

KEYWORDS
gamification, review, SDG 12, sustainability, sustainable consumption

1 | INTRODUCTION

Sustainable consumption involves the responsible use of resources to fulfill present consumption needs without compromising the ability of future generations to meet theirs (Azmat et al., 2023; Geiger et al., 2018; Lim, 2017). This concept has gained international recognition as a key development strategy, sparking extensive research into responsible consumption and production (Sustainable Development Goal [SDG] 12) alongside their critical implications for environmental sustainability and human well-being (Cohen et al., 2017; Lim, 2022a). Addressing the pressing risk of environmental harm due to unsustainable practices is a central concern in sustainable consumption discourse (Jebarajakirthy et al., 2024; Lim, 2024). A recent newsletter from Just Agriculture warns that if current rates of production and

Abbreviations: ADO, antecedents, decisions, and outcomes; AMO, antecedents, modifiers, and outcomes; COVID-19, coronavirus disease 2019; CSR, corporate social responsibility; ECM, expectation–confirmation model; GPS, global positioning system; NGO, nongovernmental organization; RQ, research question; SDG, Sustainable Development Goals; SDT, self-determination theory; SLR, systematic literature review; SPAR-4-SLR, Scientific Procedures and Rationales for Systematic Literature Reviews; TCM, theories, contexts, and methods; TM, theories and methods; TPB, theory of planned behavior.

consumption persist, global resource extraction could rise by 110% by 2060, causing serious resource shortage for future survival. To address this, stakeholders must advance persuasive technology to encourage attitudinal and behavioral changes toward sustainable consumption (i.e., persuaded rather than coerced into change) (Evans et al., 2020; Lim & Weissmann, 2023). One such notable application of persuasive technology for transition toward sustainable consumption is gamification (Huber & Hilty, 2015; Sharma et al., 2024).

Gamification, the integration of game elements into non-game settings, enhances daily tasks by making them more engaging and enjoyable (Mitchell et al., 2017). This approach not only enriches user experience but also drives participation and fosters behavioral change through incentives and rewards (Eppmann et al., 2018; Hamari et al., 2019). Moreover, the theoretical foundation of gamification, particularly self-determination theory (SDT), underscores its efficacy in motivating users (Guillen et al., 2021). The interactive nature of gamified activities, as highlighted by Xi and Hamari (2019), further amplifies user engagement. SDT posits that human behavior can be characterized by the degree to which it is either autonomous (acting with a sense of volition; e.g., intrinsic) or controlled (acting with a sense of pressure; e.g., extrinsic) (Gagné & Deci, 2005). SDT states that human behavior necessitates both intrinsic and extrinsic motivations. Thus, an action that incorporates both intrinsic and extrinsic motivations is highly likely to be successfully performed (Ryan & Deci, 2000).

Gamification is viewed as an effective strategy in promoting sustainable consumption as it engages people both intrinsically and extrinsically (Kasurinen & Knutas, 2018; Mishra & Malhotra, 2021). Through gamification, both intrinsic and extrinsic motivations are generated for routine or mundane human activities (Ghosh & Dwivedi, 2022) using the principle that "individuals are naturally inclined toward play" (Simões et al., 2013). Recognizing this, brands are employing gamification as part of sustainability marketing (Whittaker, Mulcahy, & Russell-Bennett, 2021), encouraging reduced consumption (Brannon et al., 2022) and fostering sustainable lifestyles (Guillen et al., 2021). A practical application of gamification in promoting sustainable consumption can be seen in Toyota's initiative. The company's UbiGreen smartphone application, designed to encourage environmentally conscious transportation choices, integrates gamification principles into its features. These features, such as providing feedback on fuel consumption, are aligned with Toyota's broader efforts to foster eco-friendly driving habits. Such initiatives exemplify how gamification can effectively translate into real-world applications that encourage sustainable behaviors (Huber & Hilty, 2015).

Numerous studies recognize gamification as a strategy for sustainable consumption, yet there is a lack of comprehensive, organized reviews on its application in this context (Guillen et al., 2021). The existing literature presents conflicting perspectives, with some viewing gamification primarily as a communication tool for behavioral change (Berger, 2019; Paravizo et al., 2018) while others see it as a means of engagement (Degirmenci, 2018; Fadhil & Villafiorita, 2017; Lim, Rasul, et al., 2022). In addition, descriptions of gamification vary, ranging from game activities to loyalty program solutions (Dunlop, 2021; Koivisto & Hamari, 2019), and some even restrict it to game development and testing (Fadhil & Villafiorita, 2017). This inconsistency necessitates a deeper understanding of gamification's role in sustainable consumption. Moreover, ambiguity exists in implementing gamification strategies and assessing their sustainability outcomes (Sharma et al., 2024). These challenges hinder a clear understanding of how gamification's design choices influence sustainable consumption.

To address these gaps, this study conducts a systematic review of the literature using an integrated antecedents, modifiers, and outcomes (AMO) and theories and methods (TM) framework (Luo et al., 2024; Paul et al., 2017). Specifically, the study's review aims to answer four key research questions: *how is gamification studied in relation to sustainable consumption?* (RQ1); *what are the antecedents, modifiers, and outcomes of gamification in this context?* (RQ2); *which theoretical perspectives and methodologies are employed to explore these relationships?* (RQ3); and *what directions should future research in gamification for sustainable consumption take?* (RQ4).

Utilizing the AMO-TM framework (Luo et al., 2024; Paul et al., 2017), this study comprehensively explores gamification as an approach to promote sustainable consumption. More specifically, this study examines factors that motivate individuals toward gamification, potential barriers to its adoption, and its overall effectiveness in fostering sustainable lifestyles. Moreover, this study ventures into the theories and methodologies pertinent to research in this space, ending in promising directions for future research. Theoretically, this study advances the understanding of gamification as a means for sustainable consumption and guides the trajectory of future scholarly inquiries. Practically, this study illuminates the effectiveness of various gamification strategies, such as the look-up design element (Hoffmann & Pfeiffer, 2022), play and reflection approaches (Whittaker, Mulcahy, & Russell-Bennett, 2021), the integration of practical missions and challenges or levels (Stephens, 2022), and the use of engaging tools like avatars, emojis, dashboards, quest maps, and action missions (Mylonas et al., 2023), as well as redeemable prizes (Rottondi & Verticale, 2017). These insights are pivotal in understanding and enhancing the role of gamification tactics in encouraging sustainable consumption behaviors.

2 | METHODOLOGY

2.1 | Approach

Systematic literature review (SLR) is a widely utilized method to systematically analyze and assess the existing body of literature to address specific research questions (Paul et al., 2021). SLR is highly regarded for its transparency, comprehensiveness, and its capability to mitigate bias (Ashaduzzaman et al., 2022; Siddaway et al., 2019). Owing to the ambiguities and knowledge gaps in the domain of gamification and sustainable consumption, this study employed an SLR approach to synthesize previous research, identify areas of knowledge deficiency, and enrich the future understanding of the subject matter.

As this study is not constrained by any specific theoretical or methodological perspective, it conducts a domain-based SLR (Paul & Criado, 2020) by opting to adapt two widely recognized theoretically and methodologically agnostic organizing frameworks—that is, antecedents, decisions, and outcomes (ADO) (Paul & Benito, 2018) to antecedents, modifiers, and outcomes (AMO) and theories, contexts, and methods (TCM) (Paul et al., 2017) to theories and methods (TM) frameworks—to augment understanding of gamification for sustainable consumption (context). The AMO serves as an organizer that provides systematic insights into antecedents, modifiers (mediators, moderators, controls), and outcomes in relation to gamification and sustainable consumption research; the adaptation occurs from decisions (D) to modifiers (M) for the purpose and relevance herein. Conversely, the TM organizer discloses a variety of theories and methodologies employed in studies on gamification and sustainable consumption; the adaptation occurs by dropping contexts (C) as gamification and sustainable consumption are contexts themselves.

The convergence of these frameworks is essential and in line with the seminal practice of leveraging integrated organizers in domain-based SLR (Lim & Rasul, 2022; Lim et al., 2021). Sole reliance on AMO may not capture all theoretical and methodological underpinnings central to the construct. Similarly, solely leaning on TM may not offer a comprehensive grasp of the construct's dimensions and relationships. Collectively, the comprehensive model (ADO) and toolbox (TM) emerging from these organizing frameworks represent the entirety of the literature on gamification and sustainable consumption, addressing the current understanding (via AMO) as well as theoretical and methodological underpinnings (via TM). SLRs rooted in frameworks like these significantly contribute to advancing research in their respective fields (Kraus et al., 2022; Lim, Kumar, & Ali, 2022; Paul et al., 2021). In alignment with this, the present review sheds light on the antecedents of gamification influencing sustainable consumption, the complexities of decision-making associated with the adoption of gamification that facilitates sustainable consumption choices, and the resulting consequences, thereby offering a thorough exploration of research at the intersection of gamification and sustainable consumption.

2.2 | Procedure

The present study ventures into the advancements in gamification and sustainable consumption research, leveraging the scientific procedures and rationales for systematic literature review (SPAR-4-SLR) protocol (Paul et al., 2021) for a systematic literature search and synthesis. Due to its robust nature, recent SLRs have adopted (e.g., Azam, 2023; Ciasullo et al., 2022; Das et al., 2024) and recommended (e.g., Lim, Kumar, & Ali, 2022; Sharma & Tiwari, 2024) SPAR-4-SLR as the go-to criteria. This methodology comprises three steps (assembling, arranging, and assessing) and six sub-stages (identification, acquisition, purification, organization, evaluation, and reporting) (Paul et al., 2021), discussed subsequently and visualized in Figure 1.

2.2.1 | Assembling

This phase entails defining the domain, research questions, source quality, as well as search mechanism, search period, search keywords, search fields, research/subject areas, source and document type, language, and publication stage as part of identifying and acquiring relevant articles (Paul et al., 2021). The domain focuses on gamification in the context of sustainable consumption. Only peer-reviewed journal articles published in English were considered, excluding conference proceedings, books, book chapters, editorials, dissertations, and non-English articles following the guidelines of past guides in emphasizing research rigor, relevance, and readability (i.e., 3Rs) (Kraus et al., 2022; Paul et al., 2021).

For quality assurance, the study relied on the Scopus and Web of Science databases, encouraged and recognized for conducting SLRs (Lim et al., 2024; Paul et al., 2021; Paul & Criado, 2020). A Boolean search encompassing keywords relating to gamification and sustainable consumption, using both "AND" and "OR," was employed. The authors consulted experts on gamification and sustainable consumption along with related literature to curate a robust list of search keywords to arrive at a representative dataset. Experts on gamification advocate the use of a global keyword with a wildcard (asterisk)—that is, "gamif*"—to encompass all derivative forms of the word gamification (e.g., gamification, gamified, gamifying), whereas experts on sustainable consumption suggest the use of several keywords with a wildcard where appropriate—that is, "environ*," "green," "sustain*," "responsible," and "consum*"—yielding a structured string of search keywords: ("gamif*") AND ("environ*" OR "green" OR "sustain*" OR "responsible") AND ("consum*"). The search was conducted in the article title, abstract, and keywords (ensuring research where gamification and sustainable consumption are central rather than peripheral), limited to "final" (rather than "early access" or "in press" for accuracy) journal articles published in "English" (author language competency and lingua franca) in the research/subject areas relating to business ("business, management and accounting" in Scopus, "business economics" in Web of Science) from 2016 to 2023, yielding 23 articles in Scopus and three more in Web of Science.

The interest in sustainable consumption through gamification gained momentum from 2016 onwards, influenced by the launch of the SDGs by the United Nations (2015). This global agenda significantly influence corporate strategies toward sustainability (Azmat et al., 2023; Tiwari & Khan, 2020; United Nations, 2015). The surge in research on this topic post-2015 is noted (Effah et al., 2023), leading to our focus on articles from 2016 to 2023 that specifically explore the link between gamification and sustainable consumption.

2.2.2 | Arranging

This phase involves purifying the search results and organizing the key aspects of the literature relating to gamification and sustainable consumption accordingly (Paul et al., 2021). After filtering for (ir)relevant articles relating to gamification and sustainable consumption and

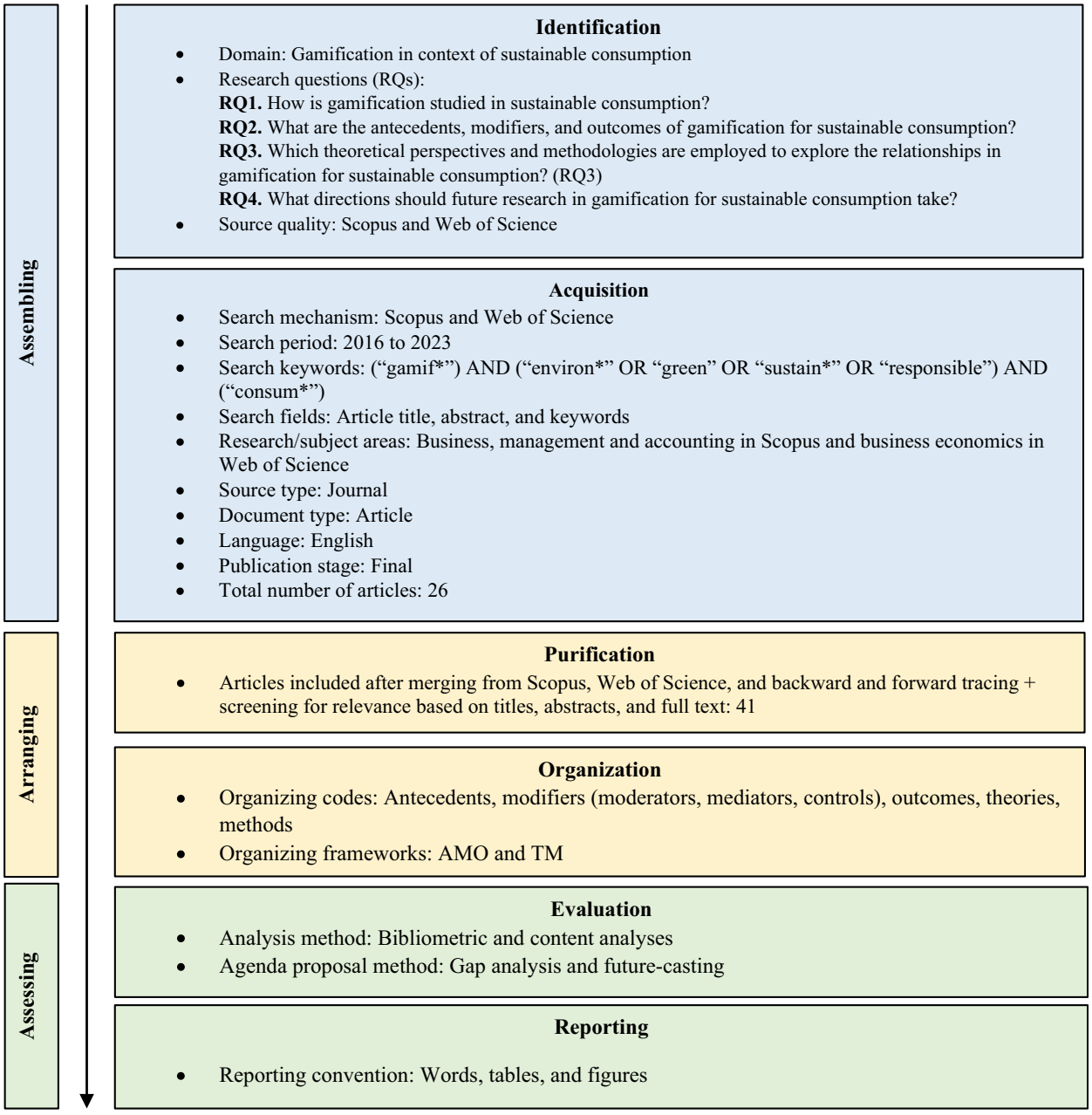

FIGURE 1 Procedure of reviewing gamification and sustainable consumption research using scientific procedures and rationales for systematic literature review (SPAR-4-SLR) protocol. AMO, antecedents, modifiers, outcomes; TM, theories and methods.

merging search results from both Scopus and Web of Science as well as from forward (via citations) and backward (via references) tracing, we reach a final set of 41 articles (Table A1).

While 41 articles may appear limited for a review, this number is significant in our context. Paul and Criado (2020), along with Paul et al. (2021), in their SPAR-4-SLR protocol, suggest performing SLRs under certain conditions: (a) a domain with at least 40 articles indicates sufficient maturity for review, (b) the absence of a review in the domain within the last 5 years, (c) a lack of reviews in high-quality journals, and (d) gaps or shortcomings in existing reviews. Our study, after an exhaustive search, identified 41 articles meeting the criteria. To date, no reviews in high-quality journals have specifically explored how gamification is approached in sustainable consumption. This justifies our review, which aims to guide future research directions in this emerging field. More importantly, we employ the organizing framework of AMO-TM (Luo et al., 2024; Paul et al., 2017) to ensure systematization and objectivity of our review on gamification for sustainable consumption research.

2.2.3 | Assessing

This phase involves analytical techniques and agenda-setting methods, where we carried out a bibliometric analysis and a content analysis.

The bibliometric analysis, which we conducted using the bibliometrix package in the RStudio software (Aria & Cuccurullo, 2017), reveals *macro-insights* on research themes (Donthu et al., 2021; Lim et al., 2024; Mukherjee et al., 2022), whereas the content analysis, which was guided by and organized using the AMO-TM framework (Luo et al., 2024; Paul et al., 2017), reveals *micro-insights* on the antecedents, modifiers (moderators, mediators, controls), outcomes, theories, and methods derived from research on gamification for sustainable consumption. Retrospective insights from the bibliometric analysis inform future directions on thematic areas ripe for investigation while those from the content analysis shape future suggestions on promising areas for study (Kraus et al., 2022; Lim, Kumar, & Ali, 2022). The combination of bibliometric and content analyses for the purpose of literature synthesis, gap analysis, and future-casting is in line with the practice of recent SLRs (Kumar et al., 2023; Lim, Kumar, Verma, & Chaturvedi, 2022), enabling the present review to deliver a comprehensive state-of-the-art overview and an evidence-based informed agenda for gamification and sustainable consumption research.

3 | FINDINGS

3.1 | Profile of gamification for sustainable consumption research

The analysis of our corpus spans a range of contexts where gamification has been applied to promote sustainable consumption. The majority of these studies have focused on key areas such as energy efficiency (Johnson et al., 2017; Paneru & Tarigan, 2023) and educational settings promoting sustainability (Gatti et al., 2019; Mylonas et al., 2023). The studies span various methodologies, from critical (Paneru & Tarigan, 2023), narrative (Cavada & Rogers, 2020), and systematic (Stephens, 2022) reviews to quantitative experimental (Mylonas et al., 2023) and non-experimental (Zafar et al., 2024) designs, and cover a broad spectrum of sustainable consumption focuses, including environmental and resource conservation (Du et al., 2020; Rottondi & Verticale, 2017), eco-driving (Stephens, 2022), health and well-being (Lowensteyn et al., 2019), sustainable tourism (Souza et al., 2020), and waste management (Vorobeva et al., 2023). This diverse body of work not only underscores the multifaceted nature of gamification as a tool for enhancing sustainable consumption but also highlights the growing academic interest in this area, especially in the context of achieving broader sustainability goals such as those outlined by the SDGs.

3.2 | Macro-perspective of themes in gamification for sustainable consumption research

A strategic diagram depicting the themes derived from an analysis of the keywords that authors specify in their articles on gamification for sustainable consumption is presented in Figure 2. This map is a visual representation of the thematic density and centrality, constructed through a four-quadrant analysis using the bibliometrix package in the RStudio software (Aria & Cuccurullo, 2017). In line with the methodology outlined by Bamel et al. (2024) and Lim et al. (2024), themes positioned with higher centrality and density on the map are considered to be of greater developmental maturity and pertinence within the field. The strategic diagram categorizes themes into four quadrants, each signifying a different stage of thematic development:

- *Lower left quadrant: emerging or declining themes*. These are either nascent areas of interest that are gaining traction or once-relevant themes that are now receiving less attention.
- *Lower right quadrant: basic themes*. These themes form the foundational bedrock of the field.
- *Upper left quadrant: niche themes*. Although these themes are well-developed, they are specialized and may not be as interconnected with the central discourse of the field.
- *Upper right quadrant: established and influential themes*. These represent themes that have not only seen significant development but are also pivotal to the ongoing research dialogue.

Our analysis, guided by a sensemaking approach (Lim & Kumar, 2024), involved a careful observation of trends, insights, and rationales, leading to the identification of recurring and significant patterns. The resultant thematic map offers an overview of the field's progression, highlighting areas ripe for future research and those that have already undergone substantial investigation. In total, six major themes appear to be discernable: The upper right quadrant revolves around gamification for sustainable behavioral changes, sustainability education, and sustainable living; the upper left quadrant around gamification for workplace sustainability; and the lower left quadrant around environmental sustainability and sustainable tourism. The lower right quadrant on digital media signifies the fundamental form through which gamification manifests in today's digital era.

3.2.1 | Gamification for sustainable behavioral changes

Within the strategic diagram, the upper right quadrant encompasses themes that are both well-established and influential. Keywords such as "engagement," "achievement," "behaviour change," and "feedback" are prominent, underscoring the recognized capacity of gamification to influence and modify behavior. These terms encapsulate the essence of gamification's effectiveness. Zafar et al. (2024) illuminate how brands leverage shared gamified platforms to showcase their green initiatives. Such platforms not only offer users a sense of achievement but also drive broader participation in sustainable purchasing behaviors. Whittaker, Russell-Bennett, and Mulcahy (2021) contribute to this understanding by demonstrating that sustainability marketing outcomes, which elicit a sense of achievement through higher tier rewards, are more effective in engaging users than lower tier rewards. Noteworthily, the scope of sustainable behavioral change influenced by gamification extends beyond consumption. For instance, Lowensteyn et al. (2019) illustrate its application in mental health management while

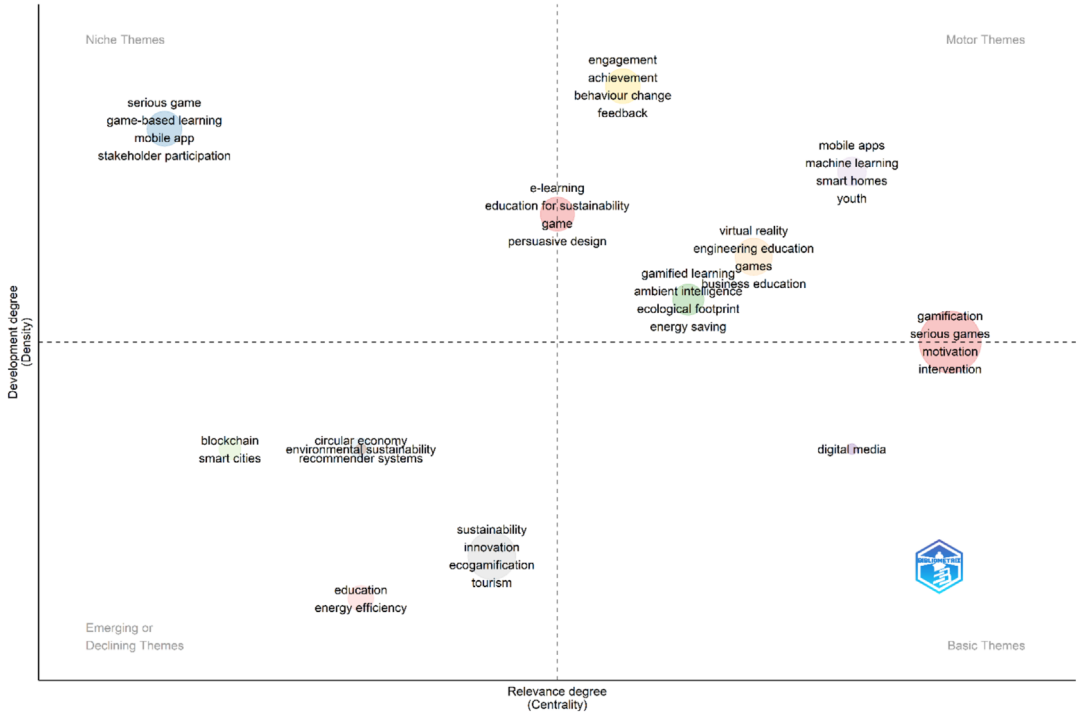

FIGURE 2 Thematic mapping of gamification for sustainable consumption research.

Cavada and Rogers (2020) explore its potential in promoting eco-friendly practices like car-sharing. Furthermore, serious games are shown to endow consumers with a sense of value when they engage in sustainable behaviors (Whittaker, Mulcahy, & Russell-Bennett, 2021). More importantly, a critical element in sustaining these behavior changes is the use of frequent feedback systems. For instance, the implementation of smart energy applications that provide real-time feedback on consumption can instill and maintain long-term energy-efficient behaviors among end-users (Paneru & Tarigan, 2023). This quadrant, therefore, highlights the central role of gamification elements—achievement, engagement, and feedback—in fostering and maintaining sustainable behavioral changes. The evidence points to a significant impact of gamification on user behavior, suggesting its potential as a powerful tool in the transition to sustainability.

3.2.2 | Gamification for sustainability education

The strategic diagram's upper right quadrant also reveals a convergence of keywords related to education, such as "business education," "education for sustainability," "engineering education," "e-learning," and "gamified learning." These varied educational contexts indicate the extensive potential of gamification as an educational tool. Analysis of the related articles demonstrates that gamified learning is being applied effectively across multiple platforms to instill sustainable practices. For instance, it has been utilized to improve waste management behaviors (Hoffmann & Pfeiffer, 2022), promote energy conservation (Romero-Rodriguez et al., 2019), and teach eco-driving techniques (Stephens, 2022). These studies highlight how gamification can make sustainability education more engaging and effective across diverse topics. Transitioning to academic environments, gamified e-learning platforms have been found to enhance student motivation and engagement. Mylonas et al. (2023) observed that students' active participation in gamified e-learning environments significantly boosts their motivation for reading and sustains their reading abilities. Similarly, game-based interventions have been successful in teaching children about healthy eating (Chow et al., 2020) while Gatti et al. (2019) found that action and experiential learning techniques within gamified contexts lead to improved cognitive outcomes and foster a positive attitude toward sustainability. Moreover, the application of gamified learning has led to an increase in competence and knowledge in sustainability-related areas. Prakash and Manchanda (2021) note that such approaches create a conducive environment for educating users about the judicious use of resources. The employment of gamification pedagogy and competitive elements like leaderboards has been linked to long-term and sustained learning, which in turn enhances students' academic performance and sustainability-oriented behavior (Li & Chu, 2021). Therefore, the literature suggests that gamification is an effective pedagogical approach to sustainability education, wherein it not only aids in knowledge acquisition but also promotes a positive and proactive attitude toward sustainability, proving to be a crucial component in shaping future sustainable practices.

3.2.3 | Gamification for sustainable living

The upper right quadrant of the thematic map features clusters with keywords such as "ambient intelligence," "ecological footprint," and

"energy saving" signified by a green circle. Additionally, "smart homes" and "youth" are represented by a grey circle while "virtual reality" is denoted by an orange circle. The proximity and alignment of these clusters suggest a thematic synergy among them, illustrating the multifaceted approach to gamification in the context of sustainable living. Closer analysis of pertinent articles reveals that gamification is particularly effective in engaging the youth with sustainable practices (Musyaffi et al., 2022). Businesses are increasingly using gamified platforms that embed sustainability and quality of life goals, which not only educates but also engages citizens, thereby contributing to the development of smarter, more sustainable cities (Cavada & Rogers, 2020). One such innovative approach is the use of gamification in energy management systems (EMS), which utilize data from smart meters. This helps raise awareness and understanding of environmental impacts associated with residential energy use, such as CO_2 emissions (Rottondi & Verticale, 2017). These gamified systems are integral in engaging consumers with the broader objectives of energy transition and sustainable living practices (Al Skaif et al., 2018). Besides that, gamification also enhances user engagement through virtual rewards systems, which foster a sense of temporal awareness and encourage participation in resilient and sustainable activities (Cavada & Rogers, 2020). Furthermore, virtual reality elements such as avatars, imaginative components, missions, quests, and levels provide users with a form of ambient intelligence that aids in developing adaptability skills (Stephens, 2022). These gamified experiences have been shown to alleviate the monotony of routine activities, like driving, leading to reduced fuel consumption and promoting environmentally friendly behaviors. The literature, therefore, suggests that gamification strategies can transform mundane activities into engaging experiences that support sustainable living. As a solution providing interactive and immersive experiences, gamification holds great promise in fostering a more environmentally conscious and active society.

3.2.4 | Gamification for workplace sustainability

Situated in the upper left quadrant of the strategic diagram is a cluster marked by terms such as "game-based learning," "mobile app," "serious game," and "stakeholder participation." These terms collectively indicate the role of gamification as an educational and communicative tool within the workplace, particularly in areas related to corporate social responsibility (CSR) and sustainability (Maltseva et al., 2019). A detailed examination of relevant studies reveals that gamification, through the use of game design objects, mechanics, and dynamics, can foster lasting behavioral change and mitigate employee disengagement. Oppong-Tawiah et al. (2020) demonstrate how a balanced gamified system can promote sustained behavioral improvements among office workers while also offering an antidote to workplace monotony. Moreover, health initiatives within the workplace that leverage enjoyable and competitive gamified activities are shown to encourage ongoing employee participation. Such initiatives contribute to fostering behavioral changes that have sustainable health benefits (Lowensteyn et al., 2019). In one innovative application, companies have utilized gamification combined with persuasive design principles to monitor and influence employees' electricity usage. For example, a mobile application using a garden metaphor has been developed, which motivates employees to reduce their energy consumption by providing visual feedback and rewards (Oppong-Tawiah et al., 2020). This quadrant, therefore, underscores gamification's capability to serve as an effective medium for communicating and instilling sustainable practices within the corporate environment. The use of game-based approaches and persuasive design in the workplace not only educates stakeholders but also actively engages them in the pursuit of organizational sustainability goals.

3.2.5 | Gamification for environmental sustainability

In the thematic map, the lower left quadrant presents emerging research themes, with clusters that include "circular economy" and "environmental sustainability," closely related clusters for "education" and "energy efficiency," as well as clusters with terms like "blockchain" and "smart cities." This quadrant is indicative of the nascent yet growing interest in the intersection of gamification, sustainable consumption, and environmental stewardship. Indeed, gamification has emerged as a key tool in promoting pro-environment behaviors, such as water-saving practices (Rottondi & Verticale, 2017) and reducing energy consumption (Johnson et al., 2017). For example, Hoffmann and Pfeiffer (2022) demonstrate how gameful learning can effectively educate individuals about waste-sorting techniques, thereby enhancing their motivation to adopt sustainable habits. Similarly, board games like "Water Ark" have been found to improve participants' understanding of and personal responsibility toward water conservation (Douglas & Brauer, 2021). Further contributions to environmental sustainability through gamification include promoting recycling and eco-friendly habits (Hsu & Chen, 2021), as well as efforts to combat climate change (Douglas & Brauer, 2021). The article by Douglas and Brauer (2021) reports on a study where participants engaged with the serious game "Factory Heroes," which led to increased awareness of environmentally friendly manufacturing practices. Such outcomes, when applied practically, hold the potential to bolster larger movements like the circular economy. Therefore, this quadrant's themes reflect a growing field where digital innovation through gamification is being leveraged to educate and engage individuals and communities in environmental sustainability practices. As these themes continue to develop, they offer promising avenues for contributing to a more sustainable society.

3.2.6 | Gamification for sustainable tourism

The lower left quadrant of the thematic map also highlights the intersection of gamification with sustainable tourism, featuring terms such as "ecogamification," "innovation", "sustainability," and "tourism." These terms represent emergent research where gamification

intersects with tourism, signaling a novel area of academic inquiry and industry practice. Eco-gamification, a niche within the broader gamification spectrum, is tailored to enhance the ecological aspects of products and services (Aguiar-Castillo et al., 2023). Research by Aguiar-Castillo et al. (2023) ventures into the impact of an eco-gamified mobile application aimed at promoting recycling behaviors and enhancing the destination's image among tourists, yielding positive results. This finding is corroborated by Souza et al. (2020), who demonstrate that gamification can foster environmentally responsible behaviors, increase visitor engagement, and help mitigate the effects of over-tourism. These studies suggest that eco-gamification is equipped to tackle the sustainability challenges faced by the tourism industry by providing engaging and user-friendly means to endorse sustainable practices. The literature further suggests that crafting gamified experiences, particularly through online platforms, can promote pro-environmental behaviors among tourists. This not only advances the sustainability of the destinations but also secures a lasting competitive edge for them in the market (Frías-Jamilena et al., 2022). The evidence from the quadrant thus substantiates the potential of gamification as a catalyst for sustainable tourism, wherein it underscores the capability of gamified interventions to influence tourist behavior positively and indicates a promising path for future research and practical applications within the tourism sector.

3.2.7 | Thematic evolution

Guided by a sensemaking approach (Lim & Kumar, 2024), our analysis of articles on gamification for sustainable consumption reveals a systematic evolution of key themes over time. With the United Nations' increased emphasis on SDGs since 2015, gamification research has increasingly focused on using gamification as a motivational tool to promote sustainable behavioral changes among consumers and the public at large. For instance, Morganti et al. (2017) discussed gamified interventions aimed at raising awareness about sustainable consumption. Rottondi and Verticale (2017) demonstrated how gamification fosters socially responsible consumption patterns. These studies laid the groundwork for subsequent research exploring gamification's potential in various domains related to sustainable consumption. For example, Berger (2019) examined gamification's role in encouraging eco-friendly food choices while Al Skaif et al. (2018) tested its effectiveness in promoting energy-saving and pro-environmental behaviors. Moreover, studies have employed gamified platforms to educate consumers on sustainable consumption through action and experiential learning techniques. This includes car-sharing schemes, smart city initiatives (Cavada & Rogers, 2020), and workplace energy-saving practices (Mandujano et al., 2021; Oppong-Tawiah et al., 2020). Further advancements in gamification research were observed when researchers integrated gamification with newer technologies such as blockchain to achieve ecological sustainability (Rottondi & Verticale, 2017), and with service sectors like tourism to foster greater pro-environmental attitudes and behaviors (Frías-Jamilena et al., 2022).

3.3 | Micro-perspective of peculiarities in gamification for sustainable consumption research

3.3.1 | Nomological network of AMO

This section elucidates the relationship between gamification and sustainable consumption through the lens of the AMO framework. Antecedents are the foundational elements that drive the adoption and effectiveness of gamification in promoting sustainable behaviors. Modifiers illustrate the conditions under which these relationships are altered or strengthened, providing insights into the dynamics between gamification elements and sustainable consumption practices. Outcomes highlight the tangible effects that result from employing gamification, offering a glimpse into its potential to alter consumer behaviors toward more sustainable practices. Where applicable, controls are identified to account for external factors that might influence these relationships. Figure 3 visualizes the comprehensive network of antecedents, modifiers (mediators, moderators, controls), and outcomes identified in gamification for sustainable consumption research. Synthesizing similar factors within each category, we aim to distill the prevailing micro-perspective that underscores the core aspects of gamification's impact on sustainable consumption. Employing a sensemaking approach (Lim & Kumar, 2024), this analysis endeavors to consolidate and synthesize extant findings, including the reconciliation of concepts and relationships, thereby rendering them more coherent and accessible. This approach is not about exhaustively reporting each study's findings but rather about how, through synthesis and reflection, concepts and relationships can be distilled to impart meaningful insights within the respective domains of examination, elucidating the core impact of gamification on sustainable consumption.

Antecedents

Antecedents are pivotal factors that directly or indirectly influence the outcomes of gamification strategies, shaping consumer behavior toward sustainability. Drawing on our sensemaking of factor categorization (Lim & Kumar, 2024), we delineate five key categories of antecedents as observed in the literature: game mechanics; incentives and motivations; social dynamics; sustainability focus; and user experience.

Game mechanics. Game mechanics constitute the structured elements and strategies within a game that guide player actions toward achieving specific goals. In the context of sustainable consumption, game mechanics are tailored to direct consumer behavior toward environmental sustainability. Our comprehensive literature review reveals three key sub-categories within game mechanics: design elements, engagement strategies, and learning and development.

Design elements

Design elements in gamification for sustainable consumption encompass a broad array of components that collectively shape the user's interaction with the game, aiming to foster sustainable behaviors. These elements include visually engaging avatars and emojis, which

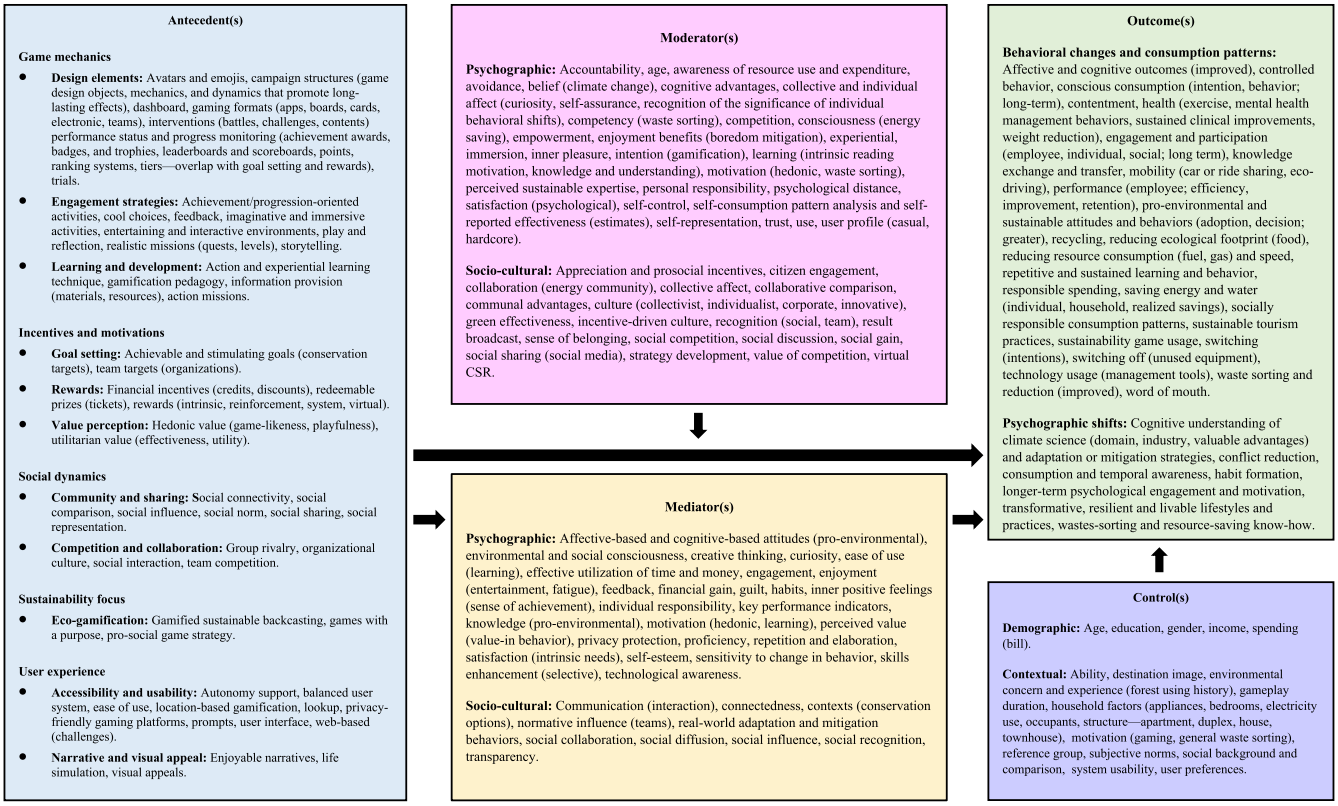

FIGURE 3 A framework of gamification for sustainable consumption. CSR, corporate social responsibility.

personalize the experience (Stephens, 2022); campaign structures that utilize game design objects, mechanics, and dynamics to create lasting engagement (Oppong-Tawiah et al., 2020); and dashboards that provide users with immediate feedback on their progress (Mylonas et al., 2023). The gaming formats are diverse, ranging from apps to board and card games, electronic games, and team-based activities, each offering unique avenues for engagement (Douglas & Brauer, 2021; Ro et al., 2017). Interventions such as battles (Li & Chu, 2021), challenges (Johnson et al., 2017), and contests (Prakash & Manchanda, 2021) introduce competitive and cooperative elements, motivating users to achieve specific sustainability goals. Performance status (Al Skaif et al., 2018) and progress monitoring (Lowensteyn et al., 2019) are crucial, with achievement awards (Pietrapertosa et al., 2021), badges (Mulcahy et al., 2021), trophies (Prakash & Manchanda, 2021), leaderboards or scoreboards (Romero-Rodriguez et al., 2019), and ranking systems (Lowensteyn et al., 2019) recognizing and incentivizing users' efforts while trials offer opportunities to experiment with sustainable behaviors in a risk-free environment (Lowensteyn et al., 2019). Collectively, these design elements are fundamental in crafting an engaging and effective gamified experience that encourages users to adopt and maintain sustainable consumption practices.

Engagement strategies

Engagement strategies in gamification for sustainable consumption are crafted to captivate and retain user interest, ultimately guiding them toward adopting sustainable behaviors. These strategies include achievement and progression-oriented activities that provide users with a clear sense of advancement and accomplishment, encouraging continued participation (Fernández Galeote et al., 2021). "Cool choices" (Ro et al., 2017) and feedback mechanisms (Paneru & Tarigan, 2023) serve to reinforce positive behavior and highlight areas for improvement. Imaginative and immersive activities (Fernández Galeote et al., 2021; Stephens, 2022), alongside entertaining and interactive environments (Maltseva et al., 2019; Vorobeva et al., 2023), draw users into the experience, making sustainability practices more appealing and relatable. The incorporation of play and reflection allows users to engage with the content on a deeper level, fostering a personal connection with sustainability goals (Whittaker, Mulcahy, & Russell-Bennett, 2021). Realistic missions, which can be structured as quests or levels (Mylonas et al., 2023; Stephens, 2022), offer practical and achievable steps toward sustainability, enhancing the user's sense of purpose and direction within the game. Storytelling further enriches the experience by providing a narrative context for the user's actions, embedding sustainable practices within compelling stories that inspire or resonate with users' values and aspirations (Du et al., 2020). Collectively, these engagement strategies create a dynamic and enriching gamified environment that motivates sustained user involvement in sustainable consumption.

Learning and development

The focus on learning and development is crucial for instilling deeper understanding and commitment toward sustainability. This is achieved through a blend of action and experiential learning techniques that

immerse users in real-life scenarios and challenges, enabling them to learn by doing (Gatti et al., 2019). The gamification pedagogy integrates traditional educational strategies with game design principles, making the learning process more engaging and effective (Li & Chu, 2021). Information provision is another key aspect, where users are supplied with materials and resources that enrich their knowledge base and support informed decision-making regarding sustainable practices (Al Skaif et al., 2018). Action missions further operationalize this learning, tasking users with specific, goal-oriented activities that translate theoretical knowledge into practical action (Mylonas et al., 2023). Through these approaches, gamification not only educates users about sustainability but also empowers them to apply what they have learned, fostering a cycle of continuous learning and development in the pursuit of sustainable consumption behaviors.

Incentives and motivations. Incentives and motivations play a crucial role in gamification strategies aimed at promoting sustainable consumption behaviors. This category encompasses the benefits or rewards provided to users for successfully engaging in sustainable behaviors. Our detailed analysis has identified three sub-categories within this domain: goal setting, rewards, and value perception. Each sub-category plays a distinct role in shaping user engagement and effectiveness of gamification in fostering sustainable consumption.

Goal setting

Goal setting within gamification for sustainable consumption plays a pivotal role in guiding user behavior toward sustainability stewardship (Paneru & Tarigan, 2023). Establishing achievable and stimulating goals, such as specific conservation targets, provide users with clear objectives that align with broader sustainability goals (Romero-Rodriguez et al., 2019). The inclusion of team targets, particularly within organizational contexts, fosters a collective effort toward these goals, enhancing motivation through camaraderie and shared responsibility (Prakash & Manchanda, 2021). This approach not only individualizes the pursuit of sustainability but also embeds it within a communal framework, amplifying the potential for impactful behavioral change.

Rewards

The reward system in gamification acts as a powerful motivator, driving user engagement and reinforcing desired behaviors. Financial incentives such as credits (Berger et al., 2022) and discounts (Vorobeva et al., 2023) offer tangible benefits for sustainable actions while redeemable prizes like tickets to events or services add an element of excitement to the gamification experience (Vorobeva et al., 2023). Beyond tangible rewards, intrinsic rewards play a critical role in sustaining long-term engagement, with users finding inherent satisfaction in their contributions to sustainability (Aguiar-Castillo et al., 2023). The reinforcement provided by the system, through virtual rewards and acknowledgments (Prakash & Manchanda, 2021), further strengthens the user's commitment to sustainable practices, making the gamification experience both rewarding and meaningful.

Value perception

Value perception is a critical aspect of gamification, where the perceived value of the gamified experience influences user engagement and behavior. Hedonic value, characterized by the game-likeness and playfulness of the experience, appeals to users' desire for enjoyment and entertainment, making the process of adopting sustainable behaviors more appealing (Hsu & Chen, 2021; Maltseva et al., 2019). On the other hand, utilitarian value focuses on the effectiveness and practical utility of the gamification system, emphasizing the tangible benefits and outcomes of engaging in sustainable practices (Hsu & Chen, 2021). The interplay between hedonic and utilitarian values ensures that the gamification experience is not only enjoyable but also purposeful, encouraging users to perceive sustainable behaviors as both beneficial and rewarding.

Social dynamics. Social dynamics play a crucial role in gamification strategies aimed at enhancing sustainable consumption behaviors, leveraging the power of social interactions and influences. Our literature review delineates two main sub-categories within social dynamics: "community and sharing" and "competition and collaboration," each contributing distinctly to fostering sustainable behaviors through gamification.

Community and sharing

Community and sharing aspects within gamification for sustainable consumption leverage the power of social dynamics to enhance user engagement and promote sustainable behaviors. Social connectivity fosters a sense of belonging among users, encouraging them to become part of a community with shared environmental goals (Al Skaif et al., 2018). Social comparison mechanisms allow users to see how their efforts stack up against peers, motivating them through friendly competition and the desire for social recognition (Zafar et al., 2024). Social influence and norm play a crucial role, as users can impact one another's behaviors and attitudes toward sustainability, creating a ripple effect that extends beyond the individual (Berger, 2019; Lowensteyn et al., 2019). Social sharing enables users to disseminate their achievements and insights, amplifying the message of sustainability through networks (Johnson et al., 2017). Social representation, where users can see themselves and their actions within the gamified environment, strengthens their identity as part of the sustainability movement, making the cause more personal and relatable (Fernández Galeote et al., 2021).

Competition and collaboration

Competition and collaboration within gamified systems for sustainable consumption intertwine to create a dynamic environment where users are driven by both cooperative and competitive spirits. Group rivalry introduces an element of competition that can spur individuals and teams to outperform each other in sustainable practices, harnessing the motivational power of competition (Lowensteyn et al., 2019). Organizational culture can greatly influence how competition and collaboration are perceived and enacted within gamified initiatives, shaping the overall approach to sustainability challenges (Behl et al., 2023).

Social interaction is central to both competitive and collaborative experiences, facilitating communication, idea exchange, and mutual support among users (Lowensteyn et al., 2019). Team competition, in particular, combines the best of both worlds, encouraging users to work together toward common goals while also engaging in healthy competition, fostering a community that is both united in purpose and stimulated by the challenge of achieving sustainability targets (Douglas & Brauer, 2021).

Sustainability focus. Sustainability focus explores how gamification integrates environmental stewardship principles to influence sustainable consumption behaviors. This focus is particularly manifested through the concept of eco-gamification, which aims to enhance the ecological appeal of products and services through gamified experiences.

Eco-gamification

Eco-gamification represents a targeted approach within gamification strategies, specifically designed to enhance engagement with environmental sustainability. It integrates concepts like gamified sustainable backcasting and games with a purpose to not only entertain but also educate users about sustainable practices and the importance of long-term environmental stewardship. Gamified sustainable backcasting involves users in envisioning a sustainable future and then working backward to identify actions that can be taken in the present to achieve that future, thus embedding a strategic planning component within the game (Mandujano et al., 2021). Games with a purpose go beyond mere entertainment, as they are crafted with the explicit intention of promoting environmental awareness and encouraging sustainable behaviors among players (Whittaker, Russell-Bennett, & Mulcahy, 2021). Moreover, incorporating a pro-social game strategy can also enhance eco-gamification engagement (Chen et al., 2022). Therefore, aligning the fun and engaging aspects of gaming with educational content and actionable insights into sustainability, eco-gamification serves as a potent tool in motivating users to adopt more environmentally friendly lifestyles and contribute to broader sustainability goals.

User experience. User experience ventures into the aspects of gamification that enhance user engagement and interaction with gamified systems aimed at promoting sustainable consumption. This category encompasses elements that shape the overall experience of users within a gamified context, influencing their willingness to engage in and adopt sustainable behaviors. Two key sub-categories have been identified: "accessibility and usability" and "narrative and visual appeal."

Accessibility and usability

Accessibility and usability are cornerstone features in the design of gamification strategies for sustainable consumption, ensuring that users can easily engage with and navigate the gamified system. Autonomy support empowers users by providing choices and control over their actions within the game, enhancing their intrinsic motivation (Du et al., 2020). A balanced user system caters to varying skill levels and interests, making the experience inclusive and engaging for a diverse audience (Oppong-Tawiah et al., 2020). Ease of use is critical, as complex systems can deter participation; hence, simplicity and intuitiveness are prioritized (Musyaffi et al., 2022). Location-based gamification leverages geographical context to offer tailored challenges, enhancing relevance and engagement (Cavada & Rogers, 2020). Look-up features (Hoffmann & Pfeiffer, 2022) and privacy-friendly gaming platforms (Rottondi & Verticale, 2017) address users' needs for information accessibility and data security, respectively. Prompts serve as gentle reminders or cues to action, seamlessly integrating into the user's journey (Paneru & Tarigan, 2023). The user interface design is pivotal, with clear, user-friendly interfaces facilitating smoother interactions (Al Skaif et al., 2018). Web-based challenges provide flexibility, allowing users to participate from any location, further removing barriers to engagement (Lowensteyn et al., 2019).

Narrative and visual appeal

Narrative and visual appeal significantly enhance the gamification experience, drawing users into the sustainability narrative through compelling storytelling and aesthetically pleasing design elements. Enjoyable narratives weave sustainability themes into engaging stories, making the learning process more relatable and memorable (Lowensteyn et al., 2019). Life simulation games offer users the opportunity to experiment with sustainable lifestyles in a risk-free, virtual environment, promoting deeper understanding and empathy (Fernández Galeote et al., 2021). Visual appeals are not merely decorative; they play a crucial role in conveying information, setting the tone, and evoking emotional responses, making the sustainability journey not just informative but also visually stimulating (Zafar et al., 2024). Together, these elements of narrative and visual appeal transform the gamification experience from a mere task to an immersive, enjoyable journey toward sustainable consumption.

Mediators

Mediators encapsulate the mechanisms through which gamification influences sustainable consumption behaviors, classified into psychographic and socio-cultural mediators based on thematic analysis of the literature.

Psychographic. Mediating variables, particularly psychographic ones, play a crucial role in bridging the gap between gamification elements and sustainable consumption outcomes, deeply influencing the effectiveness of gamification strategies. These mediators encompass a wide array of psychological and attitudinal factors that shape how individuals internalize and act upon the gamified experiences related to sustainability.

Affective-based and cognitive-based attitudes toward the environment (Hsu & Chen, 2021), along with environmental and social consciousness (Zafar et al., 2024), form the bedrock of an individual's predisposition toward pro-sustainability behaviors. Creative thinking (Pietrapertosa et al., 2021), curiosity (Li & Chu, 2021), and

technological awareness (Shahzad et al., 2023) enhance engagement with gamified content, leading to more profound insights into sustainability. Ease of use (Mulcahy et al., 2021), particularly in learning contexts, alongside the effective utilization of time and money (Prakash & Manchanda, 2021), underscore the practical aspects of engaging with gamified systems.

Engagement (Souza et al., 2020; Whittaker, Mulcahy, & Russell-Bennett, 2021), enjoyment (Du et al., 2020; Mulcahy et al., 2020; Ro et al., 2017; Shahzad et al., 2023), and hedonic motivation (Shahzad et al., 2023) are key to sustaining user interest, with feedback mechanisms (Paneru & Tarigan, 2023) and the potential for financial gain (Agusdinata et al., 2023) serving as additional motivators. The formation of habits (Morganti et al., 2017) and the cultivation of inner positive feelings, such as a sense of achievement (Li & Chu, 2021), and even negative ones like guilt (Chen et al., 2022), reinforce desired behaviors. Individual responsibility (Romero-Rodriguez et al., 2019) and key performance indicators (Papamichael et al., 2022) provide users with a clear understanding of their role and progress in contributing to sustainability.

Knowledge acquisition (Mulcahy et al., 2020), especially regarding pro-environmental practices (Frías-Jamilena et al., 2022), coupled with motivation for learning (Romero-Rodriguez et al., 2019) and skills enhancement (Hoffmann & Pfeiffer, 2022), drives the educational aspect of gamification. Perceived value (Mulcahy et al., 2020), privacy protection (Rottondi & Verticale, 2017), and proficiency (Prakash & Manchanda, 2021) are essential in ensuring users feel rewarded and secure in their engagement. Repetition and elaboration (Li & Chu, 2021), along with satisfaction from meeting intrinsic needs (Mandujano et al., 2021) and enhanced self-esteem (Aguiar-Castillo et al., 2023), deepen the user's commitment to sustainable practices. These psychographic mediators collectively influence not just the cognitive and emotional responses of individuals to gamified interventions but also translate these responses into tangible behaviors, thereby amplifying the impact of gamification on promoting sustainability stewardship.

Socio-cultural. Socio-cultural mediators are integral to understanding how gamification influences sustainable consumption within a community or societal context. These mediators facilitate the translation of individual engagement in gamified activities into broader social and cultural shifts toward sustainability. Communication, or interaction, serves as a vital mediator by enabling the exchange of ideas, strategies, and feedback among participants, enriching the gamification experience and fostering a collective learning environment (Gatti et al., 2019; Stephens, 2022). Connectedness relates to the sense of belonging and unity among users, driving communal efforts toward sustainability goals (Mylonas et al., 2023). The context, particularly conservation options provided within the game (Al Skaif et al., 2018), shapes players' understanding and attitudes toward real-world sustainability practices.

Normative influence, especially within teams, mediates behavior by establishing group norms and expectations that align with sustainable practices, encouraging individuals to conform to these group standards (Berger et al., 2022). Real-world adaptation and mitigation behaviors reflect the application of gamified experiences to tangible sustainability actions, bridging the gap between virtual achievements and actual environmental impact (Fernández Galeote et al., 2021).

Social collaboration highlights the cooperative aspects of gamification, where users work together to achieve common goals, amplifying the impact of sustainability efforts (Rottondi & Verticale, 2017). Social diffusion represents the spread of sustainable attitudes and behaviors beyond the immediate circle of game participants, extending the influence of gamification to a wider audience (Berger et al., 2022). Social influence (Douglas & Brauer, 2021) and recognition (Aguiar-Castillo et al., 2023) acknowledge the role of peer approval and acknowledgment in motivating and reinforcing sustainable behaviors. Transparency within gamified systems ensures that the processes and outcomes are clear to all participants, fostering trust and engagement (Gatti et al., 2019). Collectively, these socio-cultural mediators underscore the importance of community and social dynamics in leveraging gamification for sustainable consumption, highlighting the potential for gamified initiatives to catalyze significant cultural and social shifts toward sustainability stewardship.

Moderators

Moderators encompass the boundary conditions that influence the relationship between gamification-related antecedents and sustainable consumption outcomes. These moderators are categorized into psychographic and socio-cultural factors, each offering a distinct perspective on how gamification impacts sustainable behaviors.

Psychographic. Psychographic moderators play a crucial role in shaping the effectiveness of gamification strategies aimed at encouraging sustainable consumption, acting as filters through which the impact of gamification is either amplified or diminished. Accountability, for instance, influences how individuals take responsibility for their actions within the gamified context, directly affecting their commitment to sustainable practices (Fernández Galeote et al., 2021). Awareness of resource use and expenditure moderate the connection between gamified activities and real-world conservation efforts, making individuals more mindful of their consumption patterns (Aguiar-Castillo et al., 2023).

Avoidance (Souza & Marques, 2022) and belief in climate change (Douglas & Brauer, 2021) are significant moderators that shape the extent to which individuals engage with sustainability-themed games, with stronger beliefs potentially leading to higher engagement levels. Cognitive advantages, such as improved problem-solving and decision-making skills gained from gamification, can enhance individuals' ability to implement sustainable practices (Mandujano et al., 2021). Collective and individual affect, including curiosity and self-assurance, enrich the gamification experience, making users more receptive to adopting new behaviors (Fernández Galeote et al., 2021).

Competency in specific tasks, such as waste sorting, can be enhanced through gamification, making it a crucial moderator in the adoption of sustainable behaviors (Hoffmann & Pfeiffer, 2022). Competition within gamified environments can motivate users, but its

effectiveness as a motivator can vary based on individual preferences for cooperative versus competitive scenarios (Al Skaif et al., 2018; Berger et al., 2022; Johnson et al., 2017). Energy-saving consciousness (Mulcahy et al., 2021) and empowerment (Fernández Galeote et al., 2021) are key moderators that influence users' active participation in sustainability efforts within and beyond the gamified setting.

Enjoyment benefits (Maltseva et al., 2019), including boredom mitigation (Oppong-Tawiah et al., 2020), along with experiential aspects (Maltseva et al., 2019) and immersion (Romero-Rodriguez et al., 2019), enhance user engagement, making the gamification experience more rewarding and likely to result in sustained behavior change. Inner pleasure (Li & Chu, 2021) and self-control (Chen et al., 2022) affect the emotional responses to gamification, potentially driving or deterring sustainable actions. Intention to engage in gamification (Musyaffi et al., 2022), along with intrinsic reading motivation (Li & Chu, 2021) and knowledge acquisition (Gatti et al., 2019), underscores the importance of aligning gamified content with users' learning goals and motivations.

Motivation, whether hedonic (Maltseva et al., 2019) or specifically directed toward tasks like waste sorting (Hoffmann & Pfeiffer, 2022), dictates the extent of user engagement with gamified systems. Perceived sustainable expertise (Zafar et al., 2024), personal responsibility (Douglas & Brauer, 2021), and psychological distance (Frías-Jamilena et al., 2022) moderate the personal relevance of sustainability themes, influencing user commitment. Satisfaction derived from gamification (Agusdinata et al., 2023), self-consumption pattern analysis (Al Skaif et al., 2018), self-reported effectiveness (Mylonas et al., 2023), self-control (Chen et al., 2022), and self-representation (Cavada & Rogers, 2020) are critical in shaping users' perceptions of their impact and efficacy in contributing to sustainability goals. Trust in the gamification system and use patterns (Vorobeva et al., 2023) as well as user profiles (ranging from casual to hardcore gamers) (Mulcahy et al., 2020) further moderate the relationship between gamification elements and sustainable consumption outcomes, highlighting the diversity in user experiences and responses to gamified sustainability initiatives.

Socio-cultural. Socio-cultural moderators significantly influence the efficacy and reception of gamified initiatives, reflecting the complex interplay between social dynamics, cultural norms, and individual behaviors. Appreciation and pro-social incentives (Aguiar-Castillo et al., 2023) serve as key moderators by fostering a culture of positive reinforcement and altruism, enhancing the appeal of engaging in sustainable behaviors. Citizen engagement (Papamichael et al., 2022) and collaboration (Cavada & Rogers, 2020), particularly within energy communities (Al Skaif et al., 2018), underscore the importance of collective efforts and shared goals in driving sustainable practices.

Collective affect (Fernández Galeote et al., 2021) and collaborative comparison (Rottondi & Verticale, 2017) highlight how group emotions and peer benchmarks can motivate individuals to align their behaviors with community standards, reinforcing the social aspect of sustainability. Communal advantages (Mandujano et al., 2021), such as improved community resilience and environmental health, offer a broader context for individual actions, reinforcing the communal benefits of participation in gamification.

Cultural factors, including collectivist versus individualist orientations (Hsu & Chen, 2021) and corporate versus innovative cultures (Behl et al., 2023), moderate how gamification strategies are perceived and adopted, with different cultures responding differently to gamification cues. Green effectiveness (Du et al., 2020) and an incentive-driven culture (Mandujano et al., 2021) can enhance the perceived efficacy of sustainable actions, encouraging deeper engagement with gamified systems.

Recognition, both social and team-based (Cavada & Rogers, 2020; Lowensteyn et al., 2019), along with result broadcast mechanisms (Rottondi & Verticale, 2017), amplifies the visibility of individual and group achievements, leveraging social validation as a powerful motivator. A sense of belonging (Prakash & Manchanda, 2021), fostered through gamification, can deepen individuals' commitment to shared sustainability goals while social competition introduces a dynamic element of challenge and achievement (Al Skaif et al., 2018).

Social discussion (Ro et al., 2017), gain (Du et al., 2020), and sharing (Johnson et al., 2017), particularly through platforms like social media (Pietrapertosa et al., 2021), extend the reach and impact of gamification, enabling the diffusion of sustainable practices and ideas beyond immediate participants, for example, virtual CSR (Shahzad et al., 2023). Strategy development within gamified contexts encourages users to think critically about sustainability challenges, fostering a strategic approach to problem-solving (Papamichael et al., 2022).

Lastly, the value of competition, as a cultural norm, can either enhance or detract from the collaborative spirit of gamification, depending on how it is framed and integrated into the gamified experience (Johnson et al., 2017). Together, these socio-cultural moderators highlight the multifaceted ways in which social dynamics and cultural contexts shape the pathways through which gamification influences sustainable consumption behaviors, pointing to the need for culturally sensitive and socially inclusive gamification designs.

Outcomes

Outcomes represent the tangible results of gamification strategies aimed at promoting sustainable consumption, categorized into "behavioral changes and consumption patterns" and "psychographic shifts." These outcomes provide a comprehensive understanding of the impact of gamification on individual attitudes, behaviors, and sustainable practice adoption.

Behavioral changes and consumption patterns. The outcomes of gamification strategies aimed at sustainable consumption manifest as a wide array of behavioral changes and altered consumption patterns, underlining the multifaceted impact of gamification on individuals and communities. Affective and cognitive outcomes see improvement, leading to enhanced awareness and emotional connection with sustainability issues (Gatti et al., 2019), which in turn fosters controlled behavior (Al Skaif et al., 2018) and conscious consumption choices (Maltseva et al., 2019). This consciousness is not fleeting but extends into long-term intentions and behaviors, contributing to overall contentment

(Behl et al., 2023) and well-being, including health benefits such as increased exercise, better mental health management, sustained clinical improvements, and weight reduction (Lowensteyn et al., 2019).

Engagement and participation across various levels—employee, individual, and social—experience a notable boost, often sustained over the long term (Romero-Rodriguez et al., 2019), facilitating a vibrant exchange (Behl et al., 2023) and transfer (Hoffmann & Pfeiffer, 2022) of knowledge pertinent to sustainable practices. Mobility patterns shift toward more sustainable options like car or ride sharing (Cavada & Rogers, 2020) and eco-driving (Stephens, 2022), reflecting a broader commitment to reducing environmental impact. Employee performance metrics, including efficiency, improvement, and retention, also see positive changes (Behl et al., 2023), indicating the broad applicability of gamification beyond mere environmental sustainability to include organizational sustainability.

Pro-environmental and sustainable attitudes and behaviors become more pronounced, with individuals more readily adopting sustainable decisions (Frías-Jamilena et al., 2022). This shift is evident in increased recycling efforts (Aguiar-Castillo et al., 2023), reduced ecological footprints particularly in food consumption (Maltseva et al., 2019), decreased resource consumption including fuel and gas (Pietrapertosa et al., 2021; Stephens, 2022), and moderated driving speeds (Stephens, 2022). The gamified experience reinforces repetitive and sustained learning and behaviors (Li & Chu, 2021; Whittaker, Russell-Bennett, & Mulcahy, 2021), encouraging responsible spending habits (Aguiar-Castillo et al., 2023) and efficient energy and water use (Rottondi & Verticale, 2017), leading to tangible savings at individual and household levels (Mulcahy et al., 2020).

Socially responsible consumption patterns emerge (Rottondi & Verticale, 2017), aligning personal consumption choices with broader societal and environmental goals. Sustainable tourism practices gain traction, offering eco-friendly alternatives to conventional tourism (Souza et al., 2020). Intentions to switch to more sustainable options (Mulcahy et al., 2020), and the act of switching off unused equipment (Ro et al., 2017), reflect a heightened consciousness and responsibility toward energy conservation. The use of technology, particularly management tools (Behl et al., 2023), becomes more prevalent, aiding in the efficient management of resources.

Waste sorting and reduction practices improve, contributing to a cleaner, more sustainable environment (Vorobeva et al., 2023). Moreover, satisfied and engaged individuals often become advocates for sustainability, sharing their experiences and knowledge through word of mouth (Hsu & Chen, 2021), further amplifying the impact of gamification on sustainable consumption practices. Collectively, these outcomes underscore the potential of gamification to instigate significant behavioral shifts and transform consumption patterns toward greater sustainability.

Psychographic shifts. The psychographic shifts resulting from gamification strategies in sustainable consumption extend beyond immediate behavioral changes, deeply influencing individuals' cognitive frameworks, emotional responses, and long-term engagement with sustainability. These shifts encompass an enhanced cognitive understanding of climate science (Fernández Galeote et al., 2021), allowing individuals to grasp the complexities of environmental issues across various domains and industries (Douglas & Brauer, 2021) and to recognize the valuable advantages of adopting sustainable practices (Whittaker, Mulcahy, & Russell-Bennett, 2021). This understanding extends to a better grasp of adaptation and mitigation strategies (Fernández Galeote et al., 2021), empowering individuals with actionable knowledge to address climate change effectively.

Conflict reduction is another significant outcome (Prakash & Manchanda, 2021), as gamification fosters cooperative and collaborative environments that can ease tensions and promote harmonious interactions, both in personal and professional settings. Enhanced consumption and temporal awareness emerge (Cavada & Rogers, 2020; Morganti et al., 2017), enabling individuals to become more mindful of their consumption patterns and the long-term impacts of their daily choices. This awareness is crucial for habit formation (Berger et al., 2022), where sustainable practices transition from conscious efforts to ingrained behaviors, fostering longer term psychological engagement and sustained motivation toward sustainability stewardship (Douglas & Brauer, 2021).

The transformative impact of gamification also paves the way for the adoption of resilient and livable lifestyles and practices (Mandujano et al., 2021), encouraging individuals to not only withstand environmental challenges but to thrive in sustainable living environments. Moreover, gamification facilitates the acquisition of waste-sorting and resource-saving know-how (Agusdinata et al., 2023; Hoffmann & Pfeiffer, 2022; Vorobeva et al., 2023), equipping individuals with practical skills and knowledge to minimize their ecological footprint.

These psychographic shifts are fundamental in driving a deeper, more ingrained commitment to sustainability, transcending superficial engagement to foster a genuine, lasting dedication to environmental well-being. Through gamification, individuals are not only prompted to adopt sustainable behaviors but are also transformed in their thinking and values, contributing to a more sustainable society. More importantly, these psychographic outcomes extend beyond academic interest, offering practical implications for policy formulation and assessment. The transformative effects of gamification serve as crucial indicators for policymakers aiming to gauge environmental progress toward the circular economy and the fulfillment of the UN SDGs (Papamichael et al., 2022). This connection underscores the potential of gamified interventions to not only alter individual behaviors and attitudes but also contribute to the larger sustainability objectives.

Controls

Control variables play a crucial role in distinguishing the specific effects of gamification elements from other influencing factors. Unlike moderators, which elucidate the conditions under which certain effects occur, controls are variables that researchers hold constant or account for to isolate the true relationship between the antecedents, mediators, and consequences. This distinction is essential for ensuring the reliability and validity of research findings. These controls are categorized into demographic and contextual factors.

Demographic controls such as age (Vorobeva et al., 2023), education (Du et al., 2020), gender (Whittaker, Russell-Bennett, & Mulcahy, 2021), income (Whittaker, Mulcahy, & Russell-Bennett, 2021), and spending patterns (e.g., bills) (Whittaker, Mulcahy, & Russell-Bennett, 2021) are common control variables in gamification research. These variables represent inherent characteristics of the participants that might influence their responses to gamification independently of the gamified intervention itself. For instance, younger participants may be more receptive to gamified elements due to greater familiarity with digital platforms, or higher income individuals might respond differently to incentives within a gamified system due to differing values or motivations.

Contextual controls encompass a wide range of environmental and situational factors that could impact the effectiveness of gamification strategies. These include destination image, which could influence how users perceive and engage with gamified tourism practices (Frías-Jamilena et al., 2022); environmental concern and experiences, such as a history of forest use, which might affect users' receptiveness to sustainability-themed games (Du et al., 2020; Frías-Jamilena et al., 2022); and gameplay duration, which can vary the depth of engagement with the gamified content (Whittaker, Mulcahy, & Russell-Bennett, 2021). Household factors like the number and type of appliances, the size and type of living space, and the number of occupants can significantly impact energy consumption patterns, making them important controls in studies focused on gamification for energy conservation (Mulcahy et al., 2021). Motivation, whether related to gaming in general or specific behaviors like waste sorting (Hoffmann & Pfeiffer, 2022), along with ability (Berger, 2019), reference group (Berger, 2019), subjective norms (Frías-Jamilena et al., 2022), and social background (Berger et al., 2022) and comparison (Berger, 2019), can also influence how participants interact with gamified interventions. System usability (Hoffmann & Pfeiffer, 2022) and user preferences (Berger et al., 2022) are critical controls as well, as they directly affect the user's ability to engage with and derive benefits from the gamification system.

Considering these demographic and contextual controls, researchers can more accurately assess the direct impact of gamification on sustainable consumption behaviors, ensuring that observed effects are truly attributable to the gamified elements rather than external factors. This careful consideration of control variables is what allows for more precise and meaningful conclusions in the field of gamification research. Table 1 offers the overview of the AMO findings.

3.3.2 | TM toolbox

The TM framework within gamification for sustainable consumption research offers a rich toolbox of theoretical and methodological foundations that guide the exploration and understanding of how gamified elements influence consumer behaviors toward sustainability. This multidisciplinary approach is essential for capturing the complexity and breadth of factors that drive sustainable consumption patterns.

Theories

The utilization of diverse theoretical frameworks in gamification research related to sustainable consumption showcases the multidimensional approach scholars have adopted to understand and influence consumer behavior toward sustainability. Notably, the SDT by Deci and Ryan (1985), referenced in five articles (Chen et al., 2022; Frías-Jamilena et al., 2022; Mandujano et al., 2021; Li & Chu, 2021; Shahzad et al., 2023), underscores the importance of intrinsic and extrinsic motivations in driving sustainability behaviors. The application of this theory by these scholars implies that gamification strategies that satisfy basic psychological needs such as autonomy, competence, and relatedness can significantly enhance sustainable consumption practices.

The affect-as-information theory by Schwarz and Clore (1983), although less frequently cited, provides a unique lens to examine how emotional responses to gamified experiences can inform and shape individuals' judgments and behaviors toward sustainability (Whittaker, Mulcahy, & Russell-Bennett, 2021). The application of this theory implies that the emotional feedback from engaging in gamified activities could influence users' perceptions and attitudes toward sustainability issues, thereby affecting their consumption patterns.

The expectation–confirmation model (ECM) by Bhattacherjee (2001) and the theory of planned behavior (TPB) by Ajzen (1991), each cited in one article, offer insights into the cognitive processes underlying behavior change. ECM, as used by Hsu and Chen (2021), suggests that satisfaction with gamified experiences can lead to continued use and, consequently, sustained sustainable behaviors. TPB, cited by Frías-Jamilena et al. (2022), highlights the role of attitudes, subjective norms, and perceived behavioral control (e.g., psychological distance) in shaping intentions and behaviors, suggesting that gamification can effectively modify these components to promote sustainability.

The blockchain model by Kosba et al. (2016), though seemingly unrelated to psychological theories, was applied by Rottondi and Verticale (2017) to ensure privacy and trust in gamified systems, indicating the critical role of technology and security in facilitating sustainable behaviors. This model emphasizes the need for secure and transparent systems to encourage participation in gamification for sustainability.

While previous studies have employed various theories to explain gamification as a means for sustainable consumption, an integrated perspective of these theories provides deeper insights into how gamification strategies can effectively foster sustainable development. The SDT, adopted by Chen et al. (2022) and Frías-Jamilena et al. (2022), focuses on fulfilling the psychological needs of players—autonomy, competence, and relatedness—to encourage long-term engagement and intrinsic motivation. This theory suggests that fostering sustainable habits leads to lasting behavior changes and a stronger commitment to sustainability. In contrast, affect-as-information theory explores how users' perceptions and behaviors are shaped by the emotional feedback from their gaming experiences (Whittaker, Mulcahy, & Russell-Bennett, 2021). Positive emotions can encourage pro-environmental behavior while negative emotions may lead to

TABLE 1 Overview of factors in gamification for sustainable consumption research.

No	Author(s)	Year	Article	Antecedent(s)	Mediator(s)	Moderator(s)	Control(s)	Consequence(s)
1	Johnson et al. (2017)	2017	Gamification and serious games within the domain of domestic energy consumption: A systematic review	Challenges, feedback, leaderboards, points, rewards, social sharing	Utility of rewards	Social sharing and value of competition		Reduction of energy consumption
2	Morganti et al. (2017)	2017	Gaming for earth: Serious games and gamification to engage consumers in pro-environmental behaviours for energy efficiency	Applied gaming interventions	Habits, motivational, and contextual	Individual estimate of indirect and generic behavior		Consumption awareness, environmental education, and pro-environmental behaviors
3	Ro et al. (2017)	2017	Making cool choices for sustainability: Testing the effectiveness of a game-based approach to promoting pro-environmental behaviours	Cool choices, cards	Degree of enjoyment	Social discussion		Increased household effort in saving energy, likelihood to turn off unused equipment
4	Rottondi and Verticale (2017)	2017	A privacy-friendly gaming framework in smart electricity and water grids	Privacy-friendly gaming platform, redeemable prizes	Privacy protection, social collaboration	Collaborative comparison, result broadcast		Learning actions, socially responsible consumption patterns, water-saving behaviors
5	Al Skaif et al. (2018)	2018	Gamification-based framework for engagement of residential customers in energy applications	Information provision, performance status, rewarding system, social connection, user interface	Exploration of available options to conserve	Collaboration or energy community, self-consumption pattern analysis, social competition		Active participation in energy applications, controlled behavior-environmental behavior
6	Berger (2019)	2019	Social norm-based gamification to promote eco-friendly food choice	Social norm information			Ability, identification with reference group, purchase condition, social comparison orientation	Eco-friendly food choice
7	Gatti et al. (2019)	2019	Education for sustainable development through business simulation games: An exploratory study of sustainability gamification and its effects on students' learning outcomes	Action and experiential learning technique	Communication, transparency	Knowledge and understanding		Affective and cognitive and outcomes for sustainability-related issues, positive attitude toward sustainability
8	Lowensteyn et al. (2019)	2019	The sustainability of a workplace wellness program that incorporates gamification principles: Participant engagement	Achievement badges, enjoyable narrative, group rivalry, influence of social circles, objective establishment, progress monitoring, ranking		Team recognition		Exercise, long-term employee participation, mental health management behaviors, nutrition, sustained clinical

(Continues)

TABLE 1 (Continued)

No	Author(s)	Year	Article	Antecedent(s)	Mediator(s)	Moderator(s)	Control(s)	Consequence(s)
			and health benefits after 2 years	systems, reinforcement, scoreboards, social interaction, trials, web-based challenges				improvements, weight reduction
9	Maltseva et al. (2019)	2019	The challenges of gamifying CSR communication	Interactivity, playfulness, and game-likeness		Enjoyment-related benefits, experiential aspects, hedonic motives such as aesthetic attractions		Conscious consumption, intention and behavior, pro-environmental attitude, reducing the ecological footprint of food
10	Romero-Rodriguez et al. (2019)	2019	Gamification in MOOCs: Engagement application test in energy sustainability courses	Achievable and stimulating goals, gamification dynamics of badges, challenges, and leaderboards	Individual responsibility, motivation for learning	Competitiveness and immersion		Increased participation, increased social engagement, long-term engagement
11	Cavada and Rogers (2020)	2020	Serious gaming as a means of facilitating truly smart cities: A narrative review	Location-based gamification, virtual payments	Selective enhancement	Collaboration and learning, self-representation, societal recognition		Car-sharing schemes, more sustainable, resilient and livable practices, temporal awareness
12	Du et al. (2020)	2020	Inducing individuals to engage in a gamified platform for environmental conservation	Competition and interactivity, gamification affordance of autonomy support, visibility of achievement, storytelling	Enjoyment	Green effectiveness, social gain	Age, education, environmental experience (forest using history), gender	Intention to continue
13	Mulcahy et al. (2020)	2020	Designing gamified apps for sustainable consumption: A field study	Challenge feedback character, game design elements-points	Enjoyment, knowledge, perceived value	User differences: hardcore users versus casual users		Energy bill savings cool intentions, gamification encourages sustainable household energy usage, switch intentions, word of mouth intentions
14	Oppong-Tawiah et al. (2020)	2020	Developing a gamified mobile application to encourage sustainable energy use in the office	Balance user system, game design objects, mechanics, and dynamics that promote long-lasting effects	Sensitivity to change in behavior	Mitigating boredom		More environmentally sustainable practices
15	Souza et al. (2020)	2020	How can gamification contribute to achieve SDGs? Exploring the opportunities and challenges of eco gamification for tourism	Eco-gamification-rewards users for green practices	Dynamic engagement	Age (younger audience), avoidance		Green behavior and sustainable tourism, increased eco-consciousness of tourists, manage tourist flows
16	Douglas and Brauer (2021)	2021	Gamification to prevent climate change: A review of games and apps for sustainability	Board games, electronic games, gamified apps (board games, team competitions, electronic games, smartphone apps),	Social influence	Belief in international cooperation for finding solutions to climate change, feelings of		Increased knowledge of domain, increased knowledge of sustainable manufacturing practices, longer term

TABLE 1 (Continued)

No	Author(s)	Year	Article	Antecedent(s)	Mediator(s)	Moderator(s)	Control(s)	Consequence(s)
				smartphone apps, team competitions		personal responsibility for sustainability		psychological engagement, transportation and energy saving
17	Fernández Galeote et al. (2021)	2021	Gamification for climate change engagement: Review of corpus and future agenda	Achievement/progression-oriented, immersion-oriented, life simulations, materials, resources, social representation	Real-world mitigation or adaptation behaviors	Collective affect, individual affect (e.g., curiosity, accountability, drive, self-assurance, empowerment, recognition of the significance of individual behavioral shifts)		Cognitive understanding of climate science, comprehension of mitigation strategies, familiarity with adaptation techniques
18	Mandujano et al. (2021)	2021	Gamification of backcasting for sustainability: The development of the gameful backcasting framework (GAMEBACK)	Sustainable back casting	Satisfaction of intrinsic needs	Cognitive, communal, emotional, and incentive-related advantages		Transformation of societal practices, sustainable lifestyle
19	Hsu and Chen (2021)	2021	Advocating recycling and encouraging environmentally friendly habits through gamification: An empirical investigation	Hedonic value-playfulness, utilitarian value-effectiveness	Affective-based attitude, cognitive-based attitude, satisfaction	Users cultural orientations (individualism/collectivism)		Continuance intention, word of mouth intention
20	Li and Chu (2021)	2021	Exploring the effects of gamification pedagogy on children's reading: A mixed-method study on academic performance, reading-related mentality and behaviours, and sustainability	Battles, gamification pedagogy, and leaderboards	Curiosity and satisfaction, inner positive feelings such as a sense of achievement, repetition, and elaboration	Intrinsic reading motivation, inner pleasure		Long-term learning, sustained learning, waste-sorting knowledge
21	Mulcahy et al. (2021)	2021	"Game on!" Pushing consumer buttons to change sustainable behaviour: a gamification field study	Badges, points, and other rewards	Ease of use	Energy saving consciousness	Duration of usage, household factors (e.g., appliances, bedrooms, electricity use, occupants, structure—apartment, duplex, house, townhouse)	Realized bill savings, reduced electricity consumption
22	Pietrapertosa et al. (2021)	2021	An educational awareness program to reduce energy consumption in schools	Awards, competition	Creative thinking	Social media sharing		Energy sustainability, reduced gas, and electricity consumption

(Continues)

TABLE 1 (Continued)

No	Author(s)	Year	Article	Antecedent(s)	Mediator(s)	Moderator(s)	Control(s)	Consequence(s)
23	Prakash and Manchanda (2021)	2021	Designing a comprehensive gamification model and pertinence in organisational context to achieve sustainability	Campaign contest structure, leaderboards, organizational targets, real rewards like cash incentives and trophies, virtual acknowledgments like points, badges, and different tiers	Effective utilization of time and money, good use of time, increased levels of proficiency	A sense of belongingness toward the organization		Judicious use of the human resource, positive culture in the long run, possibly eliminating the wastage of the organization's resources, promoting a favorable cultural context for educating about the responsible use of resources in the recruitment process, specifically concerning fuel, time and energy, reduction in the conflicts
24	Whittaker, Mulcahy, and Russell-Bennett (2021)	2021	'Go with the flow' for gamification and sustainability marketing	Play and reflection	Customer engagement, value-in behavior	Sustainability knowledge	Gameplay duration, gender, income, spending (bill)	Consumers perceive a broader array of valuable advantages when engaging in behaviors promoted by serious games
25	Whittaker, Russell-Bennett, and Mulcahy (2021)	2021	Reward-based or meaningful gaming? A field study on game mechanics and serious games for sustainability	Game mechanics centered on rewards, meaningful game mechanics	Value-in behavior	Knowledge about sustainability	Gender	Sustainable behavioral intention
26	Berger et al. (2022)	2022	A digital push with real impact—Mapping effective digital nudging elements to contexts to promote environmentally sustainable behaviour	Credit, leader boards, points	Normative influence (teams), social diffusion	Competition	Social background, user preferences	Habit formation, cool choices game significantly decreased players' monthly electricity consumption
27	Chen et al. (2022)	2022	Research on the impact of pro-environment game and guilt on environmentally sustainable behaviour	Pro-social game strategy	Guilt	Self-control		Sustainability game usage
28	Frías-Jamilena et al. (2022)	2022	Gamified environmental interpretation as a strategy for improving tourist behaviour in support of sustainable tourism: The moderating role of psychological distance	Gamified environmental interpretation	Pro-environmental attitude, behavior, and knowledge	Psychological distance	Destination image, environmental concern, subjective norms	Greater pro-environmental attitude, behavior, and learning

TABLE 1 (Continued)

No	Author(s)	Year	Article	Antecedent(s)	Mediator(s)	Moderator(s)	Control(s)	Consequence(s)
29	Hoffmann and Pfeiffer (2022)	2022	Gameful learning for a more sustainable world—Measuring the effect of design elements on long-term learning outcomes in correct waste sorting	Gameful design, look-up design element	More skills	Waste-sorting motivation and competency	Motivation (gaming, waste sorting), system usability	Better municipal waste sorting, improved cognitive skills, knowledge transfer
30	Musyaffi et al. (2022)	2022	Game-based learning sustainability during social distance: The role of gamification quality	Perceived ease of use gamification	Student satisfaction	Intention to use gamification		Sustainable adoption
31	Papamichael et al. (2022)	2022	Unified waste metrics: A gamified tool in next-generation strategic planning	Gamified tool	Key performance indicators	Citizen engagement, strategy development		Better decisions on environmental policies
32	Stephens (2022)	2022	A review of gamified approaches to encouraging eco-driving	Challenges, emoji and avatars, imaginative gamified elements, missions, quests, or levels	Ease of learning, ease of use, entertainment, fatigue, interactivity, overall satisfaction: usefulness, visual quality, satisfaction	Coping with the boredom of mundane driving		Eco-driving, reduced fuel consumption, reduced speed
33	Souza and Marques (2022)	2022	Factors influencing urban tourists' receptivity to eco gamified applications: A study on transports and mobility	Eco-gamification-rewards users for green practices	Increased eco-consciousness of tourists	Avoidance		Benefits of eco-gamification, encouraging eco-friendly conduct and sustainable tourism, enhancing engagement and the overall tourism experience, facilitating the communication of information via entertainment, providing rewards to users for adopting positive behaviors
34	Aguiar-Castillo et al. (2023)	2023	Gamification and proenvironmental performance: Could tourists return home with more sustainable habits?	Intrinsic and extrinsic incentives	Self-esteem and social recognition	Appreciation and pro-social incentives, awareness on resource use and expenditure, recognition		Recycling behavior, responsible spending habits

(Continues)

TABLE 1 (Continued)

No	Author(s)	Year	Article	Antecedent(s)	Mediator(s)	Moderator(s)	Control(s)	Consequence(s)
35	Agusdinata et al. (2023)	2023	A playful approach to household sustainability: Results from a pilot study on resource consumption	Points	Financial gain	Psychological satisfaction		Carbon emissions reduction, conservation of few resources at a household level
36	Behl et al. (2023)	2023	Gamification as an innovation: A tool to improve organizational marketing performance and sustainability of international firms	Gamification-based organizational marketing culture	Environmental sustainability	Corporate culture and capacities for technological innovation		Boosting performance and contentment among staff, enhancing staff retention and efficiency, fostering knowledge exchange among employees to enhance service quality, utilizing educational management tools
37	Mylonas et al. (2023)	2023	Playful interventions for sustainability awareness in educational environments: A longitudinal, large-scale study in three countries	Action missions, dashboard, knowledge missions, quest map	Connectedness and repeated use	Self-reported effectiveness		Energy-saving activities
38	Shahzad et al. (2023)	2023	Impact of gamification on green consumption behavior integrating technological awareness, motivation, enjoyment and virtual CSR	Gamification	Hedonic motivation, perceived enjoyment, technological awareness	Virtual CSR		Green consumption behavior
39	Paneru and Tarigan (2023)	2023	Reviewing the impacts of smart energy applications on energy behaviours in Norwegian households	Feedback systems, financial incentives, goal setting, norm appeals, prompts	Frequent feedback			Potential in long-term sustainable energy behavior in end-users
40	Vorobeva et al. (2023)	2023	Leveraging technology for waste sustainability: Understanding the adoption of a new waste management system	Entertaining system features, valuable rewards (local museum or theatre tickets, discounts for electricity etc.)	Value-in behavior	Amplification of trust and use	Age, gender	Waste management, waste sorting
41	Zafar et al. (2024)	2024	Gamification and sustainable development: Role of gamified learning in sustainable purchasing	Comparison, gamification learning, interaction, reward, visual appeal	Environmental consciousness, social consciousness	Perceived sustainable expertise		Sustainable purchasing attitude

Abbreviation: CSR, corporate social responsibility.

cautious and critical thinking. Thus, while SDT aims to increase intrinsic motivation by meeting psychological needs, affect-as-information theory highlights the role of emotional responses in shaping sustainability views and behaviors.

Integrating these theories, we see that gamification strategies can be designed to fulfill psychological needs and leverage emotional feedback to influence sustainable decision-making and engagement. The TPB, employed by Frías-Jamilena et al. (2022), further complements this by focusing on the intentions influenced by attitudes, social norms, and perceived behavioral control, which identify users' initial engagement with the gamified system. This theory helps anticipate whether users will begin utilizing the system during the pre-engagement phase. Notably, gamified interpretive tools can impact users' pro-environmental knowledge and attitudes, enabling designers to create solutions that encourage the adoption and persistence of sustainable behaviors.

In contrast, the ECM, used by Hsu and Chen (2021), addresses the post-engagement stage by explaining continued engagement with the gamified system based on satisfaction from the confirmation of expectations. This theory assesses the continuance intention, determining whether users will maintain sustainable behavior after using the gamified app. A continuous feedback loop, established through this model, keeps users motivated to adopt and sustain sustainable behaviors, thereby supporting long-term engagement and commitment to sustainability goals.

Combining these theories allows for a comprehensive understanding of gamified engagement, covering the pre-, during, and post-engagement phases while promoting sustainable behavior. This integrated approach not only highlights the complementary aspects of psychological needs, emotional feedback, and behavioral intentions but also addresses potential contrasts in how these elements interact to foster sustainable consumption.

These theories, among others listed, also illustrate the interdisciplinary nature of gamification research in sustainable consumption. They reflect a comprehensive attempt to understand the multifaceted influences on consumer behavior, ranging from psychological and emotional to social and technological factors. The diverse theoretical underpinnings underscore the complexity of driving sustainable consumption through gamification and highlight the necessity for multifaceted strategies that address various aspects of human behavior and system design. Table 2 provides a summary of the theories used in gamification for sustainable consumption research.

Methods

The methods employed in gamification research for sustainable consumption reveal a diverse and multifaceted approach, reflecting the complexity and interdisciplinary nature of the field. A critical review of the methodologies shows a blend of qualitative, quantitative, and mixed-methods research designs, each tailored to explore different aspects of gamification's impact on sustainable behaviors.

Quantitative methods, such as experimental designs and surveys, dominate the landscape, providing empirical evidence of gamification's effectiveness in promoting sustainable consumption. For instance, Ro et al. (2017) utilized a quantitative experimental design to assess a game-based approach's efficacy in fostering pro-environmental behaviors, highlighting the value of structured interventions in altering consumption patterns. Similarly, Mulcahy et al. (2020) conducted a field study employing a quantitative approach to explore how gamified apps influence sustainable household energy usage, demonstrating the practical implications of gamification in real-world settings.

Qualitative methods, though less prevalent, offer deep insights into the user experience and the contextual factors influencing gamification's success. Gatti et al. (2019) adopted a qualitative approach to investigate the pedagogical aspects of gamification in sustainability education, revealing how game-based learning can enhance students' understanding and attitudes toward sustainability issues. This methodological choice underscores the importance of exploring the subjective dimensions of gamification, including user engagement, motivation, and the perceived value of gamified experiences.

Mixed-methods research, combining quantitative and qualitative techniques, provides a comprehensive understanding of gamification's multifaceted impact. Li and Chu (2021) employed both approaches to examine the effects of gamification pedagogy on children's reading behaviors, offering a holistic view of how gamified learning can sustain long-term educational outcomes related to sustainability.

The methods applied in gamification research for sustainable consumption are as diverse as the gamification strategies themselves, ranging from serious games (Johnson et al., 2017) and gamified apps (Mulcahy et al., 2020) to organizational gamification (Lowensteyn et al., 2019) and gamified learning environments (Li & Chu, 2021). These strategies are designed to engage users in various contexts, including CSR (Maltseva et al., 2019), energy conservation (Pietrapertosa et al., 2021), sustainable tourism (Aguiar-Castillo et al., 2023), and waste management (Hoffmann & Pfeiffer, 2022). Each methodological approach, whether focusing on behavioral outcomes, psychographic shifts, or user engagement, contributes to a richer understanding of how gamification can be leveraged to foster more sustainable consumption patterns across different sectors and demographic groups.

The methodological diversity in gamification research for sustainable consumption underscores the field's interdisciplinary nature and its potential to address complex environmental challenges. Employing a range of research designs and gamification strategies, scholars can continue to uncover valuable insights into how gamified interventions can promote sustainable behaviors, contribute to environmental education, and ultimately support broader sustainability goals.

4 | FUTURE RESEARCH DIRECTIONS

The section on future research directions in the context of gamification and sustainable consumption highlights several key insights and pathways for further exploration. Through a systematic review employing the SPAR-4-SLR protocol (Paul et al., 2021) and the integrated AMO-TM framework (Luo et al., 2024; Paul et al., 2017), this

TABLE 2 Theories used in gamification for sustainable consumption research.

Theory	Origin	*n* article	Gamification for sustainable consumption article
Self-determination theory	Deci and Ryan (1985)	5	Chen et al. (2022), Frías-Jamilena et al. (2022), Mandujano et al. (2021), Li and Chu (2021), Shahzad et al. (2023)
Affect-as-information theory	Schwarz and Clore (1983)	1	Whittaker, Mulcahy, and Russell-Bennett (2021)
Attitudes-behaviors corrective model of attitude	Breckler (1984)	1	Prakash and Manchanda (2021)
Behavioral reasoning theory	Claudy and Peterson (2014)	1	Zafar et al. (2024)
Blockchain model	Kosba et al. (2016)	1	Rottondi and Verticale (2017)
Expectation–confirmation model	Bhattacherjee (2001)	1	Hsu and Chen (2021)
Fogg behavior model	Fogg (2009)	1	Prakash and Manchanda (2021)
Goal framing theory	Lindenberg and Steg (2007)	1	Du et al. (2020)
Grounded theory	Glaser and Strauss (2017)	1	Berger et al. (2022)
Hierarchy-of-effects framework	Ray et al. (1973)	1	Whittaker, Russell-Bennett, and Mulcahy (2021)
Integrated theoretical gamification model in e-learning environments	Dicheva et al. (2015)	1	Romero-Rodriguez et al. (2019)
Mechanics dynamics emotional framework	Hunicke et al. (2004)	1	Prakash and Manchanda (2021)
Octalysis framework	Chou (2019)	1	Prakash and Manchanda (2021)
Technology acceptance model	Davis (1989)	1	Musyaffi et al. (2022)
The elaboration likelihood model	Petty et al. (1986)	1	Prakash and Manchanda (2021)
Unified theory of acceptance and use of technology	Venkatesh et al. (2003, 2012)	1	Vorobeva et al. (2023)
Theory of administrative behavior	Simon (1944)	1	Behl et al. (2023)
Theory of organizational creativity	Woodman et al. (1993)	1	Behl et al. (2023)
Theory of planned behavior	Ajzen (1991)	1	Frías-Jamilena et al. (2022)
Theory of pro-environmental behavior	Kollmuss and Agyeman (2002)	1	Maltseva et al. (2019)
Trans-theoretical model	Prochasker and Velicer (1971)	1	Prakash and Manchanda (2021)

study critically examines 41 journal articles published between 2016 and 2023. The core objective of this examination is to unpack the complexities of how gamification serves as a pivotal tool in fostering sustainable consumption behaviors. This involves identifying the driving factors behind the adoption of gamification techniques for sustainable actions, understanding the mechanisms through which gamification encourages sustainable behaviors, outlining the conditions under which these mechanisms operate, and delineating the outcomes of applying gamification in this domain. Moreover, with the aid of the bibliometrix package in the RStudio software (Aria & Cuccurullo, 2017), the study also reveals the major themes that form the intellectual backbone of the intersection between gamification and sustainable consumption.

Despite the depth of the existing literature, there remain numerous fertile areas for future investigation. Guided by the recommendations from Snyder (2019), the study delineates potential research directions into three main categories: thematic-specific directions, methodology-specific directions, and factor-specific directions (Table 3). Drawing from the approach by Hsu and Chen (2021), a sharp and succinct overview of future research opportunities is presented, pinpointing specific gap areas, categorizing the types of gaps, and formulating pertinent research questions. This structured outline provides a roadmap for future inquiries, ensuring a focused and holistic advancement of knowledge in the interplay between gamification and sustainable consumption practices.

4.1 | Theme-specific directions

Theme-specific directions highlight the potential pathways for future research based on the identified thematic areas within gamification

TABLE 3 Future directions for gamification and sustainable consumption research.

Future research	Gap area	Type of gap	Pertinent research question	Further reading
Theme-specific directions				
Gamification for sustainable behavioral changes	The influence of gamification on actual resource recycling behaviors, as opposed to mere intentions, is underexplored.	Empirical	How do the effects of gamification on actual resource recycling behaviors compare to its effects on intentions for resource recycling?	Hsu and Chen (2021)
	The breadth of value benefits gained from engaging in sustainable behaviors through gamification is not well-documented.	Knowledge	What variety of value benefits do users experience when engaging in sustainable behaviors through gamified platforms?	Cavada and Rogers (2020)
	There is scant research on the impact of gamification across a broader spectrum of sustainable behaviors such as disposable item usage, food consumption, water conservation, and recycling.	Empirical	How can gamification be leveraged to enhance a wider range of critical sustainable behaviors like disposable item usage, food consumption, water conservation, and recycling?	Mulcahy et al. (2021)
	There is limited analysis on the specific impact of individual gamification elements within apps aimed at fostering sustainable behavioral changes.	Empirical	What variations in the effectiveness of gamified interventions might emerge from the sequential removal of individual gamification features, with the aim of promoting sustainable behavioral changes?	Ro et al. (2017)
Gamification for sustainability education	Gamified learning programs for high school and college students are underexplored.	Empirical	How do gamified learning programs specifically impact students at different educational levels?	Park and Kim (2021)
	The long-term impact of collaborative and narrative elements in educational gamification is not well-researched.	Empirical	Do collaborative and narrative elements in educational gamification sustain positive impacts over time?	Li and Chu (2021)
	Comparative analysis of teaching techniques for sustainability-related affective, cognitive, and behavioral outcomes is lacking.	Empirical	How do various teaching techniques, including gamification, compare in generating sustainability-related affective, cognitive, and behavioral outcomes?	Gatti et al. (2019)
Gamification for sustainable living	The development of engaging games for smart city initiatives needs more research.	Knowledge	How can games be developed as tools for engaging participation in smart city initiatives, and how can these initiatives enhance environmental and societal well-being?	Cavada and Rogers (2020)
Gamification for workplace sustainability	The effectiveness of financial incentives versus conventional gamification rewards in the workplace is under examined.	Empirical	Can financial incentives effectively replace traditional gamification techniques for promoting sustainable behaviors in the workplace?	Lowensteyn et al. (2019)
	Alternative methods for fostering commitment to sustainable business practices across organizational levels are not well-studied.	Knowledge	Do gamification methods for individual sustainable actions translate effectively to an organizational context?	Oppong-Tawiah et al. (2020)
Gamification for environmental sustainability	The potential of gamification affordances to elicit sustainable actions is not fully understood.	Empirical	How do gamification affordances influence user experiences, especially in platforms designed for environmental conservation?	Du et al. (2020)
	There is a lack of a unified framework for assessing gamification's effectiveness in promoting pro-environmental behavior.	Knowledge	How can a unified framework be developed to assess the effectiveness of gamification in fostering pro-environmental behavior?	Morganti et al. (2017)
Gamification for sustainable tourism	The application of gamification across various tourism sectors requires further investigation.	Knowledge	How can eco-gamified services in different tourism sectors, like eco-friendly lodging and transportation, enhance tourist engagement?	Souza et al. (2020)
	The willingness of urban tourists to engage with eco-gamification, particularly in transportation, is understudied.	Knowledge	How can the willingness of urban tourists to engage with eco-gamification, especially in mobility and transportation, be explored?	Souza and Marques (2022)
Methodology-specific directions	Limited understanding of user continuation from a longitudinal perspective.	Methodological	How can longitudinal research designs aid in tracking the long-term impact of gamified design on pro-environmental behaviors?	Du et al. (2020)
		Methodological	Can secondary data from corporate or government sources be used to validate the	Chen et al. (2022)

(Continues)

TABLE 3 (Continued)

Future research	Gap area	Type of gap	Pertinent research question	Further reading
	Underuse of secondary data in assessing the impact of pro-environmental or pro-social gamification designs.		impact of pro-environmental or pro-social gamification designs on sustainable behavior?	
	Lack of systematic evaluation methods including control groups for comparative studies.	Methodological	How can the inclusion of control groups in experimental designs enhance the analysis of gamification's impact on sustainable consumption?	Papamichael et al. (2022)
Factor-specific directions	Limited application of gamified learning for waste sorting across diverse cultural contexts.	Knowledge	How does cultural context influence the effectiveness of gamified learning in waste-sorting practices?	Hoffmann and Pfeiffer (2022)
	Absence of comparative studies on the impact of gamification based on nationality.	Knowledge	How do sustainable practices influenced by gamification vary among users from different nationalities?	Zafar et al. (2024)
	Uncertainty about the effectiveness of gamified CSR communication for gaming-preferent audiences.	Knowledge	Is gamified CSR communication more effective for audiences with a strong inclination toward gaming?	Maltseva et al. (2019)
	Influence of privacy concerns on the acceptance of gamified sustainable learning platforms.	Knowledge	How do privacy concerns and app analytics, like GPS tracking, affect user acceptance of gamified sustainable learning platforms?	Mulcahy et al. (2020)

Abbreviation: CSR, corporate social responsibility.

for sustainable consumption research. The insights from existing literature provide a solid foundation for proposing sub-theme-specific directions for future inquiries.

4.1.1 | Advancing gamification for sustainable behavioral changes

Gamification has shown promise in facilitating behavioral changes toward sustainability, with potential applications extending to key areas like food consumption, recycling, water conservation, and the reduction of disposable item usage. While gamification strategies have been successful in enhancing users' intentions toward sustainable actions, particularly in resource recycling, there exists a notable gap in understanding the transition from intention to actual behavior (Hsu & Chen, 2021). This discrepancy underscores the need for empirical research focused on the tangible effects of gamification on real-life sustainable practices.

Additionally, the value benefits that users gain from engaging in sustainable behaviors through gamification remain underexplored. Investigating the spectrum of value benefits, from intrinsic rewards to the broader impact on quality of life, could provide deeper insights into how gamification contributes to sustainable marketing objectives (Cavada & Rogers, 2020; Whittaker, Mulcahy, & Russell-Bennett, 2021).

Another critical area for future research lies in dissecting the gamification elements to assess their individual contributions to promoting sustainable behaviors. The challenge lies in determining the relative importance of each component within gamified environments, such as "cool choices," where multiple elements work synergistically to influence behavior (Ro et al., 2017). Methodically evaluating the impact of altering or removing individual gamification features, researchers can elucidate the essential components that drive the shift toward sustainable behavior.

Future research should therefore aim to bridge the gaps between intentions and actual sustainable actions influenced by gamification, explore the multifaceted value benefits experienced by users, and dissect the gamification elements to understand their individual and collective impacts on sustainable behavioral changes. These research directions have the potential to significantly advance the application of gamification in promoting a broad spectrum of sustainable behaviors, contributing to more effective and engaging strategies for sustainable consumption.

4.1.2 | Advancing gamification for sustainability education

The integration of gamification into educational frameworks has demonstrated significant potential in enhancing learner motivation and comprehension, particularly in the context of online learning environments (Palaniappan & Noor, 2022). This approach aligns with the United Nations' SDG 4, advocating for quality education. The recent shift toward remote learning, accelerated by the COVID-19 pandemic (Mahajan et al., 2023), has further underscored the value of gamified learning tools in creating engaging and sustainable learning experiences, particularly for younger students (Landers et al., 2015; Park & Kim, 2021).

Despite these advancements, there remains a notable gap in research focused on the application of gamified learning programs for high school and college students. This demographic, especially those from vulnerable backgrounds, has been relatively overlooked in the literature, presenting a significant area for future exploration (Aini et al., 2022; Park & Kim, 2021). Understanding the impact of gamification on these educational levels is crucial for tailoring effective gamified learning experiences that cater to their specific needs and learning styles.

Additionally, gamification's influence extends beyond mere engagement, impacting affective, cognitive, and behavioral learning dimensions. Elements of gamification have been shown to enhance students' sustainability knowledge, motivation, and interest, suggesting that gamified approaches could be more effective than traditional teaching methods in certain contexts (Gatti et al., 2019). However, the comparative efficacy of gamified learning versus various traditional teaching techniques in fostering affective, cognitive, and behavioral outcomes related to sustainability remains underexplored. Such comparative studies could illuminate the unique benefits and limitations of gamification in sustainability education.

Another critical area for investigation is the long-term efficacy of gamification in education. Preliminary findings indicate that immersive gamification can significantly boost students' reading motivation and abilities, suggesting that gamified e-learning platforms could offer lasting educational benefits (Li & Chu, 2021). Yet, the enduring impact of incorporating collaborative and narrative elements within gamified educational platforms has not been extensively studied. Future research should therefore focus on the sustained effects of these gamification elements, assessing whether the initial positive outcomes observed can be maintained over prolonged periods to ensure lasting educational advancements in sustainability.

4.1.3 | Advancing gamification for sustainable living

The application of gamification in fostering sustainable living has shown promising results, particularly when aligned with technological advancements and thoughtful game design focused on sustainability principles (Cavada & Rogers, 2020; Galli et al., 2015). Effective gamification strategies must intertwine game design elements with core sustainability goals, such as resilience and quality of life enhancement, to achieve optimal outcomes. This alignment ensures that the gamification efforts not only engage citizens in meaningful ways but also remain cognizant of the environmental and societal impacts of these engagements. The concept of "way-finding" games emerges as a vital tool in this endeavor, offering a unique avenue for participation that is both enjoyable and instrumental in driving smart city initiatives forward. These games should be mindfully developed, with their outcomes strategically utilized to bolster actions that contribute positively to smart cities, thereby fostering a more sustainable, engaged, and informed citizenry (Cavada & Rogers, 2020).

Moreover, gamification's role extends beyond citizen engagement, offering a valuable resource for decision-makers tasked with navigating the complexities of environmental performance and sustainability targets. As we move toward realizing ambitions such as the circular economy, the European Green Deal, and the United Nations SDGs, gamification can provide insightful, interactive experiences that aid policymakers in understanding and addressing the multifaceted challenges inherent in these initiatives (Papamichael et al., 2022). Future research should therefore explore the integration of gamification techniques into environments tailored specifically for stakeholders like policymakers. This approach would facilitate a deeper engagement with sustainable living, enabling more informed decision-making processes and fostering a collaborative effort toward achieving global sustainability objectives.

4.1.4 | Advancing gamification for workplace sustainability

The deployment of gamification strategies within workplace settings has been recognized for its capacity to invigorate the work environment, fostering enhanced teamwork, morale, and consequently, improved performance and employee satisfaction (Lowensteyn et al., 2019). A compelling area for future investigation is whether traditional gamification elements—such as team-based competitions, progress tracking, and leaderboards, along with the creation of social connections and engaging narratives—could be as effective, or perhaps even replaced, by simple financial incentives. This inquiry addresses a critical gap in understanding the comparative effectiveness of intrinsic versus extrinsic motivators in promoting sustainable behaviors within the workplace.

Furthermore, the research conducted by Oppong-Tawiah et al. (2020), which utilized a power usage monitor for real-time energy consumption feedback, suggests that gamified interventions can enhance employees' awareness and actions toward energy conservation. Building on this, there is a need to explore a broader array of gamified strategies that might foster a deeper organizational commitment to environmentally sustainable practices. Such research would extend beyond individual actions to consider how gamification can be scaled and adapted to influence sustainability at various organizational levels.

The potential extended benefits and long-term effectiveness of gamification in workplace wellness programs and overall employee satisfaction remain areas ripe for further exploration. Investigating how alternative gamification strategies could be harnessed to cultivate enduring commitment to sustainable business practices across an organization's hierarchy presents a promising avenue for research. This direction not only aims to deepen our understanding of gamification's impact within the workplace but also seeks to identify effective strategies for integrating sustainability into the core values and operations of businesses.

4.1.5 | Advancing gamification for environmental sustainability

Gamification has emerged as a significant driver for encouraging environmentally sustainable behaviors among consumers, by engaging them through rewards and recognition mechanisms typically structured over specific durations (Al Skaif et al., 2018; Boncu et al., 2022). A promising area for future research lies in examining the impact of dynamic reward models within gamification designs and how these models can effectively promote environmental sustainability actions. This exploration could provide valuable insights into optimizing gamification strategies to foster more profound and lasting environmental engagement.

Furthermore, gamification presents an opportunity to educate consumers about the broader implications of their actions, such as the impact of demand flexibility on carbon emissions. This educational aspect of gamification can empower users to make more informed, responsible choices, contributing to overall sustainability (Du et al., 2020). Investigating how the affordances of gamification manifest in varied user experiences, particularly on platforms with a strong focus on environmental conservation, could uncover new ways to enhance user engagement and promote sustainable behaviors.

Moreover, integrating social responsibility elements into game design can motivate players to participate in pro-social activities, potentially mitigating any associated gameplay guilt and redirecting it toward positive, altruistic actions (Chen et al., 2022). Future studies could explore additional aspects of gamification that might further motivate users toward such pro-social and environmentally sustainable engagements.

The exploration of a unified framework to evaluate the effectiveness of gamification in promoting energy efficiency and pro-environmental behavior represents another critical research direction. Such a framework could standardize the assessment of gamification strategies across various contexts, aiding in the identification of best practices for environmental sustainability (Morganti et al., 2017). Advancing research in these areas, the field can better understand how gamification can be leveraged to support environmental sustainability goals more effectively.

4.1.6 | Advancing gamification for sustainable tourism

The integration of gamification into the tourism sector is recognized as a significant step toward achieving the SDGs, particularly those focusing on sustainable cities and communities (SDG 11) and responsible consumption and production (SDG 12). The concept of eco-gamification, which intertwines sustainability with engaging gaming elements, is becoming increasingly relevant in promoting sustainable tourism practices. Despite its potential, the practical application and consumer engagement with eco-gamification in tourism remain largely unexplored areas (Souza et al., 2020).

To address this gap, future research should focus on empirical studies that examine how tourists interact with eco-gamified services across various sectors within tourism, such as museums, eco-friendly transportation, and sustainable lodging options. Understanding how these gamified strategies can contribute to the preservation of cultural and natural heritage while promoting local product consumption is essential for advancing sustainable tourism across its economic, ecological, and social dimensions. Such research endeavors would not only provide valuable insights into the effectiveness of eco-gamification in tourism but also contribute to the broader goals of SDGs 11 and 12 (Souza et al., 2020).

Moreover, investigating the profiles of tourists most receptive to eco-gamification presents an intriguing research opportunity. Exploring factors such as technology acceptance, entertainment preferences, and reward expectations could shed light on the motivations driving tourist engagement with gamified eco-tourism initiatives. Understanding these dynamics is crucial for developing gamification strategies that resonate with tourists' preferences and enhance their participation in sustainable tourism practices (Souza & Marques, 2022). This line of inquiry promises to offer strategic insights for the tourism industry, enabling the industry to better align its practices with sustainability objectives while providing engaging and meaningful experiences for tourists.

4.2 | Methodology-specific directions

The examination of current gamification research reveals a predominant reliance on quantitative methodologies, with surveys and experimental methods being particularly prevalent. Review-based methodologies also hold a significant place, with SLRs leading the way, followed by narrative reviews. Qualitative approaches, though less common, contribute valuable insights through diverse methodologies. This distribution underscores the methodological diversity within gamification research, highlighting the field's multi-methodical approaches to investigating the impact of gamification on sustainable behaviors.

A notable gap identified in the existing literature is the limited exploration of user engagement with gamification over extended periods. The scarcity of longitudinal studies presents a critical area for future research, emphasizing the need to understand the long-term effects of gamified interventions on pro-environmental and pro-social sustainability behaviors. Incorporating long-term tracking and employing both cross-sectional and longitudinal study designs could provide deeper insights into the evolution and sustainability of user engagement with gamification (Du et al., 2020).

Another significant observation is the underutilization of secondary data in gamification research. This gap highlights an opportunity for future studies to explore and engage with corporate or government datasets for a more in-depth analysis and validation of hypotheses related to the impact of pro-environmental or pro-social gamification designs on sustainable behavior. Such an approach could enrich the field by grounding theoretical assumptions in real-world

data and offering empirical evidence to support gamification strategies aimed at fostering sustainable behaviors (Chen et al., 2022).

Additionally, the analysis indicates that experimental studies within gamification research often lack the inclusion of control groups, pointing to a need for more comprehensive and systematic evaluation methods. Introducing control groups into experimental setups could significantly enhance the rigor and robustness of findings, facilitating a clearer understanding of gamification's true impact on sustainable consumption behaviors (Papamichael et al., 2022).

4.3 | Factor-specific directions

Gamification research focusing on predicting sustainable behavior has extensively utilized various theoretical models, incorporating a range of variables such as antecedents, mediators, moderators, controls, and consequences. Despite this broad application of variables, there remains a substantial opportunity for further exploration and refinement of these factors in future studies.

Place-related factors, for example, suggest that the outcomes of gamified learning and sustainable practices could significantly differ across countries, influenced by cultural beliefs, religious values, and user tasks within the gamified environment. This variability underscores the potential for comparative studies to examine how nationality and cultural contexts shape users' engagement with gamification and its impact on sustainable practices (Das et al., 2022; Hoffmann & Pfeiffer, 2022; Zafar et al., 2024). Such research could provide valuable insights into the cultural dimensions of sustainability in consumption, highlighting the importance of tailoring gamification strategies to diverse cultural settings.

The role of demographics and user experiences with gamified applications in shaping sustainable behavior responses presents another intriguing avenue for research. Investigating individuals' inherent gaming preferences and experiences could reveal significant variations in engagement and effectiveness, particularly in the context of gamified CSR communication (Maltseva et al., 2019). Understanding these pecularities could aid in designing more personalized and effective gamification strategies.

Information provision within gamification, such as feedback and tips, has been identified as a simple yet impactful element in raising awareness about energy consumption and promoting sustainable behavior (Mulcahy et al., 2020). Exploring additional game design elements like reward systems, performance status, and the integration of social influence through collaboration or competition could further enhance the effectiveness of gamification in encouraging sustainable practices. The inclusion of unconventional game elements to spark curiosity and engagement represents another potential area for research (Das et al., 2023).

Privacy concerns related to app analytics, such as GPS tracking, also emerge as a significant factor influencing user acceptance of gamified sustainable learning platforms. Addressing these concerns and understanding their impact on user engagement with gamified solutions is crucial for the development of privacy-conscious and user-friendly gamified applications (Mulcahy et al., 2020).

Last but not least, examining the influence of gamification on sustainable outcomes through the lens of generational cohorts could unveil distinct attitudes and perceptions toward gamification across different age groups (Lim et al., 2023). Exploring the implications of emerging and innovative applications of gamified solutions, for example, metaverse gamification (including augmented and virtual reality gamification) and stakeholder co-creation in gamification, in promoting sustainable behavior also remains an essential area for future research, promising to enrich the understanding of gamification's role in advancing sustainable consumption practices.

5 | CONCLUSION

5.1 | Key takeaways

This study examines gamification as a transformative strategy for promoting sustainable consumption. Through a search and synthesis of literature using the SPAR-4-SLR protocol (Paul et al., 2021) and the AMO-TM organizing framework (Luo et al., 2024; Paul et al., 2017), we have unpacked how gamification intertwines with sustainable consumption practices. Our analysis reveals six main themes that constitute the core of current research efforts and a multifaceted model comprising antecedents, mediators, moderators, controls, and outcomes that delineate the gamification landscape in sustainable consumption.

The themes include *gamification for sustainable behavioral changes*, where gamification is explored as a mechanism to alter consumer habits toward more sustainable practices. *Gamification for sustainability education* underscores the role of gamified approaches in enhancing learning outcomes related to environmental sustainability. *Gamification for sustainable living* examines how gamification can be integrated into daily life to promote eco-friendly behaviors. *Gamification for workplace sustainability* looks into the application of gamification in organizational settings to encourage sustainable practices among employees as consumers at the workplace. *Gamification for environmental sustainability* encapsulates the broader environmental impacts of gamification, including its potential to reduce carbon footprints and promote energy efficiency. Lastly, *gamification for sustainable tourism* focuses on how gamification can enhance the sustainability of tourism practices, contributing to the conservation of natural and cultural heritage. Each of these themes represents a vital area where gamification can contribute to the broader goals of sustainable development and environmental conservation.

The themes, which emerged from our review, contribute significantly to the sustainability literature by demonstrating how gamification can help achieve diverse SDGs (Azmat et al., 2023). For instance, the theme of *gamification for sustainability education* illustrates how gamification and game-based learning can advance SDG 4, which ensures accessible, equitable, high-quality education and fosters opportunities for lifelong learning. Similarly, the themes of

gamification for sustainable living and *workplace sustainability* show how gamified models and practices can help achieve SDG 11, which focuses on sustainable cities and communities. Furthermore, the themes of *gamification for environmental sustainability* and *sustainable tourism* underscore how eco-gamification can promote pro-environmental behavior, thereby advancing SDG 12, which targets responsible production and consumption. Consequently, our review not only highlights the current body of knowledge and future directions for gamification as a tool for sustainable consumption (SDG 12) but also suggests that gamification could be an effective tool for promoting other SDGs, including SDG 4 and SDG 11.

Interestingly, our review, while focused on gamification for sustainable consumption, also reveals emergent themes like workplace sustainability and sustainable tourism. This suggests that the role of consumers in sustainability is not confined to personal consumption but extends to their behaviors in professional settings, such as energy and water usage and waste management at work. This narrative, however, is notably absent in the current discourse on the future of work (Lim, 2023). Addressing this gap is crucial because workplaces are significant consumers of resources, and incorporating sustainability into professional settings can lead to substantial environmental benefits. Additionally, promoting sustainable behaviors at work can foster a culture of sustainability that employees may carry into their personal lives, thereby amplifying the overall impact on sustainable consumption. Similarly, the theme of sustainable tourism, despite tourism's association with hedonism and recreation, indicates that consumption continues not only out of necessity but also desire. Gamification plays a crucial role here, not just in raising awareness and mitigating excessive consumption but also in reflecting the complex system of planetary health where sustainable practices are integral. Thus, gamification for sustainable consumption aligns not only with sustainability agendas like the SDGs (Azmat et al., 2023) and net zero targets (Gangadhari et al., 2024) but also with the larger goal of safeguarding planetary health (Lim, 2024).

Building upon the identified themes, it is essential to dive deeper into the underlying factors that drive the effectiveness of gamification in promoting sustainable behaviors. This involves examining the key antecedents, mediators, moderators, controls, and outcomes associated with gamification in the context of sustainability.

Antecedents like game mechanics, incentives, social dynamics, sustainability focus, and user experience have been identified as pivotal in steering the gamification process toward fostering sustainable behaviors. These elements lay the foundation for engaging and motivating users to adopt eco-friendly practices.

Mediators and *moderators*, both psychographic and socio-cultural, play crucial roles in shaping the gamification experience. They act as catalysts, amplifying or altering the effects of gamification strategies on sustainable behaviors. Understanding these variables offers insights into the ways in which individuals interact with gamified systems.

Controls, encompassing demographic and contextual factors, provide a lens to examine external influences that may affect the outcomes of gamification initiatives. These variables highlight the importance of tailoring gamification strategies to diverse audiences and contexts.

Outcomes of gamification in sustainable consumption manifest as behavioral changes, consumption patterns, and psychographic shifts. These changes underscore the potential of gamification to not only alter individual behaviors but also to instigate societal shifts toward sustainability.

The TM toolbox consolidates relevant theories and methodologies, underscoring the interdisciplinary nature of gamification research in sustainable consumption. *Theories* like self-determination theory and affect-as-information theory offer theoretical lenses to understand the psychological underpinnings of gamification while *methodologies* ranging from surveys to experimental designs provide the tools to empirically investigate these phenomena.

Our study identifies several promising avenues for future research, categorized into *thematic-specific*, *methodology-specific*, and *factor-specific directions*. These areas highlight the gaps in current literature and suggest paths for deeper exploration to enrich the understanding of gamification's role in sustainable consumption.

5.2 | Key implications

In an era where sustainability has become a global imperative (Lim, 2022b), the intersection of gamification and sustainable consumption presents a novel avenue for fostering sustainability responsible behaviors. This study's insights reveal the multifaceted impact of gamification on encouraging sustainable practices across various domains. In line with Lim and Bowman's (2023) multi-stakeholder approach, the ensuing implications extend far beyond academic discourse, offering actionable strategies for educators and policymakers, industry leaders and practitioners, environmental advocates and non-governmental organizations (NGOs), game designers and technology developers, as well as societal stakeholders committed to the sustainability agenda. As we lay out the key implications of our findings, it becomes evident that gamification holds the potential to transform sustainability from a concept into a lived reality for individuals and communities alike.

For *academic scholars and researchers*, the multifaceted model comprising antecedents, mediators, moderators, controls, and outcomes, along with the identified future research directions, provides a comprehensive framework for academic inquiry. Academic scholars and researchers are encouraged to venture into the underexplored areas highlighted in the study, such as the long-term effects of gamification on sustainable behaviors and the integration of gamification in diverse cultural contexts. This could lead to a deeper understanding of the mechanisms through which gamification influences sustainable consumption and the development of more effective gamified interventions.

For *educators and policymakers*, the theme of gamification for sustainability education underscores the significance of interactive learning environments in promoting environmental awareness and sustainable practices among students. Educators and policymakers should consider integrating gamified elements into curricula and

educational programs to enhance student engagement and learning outcomes related to sustainability. Moreover, the insights gained from the study advocate for policies that support gamification initiatives in educational settings, encouraging the development of sustainable mindsets from a young age.

For *industry leaders and practitioners*, the elucidation of gamification as a potent mechanism to foster sustainable behavioral changes offers practical insights for industry leaders and practitioners. Firms can harness gamified solutions to not only engage consumers in eco-friendly practices but also to build brand loyalty and a sustainable corporate image. Specifically, the thematic areas identified suggest that gamification can be integrated into product design, service offerings, and marketing strategies to encourage environmental stewardship, sustainable living, and workplace sustainability.

For *environmental advocates and NGOs*, the findings related to gamification for environmental sustainability and sustainable tourism offer a novel approach for environmental advocates and NGOs to engage the public in conservation efforts. Using gamified platforms that highlight the impact of individual actions on the environment, these organizations can increase public awareness, foster community involvement, and drive collective action toward environmental goals.

For *game designers and technology developers*, the insights into the pivotal antecedents such as game mechanics, incentives, and user experience offer valuable guidance. These findings highlight the importance of creating engaging, contextually relevant and user-centered gamified applications that resonate with target audiences. Game designers and technology developers should therefore focus on developing features that enhance social connectivity, provide meaningful rewards, and seamlessly integrate sustainability into the user experience.

For *societal stakeholders committed to the sustainability agenda*, the study's outcomes emphasize the potential of gamification to catalyze a societal shift toward more sustainable consumption patterns. Embedding sustainability into everyday activities and choices through gamification is therefore an opportunity to foster a culture of sustainability that transcends individual actions and permeates community norms and values.

The implications of this study therefore extend across various domains and stakeholders, offering actionable insights for academic scholars and researchers, educators and policymakers, industry leaders and practitioners, environmental advocates and NGOs, game designers and technology developers, as well as societal stakeholders committed to the sustainability agenda. Leveraging the power of gamification, these stakeholders can play a pivotal role in advancing sustainable consumption and contributing to the greater goals of environmental conservation, societal progression, and sustainable development.

5.3 | Limitations

Like many SLRs, our review has its limitation, particularly the scope of the review corpus. While we have taken best efforts to cast a wide net by curating the corpus from two of the largest, high-quality databases (Scopus and Web of Science) alongside forward and backward tracing, we concede that our corpus remains limited (e.g., diversity and quality of journals). Heeding the call by Lim et al. (2024), SLR is not a one-off endeavor, and thus, ongoing timely reviews of the field will be necessary. We are optimistic that our review will generate interest in research on gamification for sustainable consumption and that our future directions will be useful to pollinate new research in this space. Therefore, future reviews are highly encouraged. More importantly, as the corpus grows, further scrutiny can be afforded, including but not limited to leading author groups, country and institutional analysis, evolution and trend analysis, as well as meta-analysis of conditions (e.g., gamified app and approach types) that may reveal convergence (similarities) or divergence (differences) across contexts (e.g., consumption cultures and scenarios, product and service types, industries).

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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APPENDIX A

TABLE A1 List of articles on gamification for sustainable consumption.

No.	Author(s)	Year	Article	Journal	Impact factor	Indexing	Citations	Theory	Method	Focus of gamification	Focus of sustainable consumption
1	Johnson et al. (2017)	2017	Gamification and serious games within the domain of domestic energy consumption: A systematic review	Renewable and Sustainable Energy Reviews	15.9	Scopus, SCIE	308	-	Review (systematic)	Serious gaming	Sustainable consumption (energy)
2	Morganti et al. (2017)	2017	Gaming for earth: Serious games and gamification to engage consumers in pro-environmental behaviours for energy efficiency	Energy Research & Social Science	6.7	Scopus, SSCI	246	-	Review (systematic)	Serious gaming	Sustainable consumption (energy)
3	Ro et al. (2017)	2017	Making cool choices for sustainability: Testing the effectiveness of a game-based approach to promoting pro-environmental behaviors	Journal of Environmental Psychology	6.9	Scopus, SSCI	128	-	Quantitative (experimental)	Gamified approach	Pro-environment behavior
4	Rottondi and Verticale (2017)	2017	A privacy-friendly gaming framework in smart electricity and water grids	IEEE Access	3.9	Scopus, SCIE	52	Blockchain model	Quantitative	Gamification framework	Sustainable consumption (energy and water)
5	Al Skaif et al. (2018)	2018	Gamification-based framework for engagement of residential customers in energy applications	Energy Research and Social Science	6.7	Scopus, SSCI	150	Trans-theoretical model	Qualitative	Gamification framework	Sustainable consumption (energy)
6	Berger (2019)	2019	Social norm-based gamification to promote eco-friendly food choice	Journal of Consumer Marketing	2.8	Scopus, SSCI	35		Quantitative (experimental)	Gamification approach	Sustainable consumption (food choice)
7	Gatti et al. (2019)	2019	Education for sustainable development through business simulation games: An exploratory study of sustainability gamification and its effects on students' learning outcomes	Journal of Cleaner Production	11.1	Scopus, SSCI	207	-	Qualitative	Gamified learning	Sustainability education

TABLE A1 (Continued)

No.	Author(s)	Year	Article	Journal	Impact factor	Indexing	Citations	Theory	Method	Focus of gamification	Focus of sustainable consumption
8	Lowensteyn et al. (2019)	2019	The sustainability of a workplace wellness program that incorporates gamification principles: Participant engagement and health benefits after 2 years	American Journal of Health Promotion	2.7	Scopus, SSCI	49	-	Quantitative (experimental)	Organizational gamification	Health and well-being
9	Maltseva et al. (2019)	2019	The challenges of gamifying CSR communication	Corporate Communications	2	Scopus, ESCI	53	Theory of pro-environmental behavior	Quantitative (experimental)	Gamified communication	Socially responsible behavior
10	Romero-Rodriguez et al. (2019)	2019	Gamification in MOOCs: Engagement application test in energy sustainability courses	IEEE Access	3.9	Scopus, SCIE	97	Integrated theoretical gamification model in e-learning environments	Quantitative (experimental)	Gamified learning	Sustainability education
11	Cavada and Rogers (2020)	2020	Serious gaming as a means of facilitating truly smart cities: A narrative review	Behaviour and Information Technology	3.7	Scopus, SSCI	20	-	Review (narrative)	Serious gaming	Smart city
12	Du et al. (2020)	2020	Inducing individuals to engage in a gamified platform for environmental conservation	Industrial Management and Data Systems	5.5	Scopus, SCIE	59	Goal framing theory	Quantitative	Gamified approach	Pro-environment behavior (conservation)
13	Mulcahy et al. (2020)	2020	Designing gamified apps for sustainable consumption: A field study	Journal of Business Research	11.3	Scopus, SSCI	121	-	Quantitative	Gamified apps	Sustainable consumption
14	Oppong-Tawiah et al. (2020)	2020	Developing a gamified mobile application to encourage sustainable energy use in the office	Journal of Business Research	11.3	Scopus, SSCI	100	-	Quantitative	Gamified apps	Sustainable consumption (energy)
15	Souza et al. (2020)	2020	How can gamification contribute to achieve SDGs? Exploring the opportunities and challenges of eco gamification for tourism	Journal of Hospitality and Tourism Technology	4.7	Scopus, SSCI	35	-	Qualitative	Gamified approach	Pro-environment behavior (tourism)

(Continues)

TABLE A1 (Continued)

No.	Author(s)	Year	Article	Journal	Impact factor	Indexing	Citations	Theory	Method	Focus of gamification	Focus of sustainable consumption
16	Douglas and Brauer (2021)	2021	Gamification to prevent climate change: A review of games and apps for sustainability	Current Opinion in Psychology	5.9	Scopus, SSCI	115	-	Review (narrative)	Gamified approach	Climate change engagement
17	Fernández Galeote et al. (2021)	2021	Gamification for climate change engagement: Review of corpus and future agenda	Environmental Research Letters	6.7	Scopus, SCIE	54	-	Review (systematic)	Gamified approach	Climate change engagement
18	Mandujano et al. (2021)	2021	Gamification of backcasting for sustainability: The development of the gameful backcasting framework (GAMEBACK)	Journal of Cleaner Production	11.1	Scopus, SSCI	24	Self-determination theory	Qualitative	Gamified approach	Sustainable consumption
19	Hsu and Chen (2021)	2021	Advocating recycling and encouraging environmentally friendly habits through gamification: An empirical investigation	Technology in Society	9.2	Scopus, SSCI	40	Expectation–confirmation model	Quantitative	Gamified approach	Pro-environment behavior
20	Li and Chu (2021)	2021	Exploring the effects of gamification pedagogy on children's reading: A mixed-method study on academic performance, reading-related mentality and behaviors, and sustainability	British Journal of Educational Technology	6.6	Scopus, SSCI	81	Self-determination theory	Qualitative and quantitative (experimental)	Gamified learning	Sustainability education
21	Mulcahy et al. (2021)	2021	"Game on!" Pushing consumer buttons to change sustainable behavior: A gamification field study	European Journal of Marketing	5.18	Scopus, SSCI	28	-	Quantitative	Serious gaming	Sustainable practices
22	Pietrapertosa et al. (2021)	2021	An educational awareness program to reduce energy consumption in schools	Journal of Cleaner Production	11.1	Scopus, SCIE	46	-	Quantitative (experimental)	Gamified learning	Sustainable consumption (energy)
23	Prakash and Manchanda (2021)	2021	Designing a comprehensive gamification model and pertinence in	Cogent Business and Management	3	Scopus, ESCI	18	Attitudes-behaviors corrective model of attitude, elaboration likelihood model, Fogg	Review (systematic)	Organizational gamification	Sustainable practices

TABLE A1 (Continued)

No.	Author(s)	Year	Article	Journal	Impact factor	Indexing	Citations	Theory	Method	Focus of gamification	Focus of sustainable consumption
			organisational context to achieve sustainability					behavior model, mechanics dynamics emotional framework, Octalysis framework, trans-theoretical model			
24	Whittaker, Mulcahy, and Russell-Bennett (2021)	2021	'Go with the flow' for gamification and sustainability marketing	International Journal of Information Management	21	Scopus, SSCI	105	Affect-as-information theory	Quantitative	Gamified approach	Sustainability marketing
25	Whittaker, Russell-Bennett, and Mulcahy (2021)	2021	Reward-based or meaningful gaming? A field study on game mechanics and serious games for sustainability	Psychology & Marketing	6.7	Scopus, SSCI	26	Hierarchy-of-effects framework	Quantitative	Serious gaming	Sustainable practices
26	Berger et al. (2022)	2022	A digital push with real impact—Mapping effective digital nudging elements to contexts to promote environmentally sustainable behavior	Journal of Cleaner Production	11.1	Scopus, SCIE	10	Grounded theory	Review (systematic)	Gamified approach	Sustainable practices
27	Chen et al. (2022)	2022	Research on the impact of pro-environment game and guilt on environmentally sustainable behaviour	International Journal of Environmental Research and Public Health	5.4 (CiteScore)	Scopus	1	Self-determination theory	Quantitative	Gamified approach	Pro-environment behavior
28	Frías-Jamilena et al. (2022)	2022	Gamified environmental interpretation as a strategy for improving tourist behavior in support of sustainable tourism: The moderating role of psychological distance	Tourism Management	12.7	Scopus, SSCI	26	Self-determination theory, theory of planned behavior	Quantitative (experimental)	Gamified approach	Pro-environment behavior (tourism)
29	Hoffmann and Pfeiffer (2022)	2022	Gameful learning for a more sustainable world – Measuring the effect of design elements on long-term learning outcomes in correct waste sorting	Business & Information Systems Engineering	7.9	Scopus, SCIE	10	-	Quantitative (experimental)	Gamified learning	Waste management

(Continues)

TABLE A1 (Continued)

No.	Author(s)	Year	Article	Journal	Impact factor	Indexing	Citations	Theory	Method	Focus of gamification	Focus of sustainable consumption
30	Musyaffi et al. (2022)	2022	Game-based learning sustainability during social distance: The role of gamification quality	European Journal of Educational Research	3.0 (CiteScore)	Scopus	6	Technology acceptance model	Quantitative	Gamified learning	Sustainability education
31	Papamichael et al. (2022)	2022	Unified waste metrics: A gamified tool in next-generation strategic planning	Science of the Total Environment	9.8	Scopus, SCIE	37	-	Quantitative	Gamified approach	Waste management
32	Stephens (2022)	2022	A review of gamified approaches to encouraging eco-driving	Frontiers in Psychology	3.8	Scopus, SSCI	5	-	Review (systematic)	Gamified approach	Eco-driving
33	Souza and Marques (2022)	2022	Factors influencing urban tourists' receptivity to eco gamified applications: A study on transports and mobility	International Journal of Tourism Cities	2.6	Scopus, ESCI	4	-	Qualitative	Gamified approach	Eco-mobility
34	Aguiar-Castillo et al. (2023)	2023	Gamification and proenvironmental performance: Could tourists return home with more sustainable habits?	Journal of Hospitality and Tourism Technology	4.7	Scopus, SSCI	1	-	Quantitative	Gamified approach	Pro-environment behavior (tourism)
35	Agusdinata et al. (2023)	2023	A playful approach to household sustainability: Results from a pilot study on resource consumption	Simulation & Gaming	2	Scopus, ESCI	1	-	Quantitative	Gamified approach	Sustainable consumption (household)
36	Behl et al. (2023)	2023	Gamification as an innovation: A tool to improve organizational marketing performance and sustainability of international firms	International Marketing Review	5	Scopus, SSCI	5	Theory of administrative behavior, theory of organizational creativity	Quantitative	Organizational gamification	Sustainability marketing
37	Mylonas et al. (2023)	2023	Playful interventions for sustainability awareness in educational environments: A longitudinal, large-scale study in three countries	International Journal of Child-Computer Interaction	6.8 (CiteScore)	Scopus	6	-	Quantitative (experimental)	Gamified learning	Sustainability education

TABLE A1 (Continued)

No.	Author(s)	Year	Article	Journal	Impact factor	Indexing	Citations	Theory	Method	Focus of gamification	Focus of sustainable consumption
38	Paneru and Tarigan (2023)	2023	Reviewing the impacts of smart energy applications on energy behaviours in Norwegian households	Renewable and Sustainable Energy Reviews	15.9	Scopus, SCIE	5	-	Review (critical)	Gamified approach	Sustainable consumption (energy)
39	Shahzad et al. (2023)		Impact of gamification on green consumption behavior integrating technological awareness, motivation, enjoyment and virtual CSR	Scientific Reports	4.6	Scopus, SSCI	3	Self-determination theory	Quantitative	Gamified approach	Sustainable consumption
40	Vorobeva et al. (2023)	2023	Leveraging technology for waste sustainability: Understanding the adoption of a new waste management system	Sustainable Environment Research	4.9	Scopus, SCIE	0	Unified theory of acceptance and use of technology	Quantitative	Gamified approach	Waste management
41	Zafar et al. (2024)	2024	Gamification and sustainable development: Role of gamified learning in sustainable purchasing	Technological Forecasting and Social Change	12	Scopus, SSCI	0	Behavioral reasoning theory	Quantitative	Gamified learning	Sustainable purchasing