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GAMIFICATION AS A CATALYST TO THE CIRCULAR ECONOMY

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Introduction

Economic models of production, coordination, and consumption that are based on circularity have been postulated to remedy many of the ills of economic activity that are detrimental to the environment and all beings in the biosphere, and, more holistically to economic, social, and cultural interactions among individuals and communities (Ellen McArthur Foundation, 2021; Hamari et al., 2016; Kirchherr et al., 2017; McDonough & Braungart, 2002). However, several barriers have stopped or slowed down cyclical economic models from being adopted and integrated across different value networks (Ghisellini et al., 2016; Jaeger & Upadhyay, 2020; Ritzén & Ölundh Sandström, 2017). Changing the methods in how economic activity is coordinated on a global market requires a global will, and while cemented practices cause major friction, so does a lack of human awareness, motivation, engagement, and attitudes for shifting towards more sustainable models of economic coordination where the design of processes, products, services, (re)use, repurposing, repairing, access, and sharing of resources, both tangible and intangible, is maximised.

It has been widely postulated that motivational information systems, and chiefly gamification, are able to transform many of the systems, services, and practices towards being able to bring about similar positive experiences, motivation, and attitudinal shifts witnessed in the context of games and game culture (Hamari, 2019). The main inspiration of this development, games, has been shown to bring about cognitive, emotional, social, and motivational benefits; the premise of the use of gamification is based on the ability to translate these benefits to positive changes in motivations, attitudes, and behaviours towards a sustainable praxis. While gamification has been extensively applied and researched throughout several domains of human activities (Koivisto & Hamari, 2019a) such as in education (Majuri et al., 2018; Nah et al., 2014), health care (Johnson et al., 2016; Koivisto & Hamari, 2019b), consumption (Guillen et al., 2021), governance and citizen engagement (Buheji, 2019; Hassan & Hamari, 2019), mobility (Köse et al., 2019; Morschheuser et al., 2019), business development and enterprise systems (Humlung & Hadara, 2019; Raftopoulos et al., 2015), and workplaces (Riar et al., 2021; Warmelink et al., 2020), its research and application have been growing perhaps slower in the context of cyclical models of

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economic coordination, which albeit would hold insurmountable impact potential on net sustainability and resilience.

It is also relevant to highlight that the design and application of games and game-like affordances entails processes where critical thinking skills are honed, while also enabling a sense of responsibility and learning (Kafai & Burke, 2015) as part of an experiential, innovation-oriented, collaborative process, just as the ones needed for the circular economy (CE) to happen. Disciplines such as citizen science (Kimura et al., 2021; Milburn & Wills, 2021), collaborative design methods (Kolpondinos & Glinz, 2020), and even policy design (Kim & Nam, 2022) present examples of how gamification plays a relevant role for the execution of their processes, ultimately providing insights that can facilitate the application of gamification across different areas and activities of the CE. Building upon the learning on sustainability-related communication strategies (Guillen Mandujano et al., 2021), it is possible to identify how gamification, as a catalyst to CE, can be considered both a tool and an approach.

As a tool, gamification is a way to generate a particular understanding of CE. Through games and gamification conveying knowledge and sensitizing, a specific topic can be fun and engaging (Hamari et al., 2016; Sailer & Homner, 2020). Further, research shows that game-like and playful design can foster creativity (Arnab et al., 2019), thus it can bring about circular-oriented innovation, defined as a combination of product design, business model, and value networks that operationalise CE strategies connecting the expertise from upstream and downstream actors to develop a circular-oriented value model (Brown et al., 2021). Roth et al. (2015) explore the ways in which the forms and functions of gamification bring together different actors and stimulate creativity for business model innovation and design thinking processes, such as ideation, creation of products, services, and corporate identities. Moreover, facilitating a value-based understanding of CE is necessary for integrating the still missing human dimension in the CE needed to tackle the existing top-down policy measures inhibiting self-organisation and local, autonomous efforts to go beyond today's market and income-centred approaches on which current CE strategies are cemented (Schröder et al., 2020).

As an approach, gamification strategies are about CE, enabling actions for CE to happen and addressing some of the critical challenges related to the generation of value through circularity. Gamification can engage behavioural change as a mediation model (Nivedhitha & Manzoor, 2020), providing performance feedback, and intrinsically motivating individuals and organisations through challenges and incentives. For example, realising or even visualising life cycle–related risks and rewards in terms of individual actions and accountability can serve as a means to incentivise collaboration through reflective and adaptive actions. Ultimately, these actions lead to habit formation, effecting awareness, decisions, and preferences, such as consumption choices (i.e., water) (Gregory & Di Leo, 2006), or other activities that range from recycling (Kasioumi, 2021) to the creation of entire ecosystems of alternative markets via collaborative schemes (Botsman & Rogers, 2011). Despite these possible favourable outcomes, there seems to be a lack of overarching understanding and overview in terms of how and in what phases of CE gamification can be applied and which sustainability goals are incorporated.

To address some of these shortcomings, this study focuses on the following three questions: 1) How is gamification discussed in existing CE literature? 2) What kind of gamification approaches have been taken and studied across the different facets of CE? 3) What are the potential areas for further application of gamification in relation to CE? We will investigate what kinds of results the current literature corpus holds, as well as derive future avenues for both research and practice in the application and study of gamification in CE.

Review procedure

To draw an overview of the state-of-the-art research on gamification in the CE context, we conducted a systematic literature review (SLR). This review method is particularly useful to systematically and explicitly identify, aggregate, evaluate, and synthesise "the existing body of completed and recorded work produced by researchers, scholars, and practitioners" (Fink, 2019, p. 3). SLRs enable researchers to grasp emerging phenomena in their broader scale, to flesh out conclusions of the research corpus existing in academic publications by comparing individual qualitative and quantitative findings, and to derive conclusions based on the generated overview both to inform practice and to produce new knowledge in the field of research (Moher et al., 2009; Petticrew & Roberts, 2006; Ridley, 2012).

Depending on their objectives, SLRs can present a summary of knowledge, aggregate data from empirical studies, build an explanation, or present a critical assessment of existing literature (Templier & Paré, 2015). The present review mainly falls into the categories of knowledge summarisation and critical appraisal, as it maps the existing literature on the topics of gamification of and for the CE while providing an overview of how both fields of research (gamification and the circular economy) are intertwined and have been studied in previous research. According to Victor (2008, p. 1), a systematic literature review follows transparent and rigorous processes, thoroughly covering the literature and emphasising the quality of the included evidence to take a systematic approach to synthesise the data. We created a comprehensive analytical framework that facilitated coding the information according to the approach to the CE and gamification strategies and characteristics explored.

The coding process

Besides elements to classify the articles according to their type of publication, the domain of study, objective, and type of action where gamification to catalyse the CE was presented (i.e., project, prototype, tool, etc.), we focused on analysing the aspects related to the CE and gamification. The former is structured according to the elements of sustainable circular business models (Antikinen & Valkokari, 2016; Lewandowski, 2016; Smith-Gillespie, 2018), allowing to highlight the approach to circularity explored in the documents. Additionally, we included the areas of education, policy-making, and organisational change for and stemming from CE, which are also relevant for catalysing the CE. Table 16.1 explains these elements.

For the latter (gamification aspects), our review follows a conceptualisation of gamification in the extant literature and separates between three areas: 1) the design of the gamification approach implemented, 2) the sought-after or investigated psychological outcomes of gamification, and 3) the sought-after or investigated behavioural outcomes of gamification (Koivisto & Hamari, 2019a).

Data collection

To ensure the clarity of the results and the rigour of the literature search process (Pare et al., 2015), we used SCOPUS as our primary database since it has one of the most extensive coverage and accuracy in citation counts accessible worldwide. The literature search took place on 9 November 2021, using the query: TITLE-ABS-KEY (gamif* AND ("repair" OR "recycling" OR "remake" OR "re-make" OR "re-condition" OR ("circular" AND "Econ*") OR ("sharing" AND "Econ*") OR ("resource" AND "recovery") OR ("circular" AND "sourcing") OR ("co-product" AND "recovery"))) (ALL (gamif*) AND TITLE-ABS-KEY (("repair" OR "recycling"

Table 16.1 Components for catalysing the CE

Component	*Description*	
Education	Drawing from similarities with Education for Sustainable Development (ESD), education for CE prepares learners for transdisciplinary challenges by encouraging holistic, systems thinking – including boundaries, internal and external influences, causality, complexity, and multi-stakeholder perspectives. When using games, it entails active experimentation and concrete experience (Whalen et al., 2018).	
Policy-making	Policy instruments and mechanisms that, for instance, decouple resource dependencies, facilitating resilience to external shocks while respecting nature and people's health. The focus is on policies that enable the existence of services, production, and commercialisation of goods designed to last longer, that are easier to reuse, repair, and recycle, and that incorporate as much recycled material as possible instead of primary raw material. These measures include restricting single-use, tackling premature obsolescence, and banning the destruction of unsold goods (European Commission, 2022, n.d.).	
Organisational change	Defined as a continuous process aiming at renewing the capabilities, direction, and structure of an organisation (Moran & Brightman, 2000), these processes aim at overcoming the challenges related to introducing the CE in an organisation, such as restructuring and rebuilding systems and processes of societal acceptance, effectiveness, supporting infrastructure, multi-stakeholder involvement, technological, and operational actors (Sarja et al., 2021).	
Design	Besides considering the environmental aspects at all stages of the product development process, the act of striving for products that make the lowest possible environmental impact throughout the product life cycle – also known as eco-design. Design for CE also integrates the economic and environmental value of materials by looping them back in the system, lengthening their life, and keeping them in the economic system. Design for CE entails preventing and reversing obsolescence at the product and component level (design for integrity) and preventing and reversing obsolescence at a material level (design for recycling).	
Production patterns*	Sourcing	Sourcing recycled or renewable materials that can be returned to either the technical or biological cycle.
	Recovery	Residual/secondary outputs from one process (or value chain) become inputs for another process (or value chain).
	Remake	Manufacturing steps acting on an end-of-life part or product to return it to like-new or better performance, with a warranty to match.
	Recondition	Fixing of a fault/aesthetic improvement of a product, but with no new/additional warranty on the entire product. Includes repair and refurbishment.
Use**	Access	Providing end users with access to the functionality of products/assets, instead of ownership.
	Performance	Focus on guaranteed performance level or outcome based on the functionality of a product/asset. Typically provided as a product-service bundle.
End of cycle (in literature also presented as end-of-life)	Recovery (upcycling, downcycling)	Materials or products at end-of-cycle are incorporated into different products or used as feedstock/inputs for another process (or value chain).
	Recycling	Relevant component to prevent resource waste, it is an alternative to landfill disposal that sometimes downgrades the material and could be very energy intensive.

Notes

* Adapted from the Circular Economy Business Models guideline produced by the European-funded project "From linear to circular project R2Pi"

** This includes sharing and collaborative economies. The sharing economy presents an alternative to individual ownership, giving participants access to products and services through different economic arrangements such as flea markets, secondhand shops, and garage sales (Botsman & Rogers, 2011; Hamari et al., 2016).

OR "remake" OR "re-make" OR "re-condition" OR ("circular" AND econ*") OR ("sharing" AND "econ*") OR ("resource" AND "recovery") OR ("circular" AND "sourcing") OR ("co-product") AND "recovery")))

Besides the identifiers of author, title, year, and keywords, both author and index, the fields also included the language of origin, document type, and publication stage; this facilitated the removal of publications in other languages than English and for the selection of peer-reviewed conference papers, journal articles, reviews, book chapters, and articles in press. Moreover, the terms related to different processes of the CE were also introduced to identify literature that, without explicitly talking about the CE, brought about relevant information on how gamification contributes to the particular aspect of CE. The term 'gamif*' was used to cover all entries with the verb gamify or noun gamification.

Data selection

All the selected papers were analysed author-centrically and concept-centrically (Watson & Webster, 2022). The former comprised predefined units of analysis that were corroborated and coded for each manuscript. The concept-centric approach helped to facilitate the creation of frequency tables, which helps describe the landscape of research about gamification as a catalyst for the circular economy.

Once the database was completed, the chapter authors, who represented an interdisciplinary team with different backgrounds, first performed individual reviews to be compared and discussed with the others during group meetings. To reduce bias, the reviewers coded the same number of articles at the same time; therefore, any existing disagreement was discussed among the four researchers to reach a consensual coding (Hill et al., 1997). Figure 16.1 illustrates the process followed to consolidate the database and commence the analysis of content.

Gamification and circular economy: Findings and discussion

Landscape

The initial database was comprised of 82 documents, of which 46 publications were excluded following our assessment criteria. Four documents were discarded because they were duplicate entries, 26 papers were not related to either the CE or/and gamification, 13 were introductions to proceedings, 2 entries referred to full books, and 1 of the articles was not written in English. This exclusion reduced the final pool of considered literature for our review to 36 papers. Of the remaining papers, 13 were journal articles, 20 were conference proceedings, 1 was a book chapter, and 2 consisted of lecture notes. We noted that most of the papers were presented at conferences; this implies that this topic of interest is still relatively new. Most publications were from 2021, with 10 of them already available by the time of our search. One paper was already marked for publication in the year 2022, presenting a clear growth of research in this field.

When it comes to fields of research, the most predominant was education with nine publications, followed by human-computer interaction and information systems (with seven and five papers respectively). Twelve of the analysed papers presented preliminary work or concepts under development.

The research presented in the reviewed publications seems to pursue similar objectives, mainly promoting recycling behaviours, with thirty-one papers explicitly looking into "sustainable behaviours". Twenty-two of these papers feature recycling-related actions while three analyse

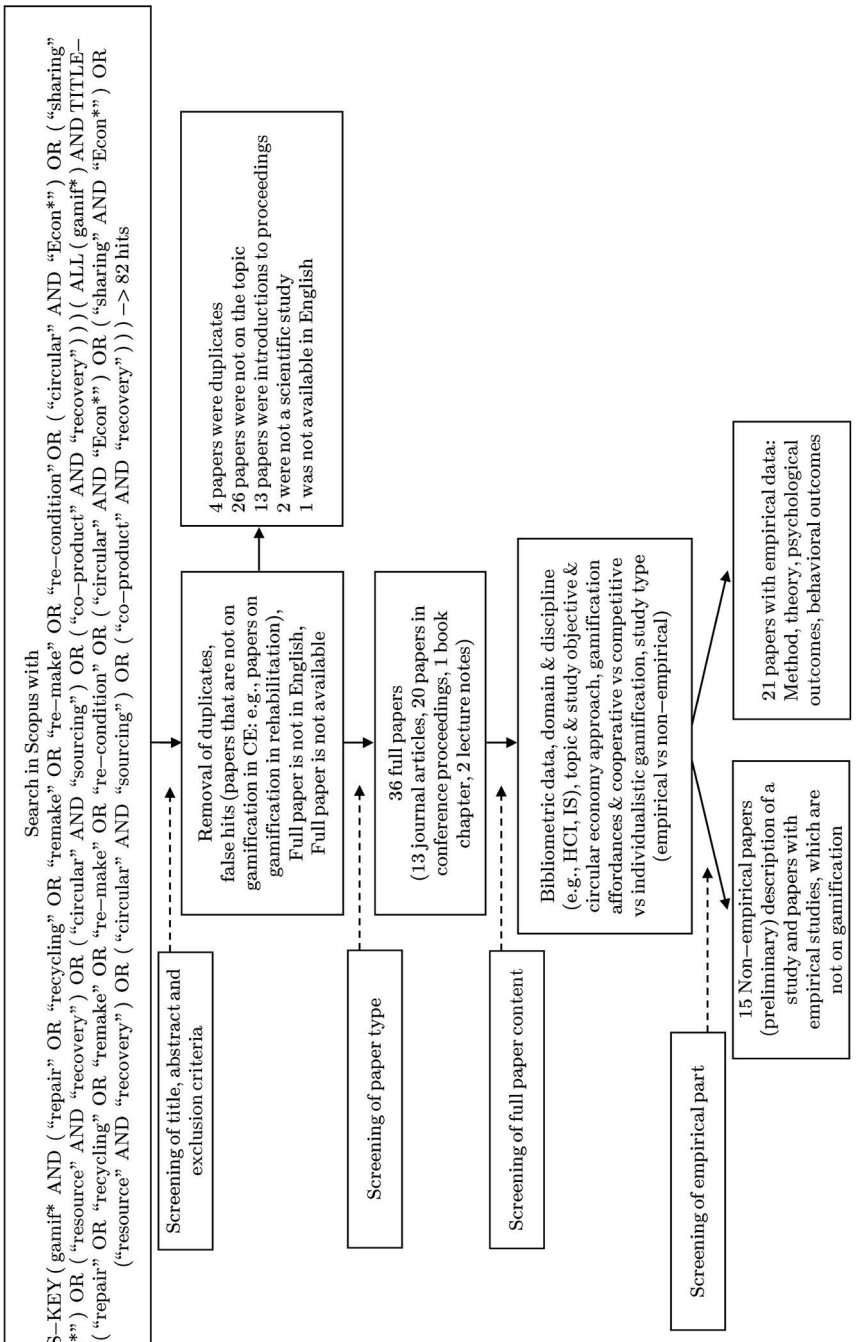

Figure 16.1 Database consolidation and analytical process.

Table 16.2 Publications per CE phase

CE Phase	*Articles*	*Total*
Design	Gera & Hasdell, 2020; Helmefalk & Rosenlund, 2020; Kragić Kok et al., 2020	3
Production	Jääskä et al., 2021; Kragić Kok et al., 2020; Whitaker, 2021	3
Use	Akasaki et al., 2016; Gera & Hasdell, 2020; Kragić Kok et al., 2020; Morschheuser et al., 2019; Pasca et al., 2020; Prabowo et al., 2019; Shevchuk et al., 2019; Tan et al., 2017; Tomé Klock et al., 2021	9
End-of-life (end-of-cycle)	Aguiar-Castillo et al., 2018, 2019; Berengueres et al., 2013; Cheng et al., 2020; Comber et al., 2013; del Campo et al., 2018; Delnevo et al., 2021; Ekundayo et al., 2022; Gibovic & Bikfalvi, 2021; Gizzi et al., 2019; González-Briones et al., 2019; Helmefalk & Rosenlund, 2020; Hsu & Chen, 2021; Keivanpour, 2021; Kragić Kok et al., 2020, Leitão et al., 2022; Lessel et al., 2015; Naskova, 2017; Ponis, 2021; Santti et al., 2020; Shevchuk et al., 2019; Sreelakshmi et al., 2015; Stengos et al., 2019	23

behaviours in different aspects of the collaborative economy, such as the use of sharing solutions or motivations to partake in crowdsourcing. There were also four papers related to recycling; they had little to no mention of CE. Most of these papers included process optimisation (i.e., via artificial intelligence or sensor application) as their focus.

Zooming into the different stages of the CE, the articles were distributed as shown in Table 16.2. It is relevant to note that some publications touched upon several phases of CE.

In general, most studies reported behavioural outcomes related to the end-of-life stage, having recycling as the objective of implementing gamification. Use was the second most addressed stage of CE, equally presented in terms of access or performance, as these publications investigated different elements of the sharing economy, particularly studying collaborative consumption platforms (Gera & Hasdell, 2020; Prabowo et al., 2019). Also, a total of nine articles presented games, six of them still in their prototype and testing stages. Of these nine games, two were presented as serious games, while one was described as a simulation. All but two of the papers presenting games reviewed recycling.

Regarding the type of study, 83% of the papers reported empirical research, 36% were nonempirical, and 5.5% were not determined, mainly because they were reporting work in progress. Of the papers presented, 30% had experimentation as its primary research method, often linked to surveys or interviews; 25% of the papers analysed reported mixed methods. Systematic reviews featured in 15% of the papers, whereas case studies and other types of studies (i.e., idea proposals) represented 22% of the sample; 11% of the documents did not report a specific method.

The strong presence of empirical studies allowed us to identify some of the most applied theories across the field. While 22 documents did not report a particular theory, 5 of them emphasised Self-Determination Theory, followed by Flow Theory, and the Technology Acceptance Model (TAM) (3 mentions each), and to a lesser degree, theories of experiential learning and social learning (1 document).

Gamification applied in CE research

Considering that gamification elements (affordances) are implemented to a system or service with the purpose of evoking psychological and behavioural outcomes within a certain context (Koivisto & Hamari, 2019), gamification design conveys meeting individual motivational needs

Table 16.3 Affordances per publication

Type of affordance	*Articles*	*Total*
Points	Aguiar-Castillo et al., 2018; Aguiar-Castillo et al., 2019; del Campo et al., 2018; Ekundayo et al., 2022; Gera & Hasdell, 2020; Helmefalk & Rosenlund, 2020; Jääskä et al., 2021; Kragić Koc et al., 2020; Leitão et al., 2022; Lessel et al., 2015; Prabowo et al., 2019; Shevchuk et al., 2019; Santti et al., 2020	13
Leaderboards	Akazaki et al., 2016; Ekundayo et al., 2022; Helmefalk & Rosenlund, 2020; Jääskä et al., 2021; Santti et al., 2020; Shevchuk et al., 2019; Stengos et al., 2019	7
Badges	Akazaki et al., 2016; Cheng et al., 2020; Ekundayo et al., 2022; Gera & Hasdell, 2020; Jääskä et al., 2021; Leitão et al., 2022; Shevchuk et al., 2019	7
Levels	Cheng et al., 2020; Gera & Hasdell, 2020; Jääskä et al., 2021; Sreelakshmi et al., 2015	4

in varying contexts influenced by factors and situations where the gamified system is being used. Therefore, we identified the most used affordances to map out existing evidence about the gamification elements chosen in the context of the CE, and if possible, to identify the reasons behind these choices. After all, one of the objectives of applying gamification is to transfer motivational effects into different environments, building upon systems that support the users towards a specific behaviour or activity (Koivisto & Hamari, 2019).

The reviewed body of literature presents diverse concepts of using gamification in CE. Point-giving is the most used reward system (13 documents), followed by leaderboards (7 documents), badges (7 documents), and level counts (4 documents). Table 16.3 illustrates these publications. Some of the non-point/badge awards include suggestions for physical rewards, most of them monetary (Santti et al., 2020; Shevchuk et al., 2019) and even penalisation (Gonzáles-Briones et al., 2019). This finding leads to several questions about the motivations behind engaging in actions for CE. For example, the potential economic value that recycling conveys, despite its limitations in facilitating the circulation of materials, seems to be one of the main appeals for companies engaging in end-of-life cycle activities (Ranta et al., 2018). The papers analysed reveal that the same notion seems to hold for individual households. However, 'pro-environmental behaviours' are intrinsically motivated because individuals are aware of their responsibility and the impact of their actions, for example, when using apps designed for activities such as recycling (D'Arco & Marino, 2022). Therefore, it is relevant to question why the strong reliance on extrinsic reward structures, as these can be counterproductive as well (Aguiar-Castillo et al., 2019), thus calling for gamification designs that reinforce intrinsic motivation, giving more meaning to the action itself than receiving additional rewards.

Mostly we encountered the application of games as educational tools, with 67% of the papers focusing on end-of-life activities; of these papers, 92% investigate recycling, and the other 8% are about product recovery. All these games were presented as prototypes or in the initial stages of their implementation. Four studies (del Campo et al., 2018; González-Briones et al., 2019; Ponis, 2021; Stengos et al., 2019) propose applying gamification in combination with Internet of Things (IoT) technology. Specifically, these studies propose using gamification in relation to waste management, from marine littering control (Ponis, 2021; Stengos et al., 2019) to waste management simulations (González-Briones et al., 2019; Jääskä et al., 2021). The proposed solutions involve the use of sensors to capture the amount and increase of waste in waste disposal containers by which users are credited for having used the recycling container (del Campo et al.,

2018; González-Briones et al., 2019). Two studies propose the involvement of government or city councils, where gamification is understood as a form of subsidising or penalising users with an increase or decrease in the rate of garbage tax imposed by the local government (del Campo et al., 2018; González-Briones et al., 2019). One paper (Silva et al., 2021) brings forward the issue of how gamification enables reflexivity to connect CE organisational actions with local contexts and stakeholders, giving gamification an instrumental role in communication and trust building. In four of the papers analysed (Aguiar-Castillo et al., 2018; Gera & Hasdell, 2020; Kelly et al., 2020; Prabowo et al., 2019), the latter relays one of the main psychological outcomes of introducing gamification to platforms and activities promoting the CE. Despite being a minority, the studies presenting gamification as a tool that shared similar objectives: improving the participation in collaborative schemes via online platforms, where gamification also helps to generate pride and the perception of added value to the users, like the case of 'superhosts' for Airbnb (Gera & Hasdell, 2020). What these studies highlight are the relationships between service providers and users, in some cases even presenting opportunities for co-creation and customisation.

While most of the papers aim at motivating user participation, attitude change also features as one of the desired outcomes to influence the formation of new habits, even though in some instances, attitude change is not even needed for shifting behaviours (Ro et al., 2017), because the users may only need support for turning their existing awareness into tangible actions. However, the issue of awareness was brought up only by six of the studies. It can be argued that more research is needed to identify existing needs and opportunities to bridge the current gaps between awareness and the strategies to engage in activities that facilitate CE. Quite possibly the need is about raising awareness in the first place; for example, widening the designers' and developers' understanding that, in addition to recycling, end-of-life alternatives include options like reducing or reusing via upcycling or downcycling.

When it comes to mechanics, most papers presented competitive (15) and individualistic (14) approaches. Cooperative designs were present in 7 publications while only 3 of them had inter-team possibilities. Only one example (Santti et al., 2020) presents the four approaches; in addition, there is only one paper presenting an individualistic, cooperative, and competitive design (Jääskä et al., 2021) meaning that while individuals play on their own, they can also form groups to play together and compete against other groups. It is worth noting that most of the cases presented in the analysed papers seem to emphasise the skills that users can gain by engaging in CE activities rather than by having an emotional involvement. This situation could be because of the prevalence of gamified approaches that examine resource management tasks, leaving a void for games in other areas (Scurati et al., 2020). Most of the papers reported the results of very small samples comparing gamification features (i.e., Aguiar-Castillo et al., 2018; Akazaki et al., 2016; Leitão et al., 2022), opening the floor to follow-up questions concerning issues such as the outgrowth of the studies, or what the outcomes would be when applied on a larger population. Only one of these publications presents a preliminary analysis in 2018 expanded through an empirical study with the specific target group of tourists in 2019 (Aguiar-Castillo et al., 2019). Moreover, a question that lingers is: what kinds of messages are being communicated through the game mechanics applied?

Figure 16.2 summarises the objective of gamification in the context of the CE as analysed in the systemic literature review.

Gamification in relation to transition management

CE catalysts should investigate facilitating the transition that different societal actors must go through to make CE happen. Therefore, we took Loorbach's Transition Management Cycle

Figure 16.2 Visualisation of the most addressed topics in the analysed literature.

(TMC), a "governance typology used to develop systemic instrument and process strategies" (Loorbach & Wijsman, 2013) as a reference to further analyse the implications that the findings of this literature review entail for implementing gamification as a CE catalyst. This framework was originally developed to contextualise actors' behaviour in societal transitions and has also been applied to business transition management analyses with the understanding that current sustainability problems are persistent and require systemic changes (Loorbach & Wijsman, 2013). The TMC has four types of governance activities, as Figure 16.3 presents.

By analysing the objectives for implementing gamification in relation to CE, our study intends to depict the TMC elements that are identified in our systemic literature search as currently being explored and to point out further opportunities to facilitate transitions towards CE through gamification.

Of the studied papers, 25% presented activities of an operational nature, reporting the results of experiments and prototypes with the intention of supporting everyday decisions; eight of these papers also presented reflective actions as part of the studies' objectives. Five of the publications were both operational and tactical, and four were operational with strategic actions.

The second most present activities had a reflexive nature (16 papers); most of these papers are literature reviews or studies meant to analyse the effects of applying gamification in certain

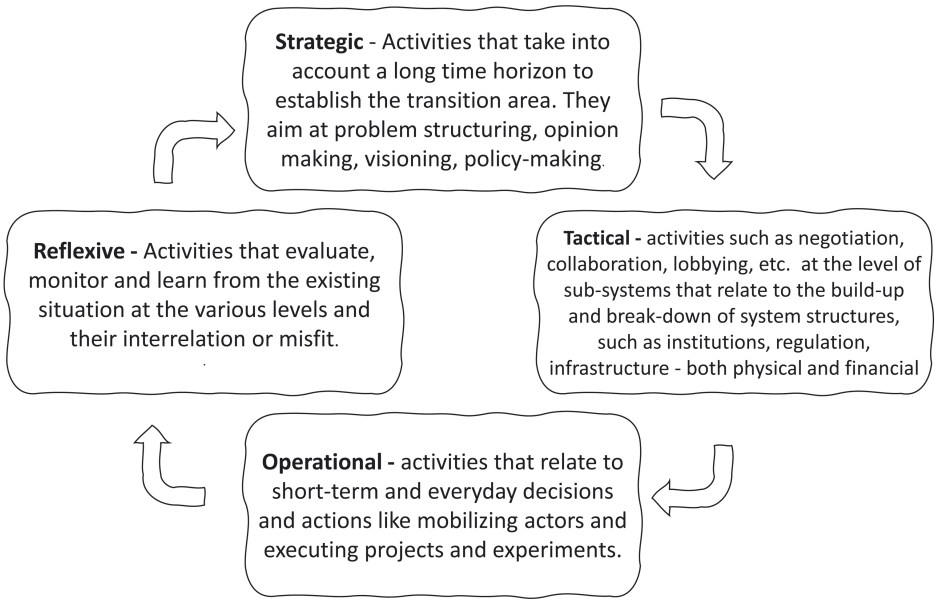

Figure 16.3 The transition management cycle.
Source: Loorbach, 2007; Loorbach & Wijsman, 2013.

contexts, mainly recycling and use-related activities (both access and performance). Two of these papers also present strategic objectives, whereas only one reports gamification as a form of tactical activity for CE transitions, namely communication (Silva et al., 2021). Strategic and tactical actions featured in almost the same number of papers (eight and seven, respectively) and normally in combination with operational and reflexive activities, as detailed previously.

Figure 16.4 presents the TMC types the papers addressed in relation to the encountered CE phases and the expected impact area of gamification as a CE catalyst. There is a strong

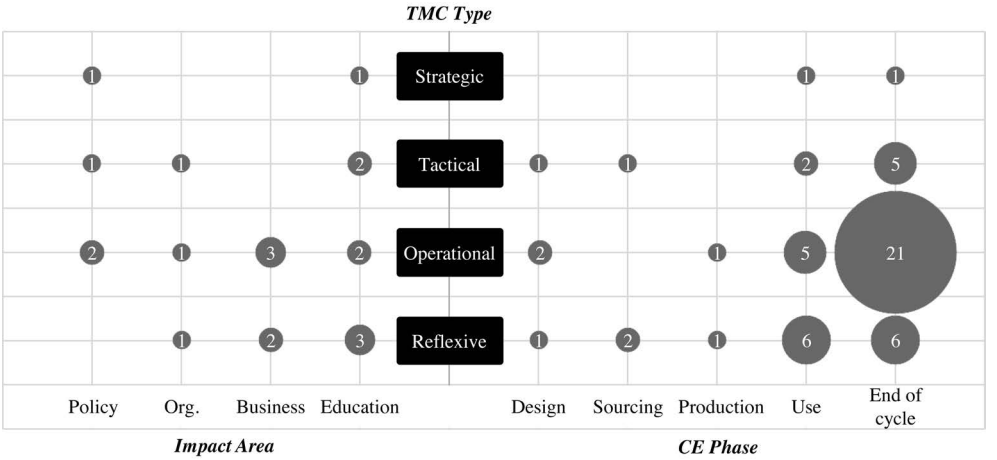

Figure 16.4 TMC type concerning impact area of gamification and CE phase.

predominance of operational papers, particularly among those studying topics related to end-of-life cycle activities. It is important to note that Figure 16.4 only depicts the papers where the impact area (policy, organisational change, business development, and education) is a core part of the study. The papers where the impact area is marginally mentioned as a potential beneficiary or as a background argument are not included in the graph. This visualisation shows how none of the papers that reflect a strategic approach to transition management apply gamification for organisational change or business processes, as most of the papers are concerned with applying gamification for education or policy-making. This is quite a significant finding, as businesses and organisations should have processes to manage their transitions to the CE; however, the evidence of this study indicates that none of them are using gamification as part of their CE execution, a potentially missed opportunity considering the existing evidence of gamification applications. Another interesting observation is that papers that have business development at their core are also lacking gamified tactical activities to support their CE transition processes.

Gamification in relation to the United Nations Sustainable Development Goals

While there is no doubt that the United Nations Sustainable Development Goal 12 (United Nations, n.d.), responsible consumption and production, is the one that closely attains a CE, the goal is barely mentioned in the literature. This is noteworthy because 24 publications address the topic of waste management with 22 papers featuring recycling as its main objective, thus directly contributing to Target 12.5: "By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse" (United Nations, n.d.). The other goals that feature quite clearly in the literature studied are Goal 6 – Ensure access to clean water and sanitation – (Kragić Kok et al., 2020) and Goals 14 and 15 – life below water and life on land respectively – (Ponis, 2021; Stengos et al., 2019), as these papers talk about the problematics of sea littering and the opportunities to tackle the problem. These studies present a technology-oriented approach to the regenerative eco-innovation notion (restore, renew, and revitalise natural systems), which is often linked to CE. There seems to be a lack of perspective on the social and collective potentials of gamification encountered in the present study is in accord with indications of previous broader-scale gamification reviews (e.g., Koivisto & Hamari, 2019; Riar, 2020). Some relevant exceptions to this trait highlight the relevance of having access to proper infrastructure that facilitates "deep civil deliberation in global and multi-regional debates" (Whitaker, 2021), the need for a "critical mass" for the success of sharing platforms (Gera & Hasdell, 2020), and the importance of collaborative elements to increase the willingness to use crowdsourcing platforms (Morschheuser et al., 2019).

Gamification in relation to CE in different domains and sectors

Gamification concerning the policy-making domain presented a skewed picture, as gamification is presented as a tool that facilitates some aspects of the circular economy, with only a few mentions of policy-makers being the beneficiaries of these processes rather than their enablers (Gibovic & Bikfalvi, 2021; Tomé Klock et al., 2021). Of the six papers that touch upon policy implications, three do so as part of the papers' background (Aguiar-Castillo, 2018; Naskova, 2017; Stengos et al., 2019) and only 1 had policy-making at the core, as it is about a system motivating citizen participation through the application of garbage tax reductions (González-Briones et al., 2019), an action that only local governments can undertake.

A similar situation appeared regarding organisational change, except for two publications that presented gamification as a means to enable organisational change (Prabowo et al., 2019; Tomé

Klock et al., 2021), the other three publications that touched upon organisational change presented it as an area of potential application (Kelly et al., 2020; Gera & Hasdell, 2020; del Campo et al., 2018).

Despite being the most relevant topic for education, with nine publications addressing it, business development was also marginally present as a contextual element (Aguiar-Castillo, 2018; Morschheuser et al., 2016; Naskova, 2017; Pasca et al., 2020; Prabowo et al., 2019;) but not as the focus of the study as such. Of the four publications that had business development as a focal cornerstone, gamification was presented as an educational tool to teach about project management and entrepreneurial applications (Jääskä et al., 2021); with two papers analysing the business implications of gamifying CE, mainly from the business model perspective (Gibovic & Bikfalvi, 2021) and a product-service perspective (Hsu & Chen, 2021; Tan et al., 2017).

It is worth noting that the gamification strategies, and even the games presented in the studies analysed in this review, present a picture of open possibilities to explore the CE as a system, encompassing emotional elements with technological possibilities, shifting the ways that we perceive the interactions between individuals, nature, and societies. In this vein, it is also relevant to highlight that the analysed literature unequivocally presented gamification in a positive light, emphasising its potential for engaging individuals and facilitating the implementation of different processes. However, it is important to remember that gamification is a design approach that leads to ethical concerns due to its primary objective of affecting individual psychological states and behaviour (Thibault & Hamari, 2021). Therefore, designers, policy-makers, managers, educators, and all stakeholders involved in developing gamified strategies for whatever purpose – the CE in this case – should bear in mind issues ranging from transparency for data management to potential psychological harm.

The way forward

Although there is no doubt that games, and to some extent gamification, are playing a role in different fields of study and action of CE, what this systemic literature review and analysis highlighted is the need to further explore other aspects of circularity than end-of-cycle recycling approaches. There is also a need for more empirical evidence to present the practical challenges for researchers, designers, practitioners, policy-makers, and industry that gamifying CE might help to overcome.

In practice

When it comes to the expected areas of impact of implementing gamification towards circularity, we found extensive focus on education and recycling, while there is little to no evidence about the intention to contribute to policy-making or business development, a situation that reflects the current criticism of the lack of action in the implementation of policies towards circularity, for example in the European Union where "there is a dichotomy between the EU discourse – talk – and EU policies – actions – on the CE […] EU *talk* is in the optimist and holistic framing of Reformist Circular Society discourses, while EU *action* falls within the segmented and optimist typology of technocentric CE discourses" (Calisto Friant et al., 2021). To portray different approaches to CE, it is necessary to confront existing notions of what these processes are for in the first place.

A similar situation appears in relation to organisational change processes. While literature reveals that firms transitioning or transforming themselves to the CE need changes in their strategies, capabilities, and organisational structures (Chizaryfard et al., 2021), there is an information void about the role that gamification plays – or could play – for these purposes. It is worth

highlighting that this finding applies solely to gamifying organisational change for the CE, as literature related to gamifying organisational change is a growing field of research (Alexandrova & Rapanotti, 2020; Deterding, 2019; Jacob et al., 2022; Krath et al., 2022; Morschheuser et al., 2022) and can serve as a reference for organisations transitioning towards more circular processes.

Another future research avenue this study found relevant and necessary is the potential of gamifying communication of, for, and about CE. While evidence of the effects of gamifying communication processes is still in an early stage and mainly applied for internal processes or corporate social responsibility programs (i.e., Maltseva et al., 2019), current research points to increasing efficiency and understanding of the topics at hand, such as project management (Muszyńska, 2020). In the case of CE, gamifying may help to address some of the ambiguity around current discourses related to the topic (Rödl et al., 2022).

This literature review showed how the convergence towards a CE may also depend on an effective combination of gamification with contemporary technologies, such as IoT. While some of the reviewed studies point toward promising ideas for using IoT (González-Briones et al., 2019; Stengos et al., 2019), there are further technological trends that can be relevant for accomplishing sustainable practices such as big data, blockchain, artificial intelligence, augmented reality (AR), and virtual reality (VR) (Demestichas & Daskalakis, 2020). For example, gamification could be used in combination with artificial intelligence with the prospect of creating smarter gamified sustainability apps and intelligent virtual characters that may assist users with accomplishing sustainability goals.

Another technological trend topic that is gaining attention for its potential to establish cost-effective and sustainable solutions is the use of immersive technologies. AR and VR can be utilised to create virtual environments or simulate processes and ideas, which can prevent the use and waste of physical resources. AR/VR can be used in diverse stages within the supply chain, such as in e-procurement (Korbel et al., 2022) or at the factory level (Rocca et al., 2020), as well as by consumers as a try-on technology (Riar, Xi et al., 2022), resulting in critical environmental benefits such as reducing returns of articles due to prior virtual trying and by avoiding a build-and-waste culture. While these and similar technological trends have taken a foothold across several domains, attempts to understand if and how these technologies can be afforded with gamification to produce unique advantages for a CE system remain unassuming. Therefore, future research should explore the potential of using gamification in combination with contemporary technologies in CE practices.

Implementing gamification or any other approach to circularity also requires a thorough understanding of social and economic contexts, presenting a systemic picture where experimentation plays an important role. Practitioners and designers must be aware of the consequences of both the intended and the unintended gamification strategies they implement in their activities, particularly the impacts that may occur in the mid and long term. This also means that not all gamification design interventions pose crowning solutions in all circumstances. Rather, it is necessary to shed more light on where and especially how gamification should be employed. The analysed studies present different views on CE, showing both the complexity of the topic and the challenges of providing holistic gamification strategies. Yet, it is possible to decide on the mechanics that designers and practitioners believe can meet the objectives of the task at hand and incorporate elements for potential follow-up. The choice of gamification affordances and strategies may challenge conceptions of 'business as usual,' taking the users (and potentially the designers) out of their comfort zone and presenting a picture of limited scientific ambition. For example, the gamification mechanics portrayed in most of the studies – competition, individualism, and the pursuit of efficiency – are the defining characteristics of the classical economy that the CE challenges. The findings of this review

accentuate that, currently, there seems to be uncertainty in terms of how gamification should be applied and towards what underlying motivational sentiment (e.g., extrinsic or intrinsic, collectivistic or individualistic, etc.) for the promotion of a positive demeanour towards CE practice. For example, open questions remain to what degree gamification should be used to motivate individuals on an extrinsic or intrinsic level. Interestingly, several studies (i.e., Aguiar-Castillo et al., 2019; Helmefalk & Rosenlund, 2020; Shevchuk et al., 2019) propose gamification to provide tangible rewards, such as prizes that can be redeemed for collected points, or even approaches to subsidise tax payments as a reward structure for sustainable behaviour, thereby opting for extrinsic motivational routes. However, sustainable behaviour may be an inherently intrinsic-driven behaviour and gamification has established itself as an approach that can tap into the intrinsic motivation of people (Xi & Hamari, 2019) and even eliciting altruistic sentiment (Riar et al., 2020, Riar et al., 2023). One study within the reviewed body of literature indicated that the expectation of prizes could be counterproductive (Aguiar-Castillo et al., 2019), thus extrinsic rewards may be perceived negatively by individuals that engage in sustainable behaviour for intrinsic reasons. Empirical investigations into possible negative side effects and more holistically, how different oriented design options prompt engagement in CE action based on extrinsic and intrinsic motivation remain modest. Therefore, future research should empirically investigate and compare the effectiveness of gamification design interventions that address extrinsic and intrinsic reward structures, as well as a combination of both, to shed light on which doctrine is more favourable for accomplishing sustainable behaviour. Moreover, cooperative mechanics remain far behind individualistic and competitive mechanics when it comes to the proposed design options. As discussed previously, sustainable behaviour and efforts to create a CE are a global endeavour that requires communication, communal awareness, and the mobilisation of society as a collective. However, the underrepresentation of studies that use gamification to motivate collective efforts in the realm of CE is striking and requires more attention in future research.

In enquiry

While research about gamification and innovation continuously shows examples of team spirit, consensus building, creative thinking, productivity, knowledge transfer, and engagement, particularly for new product development and market integration (Patrício et al., 2018), it is noteworthy that most of the reviewed studies did not draw on a particular theory to investigate gamification as a catalyst to CE. This is staggering, considering that solid theoretical groundwork is indispensable to our understanding of how gamification may give rise to diverse cognitive and affective outcomes that can ultimately result in a desirable behaviour. Depending on the theme, the future scientific enquiry ought to find it appropriate to draw on theories of need satisfaction (Xi & Hamari, 2019), theories of collective intentionality (Morschheuser et al., 2017; Riar, Morschheuser et al., 2022), as well as on personality-related concepts, and reinforcement theories that consider both the effects of reward, and punishment structures, and that have previously been considered in the context of sustainable behaviour (Bergmann et al., 2017). These are only a few examples, and more diversity in terms of conceptual exploration is necessary to move the field forward in understanding how gamification can motivate engagement in CE action based on theoretically sound assumptions.

Considering that the CE represents a systemic innovation leading to transitions at all levels (Kirchherr et al., 2017), change processes within organisations, public institutions, and even interactions with consumers must be planned and managed. Gamification has long been recognised as an approach to simplify management processes, as it enables higher participation, interaction,

knowledge generation, and utilisation of resources (Markopoulos et al., 2017; Perryer et al., 2016). Therefore, gamification's potential to catalyse the CE across organisations and public institutions is an opportunity worth analysing and developing further. The literature review also pointed to the emergence of another function of gamification: communicating the concept of CE (Silva et al., 2021). The fact that only one study approached this topic shows a relevant research avenue as communication lies at the heart of any transition process, such as the ones required for catalysing the CE.

Most of the reviewed papers seem to have a narrow focus to the present sustainability challenges and themes. Besides the lack of systemic approaches to the issue of CE, when it comes to the big picture of sustainability, the ethics of using gamified approaches or implementing gamification as a tool is another notable absence from the overall discourse presented by the studies. Although sustainability and CE are a series of global efforts that require collective actions, most gamification design interventions focus on individuals and households, which somewhat neglects social components that could motivate people to form and achieve sustainability goals collectively. The absence of the United Nations Agenda 2030 across the reviewed literature also opened several questions about how research on CE is contextualised, from general framing: why is the Agenda 2030 largely underrepresented in the current research that aims to contribute to sustainable development through CE? To the expected impact that these studies (particularly the ones presenting prototypes) want to achieve, are they considering the transition dynamics from linear to circular models? In what ways are these studies portraying potential trade-offs when switching from 'as usual' behaviours to circular ones? To harness the potential of gamification about and of the CE, there is a need to be pragmatic, acknowledging existing and potential limitations to create holistic, coherent, and interdisciplinary strategies. In the context of open innovation, research on gamification is scarce. It has been studied mainly from the perspective of facilitating ideation or the inflow of ideas to the firm by involving key stakeholders such as customers, consumers, and other communities and ideation platforms through crowdsourcing or co-creation (Morschheuser et al., 2017; Stieglitz et al., 2017). The results of this study also highlight a strong tendency to rely on technology-driven approaches to facilitate CE, therefore, to develop these interdisciplinary strategies, gamification scholars and designers could explore other approaches, such as bringing the elements of the IPAT equation into their co-creative endeavours. The IPAT expresses I (environmental impact) as a function of P (Population), A (Affluence), and T (Technology) (Zhang et al., 2018) therefore, providing a wider context to where and how gamified CE strategies could take place, whether entirely facilitated by the T or not. Although the formula has been the subject of much debate (Holdren, 2018), it provides a basis for considering several other factors that impact and can result from transitioning to circularity. In general, drawing from gamified experiences in collaborative design methods, citizen science, and policy design can help broaden the horizon to address some of the identified shortcomings. This study shows the potential to strengthen multi-stakeholder, playful, catalytic actions that can bring us closer to CE.

Conclusions

This systemic literature review revealed a strong tendency towards applying gamification as an approach to motivate recycling behaviours. Among this line of study, there seems to be a consensus on the strategies that facilitate understanding the core concepts of recycling while not necessarily explaining this activity as one of the various elements that comprise the CE nor presenting some of the most critical issues related to recycling, like energy intensity and CO_2 emissions needed for these processes. Moreover, within this group of studies, games are presented as a

series of educational tools with little to no relevance for raising awareness or communicating a bigger picture of the CE beyond one or two elements of the CE.

The application of two analytical frameworks for reviewing existing literature on gamification and the CE led to an unpacking of the intention, dynamics, and potential impact of applying gamification to the CE, creating awareness about existing gaps in the field as well as clear avenues for further action. For example, it is an invitation to explore opportunities such as introducing the IPAT equation in CE and design implementation processes to consider the population and affluence elements of CE, not only the technology and environmental impact. Gamification can play a relevant role as a strategic tool to facilitate the inclusion of these two elements throughout the development and deployment of solutions.

Although gamification is shown to gain or strengthen skills, the lack of elements that tap into emotional aspects related to individual agency, for example, the recognition that one is contributing to a circular process, leaves room for further exploring the possibilities that gamified approaches can bring. This is particularly relevant to overcoming the pitfalls that using gamification for repetitive resource management tasks, as is currently the case, may convey. Transitioning from a linear to a CE is a joint, progressive effort that requires decision-making and adoption of new habits and practices at all levels; if properly designed and applied, gamification as a catalyst of the CE has the potential to support the efforts along this journey.

This systematic literature review of 36 documents allowed for the development of an overview of how gamification is presented in academic work related to CE. Figure 16.5 shows a summary of these findings, comprising the results associated with research (theories explored, types of study), implications for application in other domains (Sustainable Development Goals, transition management), and potential avenues of practice and enquiry to pursue to maximise the potential that gamification conveys as a catalyst for CE.

Educational content

Research about the role of gamification as a catalyst for CE is full steam ahead. Our findings point to several avenues that researchers and practitioners can take. Bearing these in mind, this chapter poses the following reflective questions to its readers:

- What kind of gamification approaches could be designed and adopted in different scenarios of CE?
- What motivational forces both enable and disable CE, and what type of gamification may help catalyse them effectively, and for whom and in what contexts of CE?
- What tensions exist between different enablers and disablers of CE (e.g., economic, environmental, technological, societal, cultural) and how can gamification be differently incorporated in alleviating them?
- In what ways can CE business models be gamified?
- Why and how can gamification become an enabler of participatory policy-making processes?

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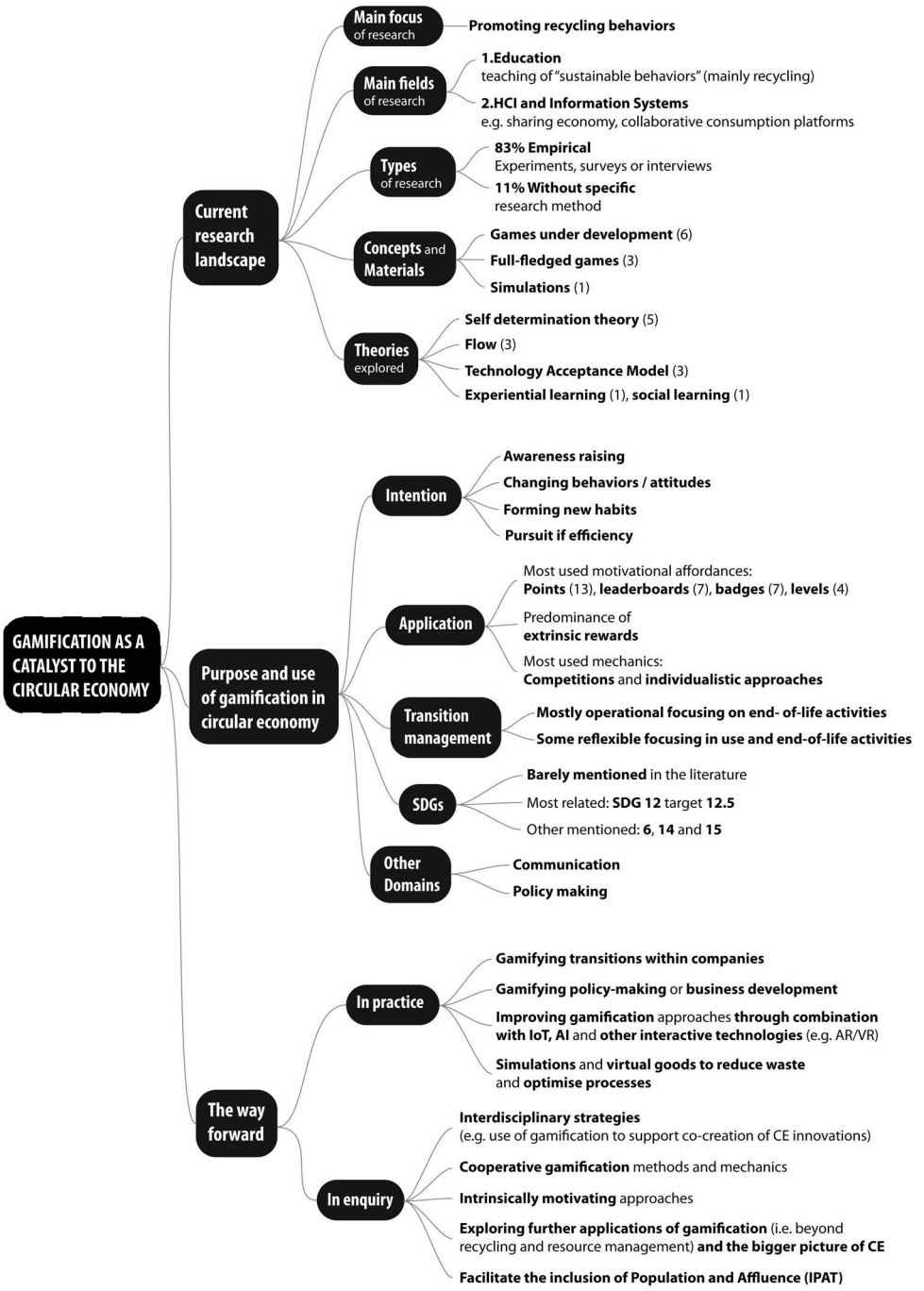

Figure 16.5 Graphic summary of the chapter.

Source: The authors.

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