June 2024

Gamification and Knowledge Sharing: A Meta-Analytic Review

Hairui Tang
Tampere University, hairui.tang@tuni.fi

Nannan Xi
Tampere University, nannan.xi@tuni.fi

Xinyi Yang
Tampere University, xinyi.yang@tuni.fi

Juho Hamari
Tampere University, juho.hamari@tuni.fi

GAMIFICATION AND KNOWLEDGE-SHARING: A META-ANALYTIC REVIEW

Completed Research Paper

Hairui Tang, Tampere University, Tampere, Finland, hairui.tang@tuni.fi
Nannan Xi, Tampere University, Tampere, Finland, nannan.xi@tuni.fi
Xinyi Yang, Tampere University, Tampere, Finland, xinyi.yang@tuni.fi
Juho Hamari, Tampere University, Tampere, Finland, juho.hamari@tuni.fi

Abstract

As a typical motivational information system, gamification has been given high expectation regarding facilitating knowledge management, and especially sharing motivation and behaviors. However, there is no consensus on the effects of gamification on knowledge-sharing due to conflicting views supported by the existing empirical evidence. It is still unclear under what circumstances gamification can effectively enhance knowledge-sharing, e.g., the forms of gamification, purposes of employing gamification, and where gamification is used. To address these gaps, we conducted a meta-analysis of a body of literature (25 studies) that empirically examined the effects of three primary forms of gamification on knowledge-sharing across two types of platforms (public vs. organization). The findings reveal that compared to achievement and social-related gamification, immersion-related gamification can enhance both the quality and quantity of knowledge contribution. Notably, organizational platforms temper gamification's influence on knowledge-sharing quantity, but amplify its effect on knowledge-sharing quality compared to public platforms.

Keywords: Gamification, Persuasive information system, Knowledge-sharing, Meta-analysis.

1 Introduction

The pursuit of effective knowledge and information management has long been a strategic objective for diverse entities, including firms, organizations, governments, and society as a whole, especially in the digital age of information. Traditional approaches to promote knowledge sharing have encompassed mentorship programs, training and development initiatives, and knowledge repositories, among other things. However, practitioners and managers have long been troubled by the challenge of motivating and engaging users to contribute knowledge and exchange information. In the past decades, organizations and firms have explored various ways to establish and nurture organizational learning systems and knowledge management processes, and to encourage their members to actively share work-related knowledge, aiming to enhance their competitive advantage. For example, the IBM internal social networking platform known as IBM Connections, implemented badges and points to encourage employees to share expertise, participate in discussions, and assist colleagues in solving problems. Such a practice involving the use of game design elements and digital nudges in the non-game context is called ‘gamification’ (Deterding et al., 2011). Similar attempts can also be observed on external public platforms, represented by online knowledge sharing communities such as GitHub (open-source software knowledge platform), Quora (public knowledge Q&A community), and Reddit (interests and hobbies community). For example, users earn reputation points for their contributions, which enhance their status/levels/titles within the community and unlock new privileges. In contrast to traditional incentive mechanisms, those approaches have shown potential in reducing social barriers to participation,

optimizing time investments, and minimizing monetary expenditures. Nevertheless, we still lack comprehensive knowledge about which design elements can effectively promote knowledge contribution and which cannot, as well as which ones can encourage users to contribute more and higher-quality information. But for platform developers and organization managers, gamification undoubtedly increases development costs and may potentially overwhelm users with information overload, consequently diminishing their user experience.

Researchers have attempted to tackle the practical challenge of meticulously understanding the role of gamification in knowledge sharing through empirical evidence and theoretical explorations. Yet the inconsistent results from studies mainly focusing on isolated game elements have further complicated our comprehension of the effectiveness of gamification which prompts the requirement for developing a more holistic view. Furthermore, gamification has been examined in knowledge management for different purposes, such as influencing the amount of knowledge dissemination (Chen et al., 2019) and uncovering the meaningfulness and intrinsic value of knowledge (Suh et al., 2022). There is a concern that these purposes related to quantity and quality are contradictory. Therefore, an important research gap exists regarding *how different gamification practices would differently affect knowledge sharing quantity and quality*. In addition to the potential variations in the effectiveness of gamification in knowledge management due to differences in purposes, contextual factors may also play a role as it is associated with the characteristics of the overall user base. Taking the game element progress graph as an example: On one hand, it can foster a sense of achievement and motivate members in the organizational network to contribute high-quality knowledge within the workplace (Oliveira and Kang, 2021); while on the other hand, it may cause the users to excessively prioritize growth speed while overlooking the quality of the shared knowledge in public platforms in which users are not familiar with each other (Petter et al., 2020). Such a difference may be led by the different degrees of relationship or connection between individuals within a social network – originating from an internal organization or public platform. Thus, the other important research gap pertains to *whether the effect of gamification on knowledge-sharing varies across different network types* (organizational vs. public platforms).

To address these gaps, mathematical meta-analysis of the previous literature is considered as the best approach, as it can allow us to discuss various gamification elements and quantify their effects on promoting knowledge-sharing across different platforms. Therefore, by conducting a meta-analytic review of 25 studies, in this study, we empirically examine the effects of three primary forms of gamification on knowledge-sharing (immersion-based, achievement-based, and social-based) across two main types of platforms (public vs. organizational) representing different patterns of social connections.

2 Background

2.1 Gamification

The research on gamification has evolved over the past decade since the term ‘gamification’ was first defined in 2011 by Deterding et al. The comprehension of gamification has progressively deepened and broadened, transitioning from regarding it as ‘the use of game design elements in non-game contexts’ (Deterding et al., 2011) to encompass systems or services that provide a game-like experience (Koivisto and Hamari, 2019). Hamari (2019) provided the definition of gamification from a broader perspective in that ‘it refers to technological, economic, cultural, and societal developments in which reality is becoming more gameful, and thus to a greater extent can afford the accruing of skills, motivational benefits, creativity, playfulness, engagement, and overall positive growth and happiness.’

Gamification has been studied in the form of gamification features or affordances under the theoretical framework of S (Stimuli)-O (Organism)-R (Response). As the gamification features evolved from game design elements and have been implemented in services, platforms and systems, the early classifications of gamification often draw on game design principles, including MDA (Mechanics, Dynamics and Aesthetics), DMC (Dynamics, Mechanisms and Components) (Werbach and Hunter, 2012), and Octalysis framework (Chou, 2020). In order to synthesize gamification research from an information

system perspective, Koivisto and Hamari (2019) conducted a systematic literature review of 819 relevant studies and identified the three main categories including achievement/progression-related, social-related, and immersion-related features, which were also subsequently empirically examined by Xi and Hamari (2019) by referring to the theories related to self-determination and player types. From the perspective of understanding how gamification satisfies users' needs, this classification approach is rooted in user-intrinsic motivation drivers rather than design aspects. It holds practical significance as it enables the design and implementation of gamification strategies tailored to individual preferences and organizational objectives. Thus, the adoption of this classification method represents a logical choice, aligning with both theoretical frameworks and practical management considerations.

The achievement-features are defined as features which provide users with challenging situations and a sense of enjoyment toward achieving particular goals (Xi and Hamari, 2019; Bauer et al., 2020), mainly including badges, tasks, points, leaderboards, ranking, performance graphs, etc. The immersion-related features are defined as features which immerse and keep users engaged in enjoyable self-directed activities (Xi and Hamari, 2019; Syrjälä et al., 2020; Pandey et al., 2023), mainly including mechanics such as avatars, storytelling, roleplay, etc. Finally, the social-related features are defined as features which build a social environment and enable users' social interaction (Jang et al., 2018; Xi and Hamari, 2019), mainly including team, group, competition, etc. The utilization of diverse indicators of achievement or advancement is typically the predominant method for incorporating gamification into activities. The second most prevalent approach involves the inclusion of social elements in various manifestations. While various immersion-related features such as the incorporation of narratives, avatars and virtual worlds were present, they were not as widely adopted as achievement-related and social-related features (Koivisto and Hamari, 2019; Xi and Hamari, 2019; Cheng et al., 2023; Luarn et al., 2023).

2.2 Gamification and knowledge-sharing

As one of the most important and typical motivational information systems, gamification has been believed to drive motivation (Sailer et al., 2017), facilitate information and knowledge processing (Suh and Wagner, 2017), and lead to behavioral changes (Xi and Hamari, 2019). Traditional approaches often relied on top-down knowledge dissemination, formalized training programs, and hierarchical information systems. While well-intentioned, these methods have frequently struggled to motivate individuals to engage in the active and impactful knowledge sharing required in our interconnected world. In some cases, they have even led to resistance or disengagement among participants (Hammedi et al., 2021). Empirical evidence has shown that gamification can satisfy the basic psychological needs of achievement, social relatedness and autonomy, and is therefore believed to enhance individuals' motivation to share knowledge.

Within the limited amount of literature, gamification has been investigated to influence knowledge contribution, co-innovation, or value co-creation (Barile et al., 2020; Qian et al., 2022). Among the outputs of knowledge sharing, quantity and quality are commonly used and seen as important in existing literature. At the same time, measuring knowledge-sharing behaviors directly (quantity and quality) provides actionable insights for practitioners and policymakers, which enables organizations or platforms to design targeted interventions to improve knowledge-sharing practices. Therefore, this study mainly focuses on the quantity and quality of knowledge-sharing behaviors, and bridges the gap between theoretical frameworks and empirical observations, enhancing our understanding of how gamification impacts knowledge sharing.

In scholarly literature, the efficacy of gamification has been elucidated through a variety of theoretical perspectives. A widely accepted explanation of the effectiveness of gamification is rooted in self-determination theory (SDT) (Deci and Ryan, 1985). Individuals are motivated by three basic needs: autonomy, competence, and relatedness (Ryan and Connell, 1989). Autonomy pertains to the inclination to exert influence over one's own actions and choices, competence relates to the aspiration to experience capability and efficacy in one's endeavors, and relatedness encompasses the yearning to experience a sense of connection and appreciation from others. Gamification can be a powerful tool for enhancing

motivation by addressing these basic needs, while knowledge-sharing behavior is likely to be intrinsically stimulated in a way similar to helping others and performing prosocial behavior, instead of motivating by rewards and pressure (extrinsic motivation) (Van Den Hooff and De Ridder, 2004). Specifically, achievement-related features (e.g., badges, levels) could provide users with a sense of enjoyment towards achieving knowledge sharing goals, social related features (e.g., social networking, cooperation) provide relatedness with others when users share knowledge, and immersion-related features (e.g., game world, avatar) keep users engaged in self-directed knowledge sharing behaviors. Due to their ability to trigger different psychological motivations, achievement-related, social-related, and immersion-related features may cause different effects on the quality and quantity of knowledge sharing. For instance, achievement-related features may primarily impact the quantity rather than the quality of knowledge sharing, whereas social-related features are more likely to enhance the quality of knowledge sharing but may not significantly affect the quantity (Oliveira and Kang, 2021). Additionally, there exists a constraint of the existing body of literature that the majority of studies have only examined the correlation between a limited number of gamification features, and either the volume or caliber of knowledge contribution. Therefore, we should develop a comprehensive understanding of how gamification features might differentially influence sharing in knowledge management, based on a more granular examination.

2.3 The moderating effects of platform type

Knowledge contributors' motivation can be influenced not only by intrinsic drivers stemming from gamification elements, but also by the nature of their relationship with knowledge receivers, particularly the frequency and proximity of interactions. Researchers have observed the emergence of relationships among users within platforms, and have explored the effect of established social network dynamics in the realm of information management (Abubakar et al., 2019; Hock-Doepgen et al., 2021) Social network theory explains the difference in information spread through different social networks (McKenna et al., 2002; Hock-Doepgen et al., 2021). Specifically, in hierarchical organizational structures characterized by strong emotional bonds and close relationships, information exchange tends to be redundant yet effective, facilitated by shared backgrounds and a trust among individuals, while in decentralized digital networks where individuals are not closely associated, weak ties facilitate access to diverse and non-redundant information with unverified quality (Constant et al., 1996).

Therefore, we consider the organizational knowledge-sharing platform as a strong tie social network where users share knowledge with colleagues or someone they are familiar with, while we consider the public online knowledge-sharing platform as a weak tie social network platform where users share knowledge with strangers. According to social network theory, a public platform allows individuals to reach beyond their immediate social circle and expand their knowledge network (McKenna et al., 2002), so that individuals can gain more perspectives and ideas, and then increase their knowledge-sharing intention. In addition, strong ties are characterized by higher levels of trust, reciprocity, and shared experiences (McKenna et al., 2002). As a result, individuals may be more invested in maintaining and improving the quality of their interactions through strong ties. Following this logic, we would expect platforms to have a moderating effect on gamification for knowledge-sharing.

3 Method

3.1 Search and selection

To address the practical and research gaps indicated in the introduction and background section, we conducted a meta-analytic review of the relevant and qualified literature related to gamification and knowledge-sharing. The meta-analytic review method offers a highly precise approach to quantifying the effectiveness of gamification in promoting knowledge-sharing, encompassing diverse theoretical approaches and study contexts to providing a comprehensive and robust evaluation of the relationship. This research adheres to the Reporting Items for *Preferred Systematic Reviews and Meta-Analyses*

(PRISMA guidelines for conducting a systematic literature review and documenting the screening process: Page et al., 2021). This process entails refining research questions or objectives, and delineating the extent of the search. It involves conducting literature searches in databases, checking the searched results, dropping irrelevant papers, and synthesizing results from the literature.

The *Scopus* database was chosen as the primary database because it is globally recognized as the largest abstract and citation database, covering more than 20,000 peer-reviewed journals across various fields (including Elsevier, Emerald, Inderscience, Informs, Springer, Taylor and Francis, Wiley publications). Known for its thoroughness, Scopus ensures a detailed examination of worldwide research output (Baas et al., 2020). Purposeful selection enhances the study's reproducibility and aligns with the principles of systematic review, emphasizing transparency, clarity and rigor in the search strategy (Paré et al., 2016). The database's reliability, extensive coverage, and recognition as a standard source in specific research areas highlight its crucial role in this comprehensive literature review.

The initial step involved the identification of pertinent literature for the meta-analysis through a comprehensive systematic literature search conducted in December 2022. Subsequently, we identified relevant literature for any material containing original analysis and findings such as journal articles, book chapters and conference papers. To prevent the inclusion of redundant effect sizes, our analysis was based on datasets. It is important to note that certain papers may analyze multiple distinct datasets, while some datasets may be discussed in more than one paper – for instance, where an empirical study may be included in a conference version and also a journal paper (Cavusoglu et al, 2015; Cavusoglu et al 2021). A visual representation of the search process is provided in Figure 1.

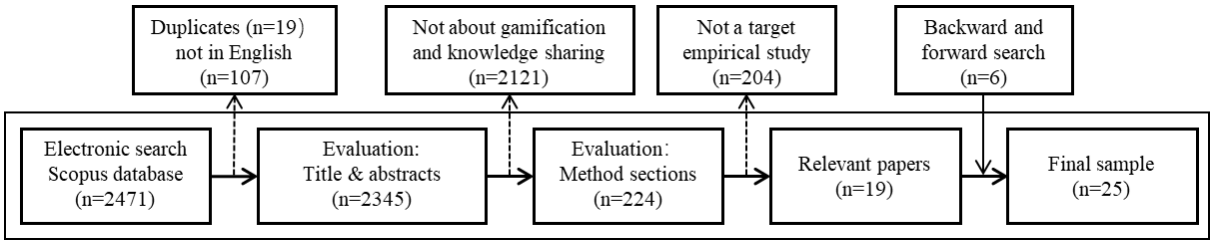

Figure 1. Flowchart visualization of system search process.

An initial broad search string was formulated: TITLE-ABS-KEY (gamif* OR game* AND NOT "game theory") AND TITLE-ABS-KEY ("knowledge shar*" OR "knowledge co-creat*" OR "knowledge contribut*" OR "knowledge exchang*" OR "knowledge interact*" OR "knowledge transfer*" OR "knowledge diffusion" OR "knowledge dissemination" OR "knowledge provi*" OR "information shar*" OR "information co-creat*" OR "information contribut*" OR "information exchang*" OR "information interact*" OR "information transfer*" OR "information diffusion" OR "information dissemination" OR "information provi*" OR "knowledge distribut*" OR "information distribut*"). This specific string of keywords was utilized to perform an extensive search within the electronic database Scopus, without imposing any limitations on the publication dates of the papers. The search criteria included title-abstract-keyword searches, and was restricted to peer-reviewed research published in journals, conferences, and book chapters. The dataset obtained from the initial search comprised 2,471 scholarly articles that were published from 1969 to December 2022.

To effectively classify the search records, all papers were systematically managed using Excel and EndNote. Two doctoral students employed a two-stage identification process to retrieve all papers intended for inclusion in our meta-analysis. Initially, they scrutinized the titles and abstracts of 2345 papers to ascertain their potential relevance for the study, focusing specifically on papers describing the impact of gamification on knowledge-sharing. To be considered relevant, a paper had to address the correlation between (a) at least one form of gamification and (b) at least one contribution to knowledge. This process involved excluding papers that discussed games in a conceptual context related to "game-related community" or "game design" rather than the "utilization of game elements in non-entertainment contexts". Many of the papers identified as games were actually related to game theory or sports games. Furthermore, several papers primarily discussed knowledge acquisition, education, and training (e.g.,

Stasewitsch and Kauffeld, 2022; Allal-Chérif et al., 2022), which were subsequently excluded after a thorough review of their abstracts. Following the initial screening process, a shortlist of 224 potentially relevant papers on gamification and knowledge-sharing remained.

Second, a thorough examination of 224 papers was conducted to determine their eligibility for inclusion in the meta-analysis. The objective was to identify relevant experimental research on gamification's impact on knowledge-sharing, allowing for a comparison of effects across studies. Papers were required to meet two specific criteria for consideration: (a) they had to report on an empirical study, and (b) the study must have empirically investigated the effects of gamification on quality or quantity of knowledge-sharing. Definitions of these outcomes and moderator variables are provided in Table 1. Following comprehensive forward and backward searching, the systematic review process yielded 25 papers that satisfied all criteria. Consequently, a final selection of 25 papers, encompassing 54 data sets, was identified, as detailed in Table 2.

Variables	Definitions
Dependent Variables: Knowledge-Sharing	
Quantity	The number of knowledge-sharing behaviors or knowledge-sharing outputs such like articles, posts, and so on (Suh and Wagner, 2017).
Quality	The quality of knowledge-sharing behaviors or knowledge-sharing feedback such like ranking, votes, likes and so on (Suh and Wagner, 2017).
Independent Variables: Gamification Features	
Immersion -Related	Features that attempt to engage players in self-directed exploration, including elements such as avatars, role-playing mechanics, storytelling, narrative structures, and customization (Xi and Hamari, 2019; Feng et al., 2022).
Achievement-Related	Features that offer opportunities for players to acquire new skills, establish clear objectives, and receive feedback (Xi and Hamari, 2019; Feng et al., 2022; Chen et al., 2022).
Social -Related	Features such as groups, messages, blogs, connection to social networks and chat can enhance players' sense of connectedness and belonging through frequent communication, idea sharing, and reciprocity (Xi and Hamari, 2019; Feng et al., 2022).
Moderating Variable	
Platform Type	Organizational (or internal) platforms are usually formed based on strong relationship (e.g., family ship, friendship, colleagueship) exists between close members with frequent interactions or meetings while public platforms involve weak relationships caused by distant social relationships and very infrequent meetings or interactions (McKenna et al., 2002).

Table 1. The overview of dependent, independent and moderator variables.

3.2 Model analysis

For each dependent variable, we conducted a meta-analytical model by utilizing correlations as the effect size (Van Berlo et al., 2021). In total, we analyzed 25 studies and 54 data sets across the quantity and quality of knowledge-sharing spectrum (See Table 3). Most correlations were directly estimated from the coded information. In instances where this was not feasible (e.g., t value, p value), we converted it into effect size by applying an algebraic transformation (Schmidt, 2015).

In order to investigate the moderating impact of platform type on the association between gamification and knowledge contribution, a meta-regression analysis was carried out. In accordance with previous research (Bijmolt and Pieters 2001; Van Berlo et al., 2021), a nested error structure was utilized within studies to account for interdependence of effect sizes, employing a hierarchical linear model (HLM) approach which is acknowledged as the preferred method for evaluating moderating effects in meta-regression. The general model employed for this purpose was as follows:

$$\theta_{ij} = \alpha_{i0} + \alpha_{i1} * X_{platform_j} + u_{0j} + e_{ij} \quad (1)$$

where θ_{ij} denotes the coefficient of the outcome variable (quantity or quality), while i =1, 2, 3 gamification types, and j=1, …, 54 data sets. $X_{platform_j}$ represents the platform type in the j_{th} data set, 0 means public platform, 1 means organizational platform.

Paper Characteristics			Data Set Characteristics			Study Design Characteristic		
Year	Author	Data Set	N	PLT	Co.	Gamification Type & Features	Knowledge-Sharing	
							Quality	Quantity
2022	Suh et al.	2	212	O	KR	Immersion (game world)	●	●
	Chen et al.	3	4130	P	US	Achievement (levels)		●
						Achievement (reputation)		●
						Achievement (badges)		●
	Feroz et al.	3	395	O	PK	Social (social networking)	●	
						Social (multiplayer)	●	
						Social (cooperation)	●	
	Duong and Thi	2	336	O	VN	Social (peer-rating)	●	
						Achievement (skill trees)	●	
	Van Toorn et al.	1	33	O	AU	Social (teams)	●	
	Feng et al.	3	386	P	CN	Achievement (badges)		●
						Immersion (avatar)		●
						Social (social networking)		●
	Chou et al.	1	209	P	CN	Social (social networking)		●
2021	Weretecki et al.	1	468	P	DE	Social (social networking)		●
	Trang and Weiger	1	491	P	DE	Social (social networking)		●
	Krath and von Korflesch	2	1075	O	DE	Social (teams)		●
						Achievement (performance stats)		●
	Oliveira and Kang	6	154	P	BR	Immersion (avatar)	●	●
						Achievement (progress graph)	●	●
						Social (peer rating)	●	●
	Cavusoglu et al	1	46571	O	US	Achievement (badges)		●
2020	Petter et al.	5	289	P	US	Achievement (progress graph)	●	
						Social (social network)	●●●●	
	Holzer et al	2	458	O	CH	Achievement (levels)	●	●
2019	Chen et al.	5	2813	P	US	Achievement (votes)	●●	
						Achievement (leaderboards)	●	
						Achievement (badges)	●	
						Achievement (ranking)	●	
2017	Silic and Back	1	147	O	US	Immersion (game world)	●	
	Suh and Wagner	2	166	O	KR	Immersion (game world)	●	●
2016	Goes et al.	1	117174	P	US	Achievement (points)		●
2015	Khansa et al.	2	2920	P	US	Achievement (levels)		●
						Achievement (badges)		●
	Wei et al.	4	692	P	US	Achievement (ranking)	●	●
						Achievement (badges)	●	●
2013	Lou et al.	6	367	P	CN	Social (cooperation)	●	●
						Immersion (skill trees)	●	●
						Achievement (badges)	●	●
2012	Li et al.	3	55946	P	US	Achievement (badges)		●
			2480	—	—	Achievement (badges)		●
			18000	—	—	Achievement (badges)		●
2010	Lee et al.	4	203	P	SG	Immersion (role play)		●
						Social (social network)		●
						Immersion (storytelling)		●
						Social (teams)		●

Note: The presence of duplicate information is denoted with "—". "●" represents that one data set explores the relationship between gamification feature and quantity/quality of knowledge-sharing. PLT=Platform, O=Organization, P=public; Co.=country; AU=Australia; BR=Brazil; CH=Switzerland; CN=China; DE=Germany; KR=South Korea; PK=Pakistan; SG=Singapore; US=United States; VN=Vietnam. We categorize the gamification features based on the existing literature: Koivisto and Hamari (2019), Xi and Hamari (2019) data. Papers from some top journals such as, *Decision Support Systems*, *International Journal of Information Management*, *Computers in Human Behavior*, *Information Systems Research*, and *Journal of Management Information Systems* are included in the final dataset.

Table 2. The summary of chosen research, ordered by publication year.

4 Results

4.1 Heterogeneity test

As shown in Table 3, we employed a heterogeneity test to check the homogeneity between these studies and then decide which model to choose. Since it shows that I^2>60% and P(Q)<0.001 in the overall heterogeneity test results for the study on both quantity and quality of knowledge-sharing, we chose a random-effects model. After the heterogeneity test for the overall model, we also conducted a

Study (Quantity of Knowledge Contribution)	Effect Size with 95% CI	Weight (%)	Study (Quality of Knowledge Contribution)	Effect Size with 95% CI	Weight (%)
Social-related gamification			Social-related gamification		
Duong and Thi, 2022	-0.24 [-0.37, -0,11]*	3.62	Feroz et al., 2022	0.81 [0.65, 0.94]*	4.43
Weretecki et al., 2021	0.37 [0.13, 0.61]*	3.59	Feroz et al., 2022	0.27 [0.15, 0.38]*	4.69
Trang and Weiger, 2021	0.28 [0.04, 0.53]*	3.58	Feroz et al., 2022	0.54 [-0.43, 1.51]	0.94
Krath and von Korflesch, 2021	0.18 [0.05, 0.30]*	3.62	Van Toorn et al., 2022	-0.08 [-3.39, 3.23]	0.10
Oliveira and Kang, 2021	0.48 [-1.34, 2.30]	2.01	Oliveira and Kang, 2021	0.16 [0.02, 0.31]*	4.52
Lou et al., 2013	0.16 [0.01, 0.31]*	3.61	Petter et al., 2020	0.33 [0.16, 0.51]*	4.36
Lee et al., 2010	0.10 [-0.01, 0.21]	3.62	Petter et al., 2020	0.25 [0.12, 0.38]*	4.60
Lee et al., 2010	0.12 [-0.01, 0.25]	3.62	Petter et al., 2020	0.05 [-0.01, 0.11]	4.88
Heterogeneity: τ^2=0.03, I^2=81.58%, H^2=5.43	0.13 [-0.01, 0.27]		Petter et al., 2020	0.32 [0.16, 0.49]*	4.42
Test of $\theta_i=\theta_j$: Q(7)=34.44, p=0.00			Lou et al., 2013	0.32 [0.21, 0.42]*	4.74
Immersion-related gamification			Heterogeneity: τ^2=0.04, I^2=90.10%, H^2=10.11	0.31 [0.16, 0.46]*	
Suh et al., 2022	0.15 [0.02, 0.29]*	3.62	Test of $\theta_i=\theta_j$: Q(7)=88.87, p=0.00		
Oliveira and Kang, 2021	0.35 [0.17, 0.53]*	3.60	Immersion-related gamification		
Suh and Wagner, 2017	0.39 [0.18, 0.60]*	3.59	Suh et al., 2022	0.45 [0.20, 0.70]*	3.85
Lou et al., 2013	0.49 [0.40, 0.59]*	3.63	Oliveira and Kang, 2021	0.20 [0.07, 0.34]*	4.60
Lee et al., 2010	0.01 [-0.11, 0.13]	3.62	Silic and Back, 2017	0.54 [0.17, 0.91]*	3.05
Lee et al., 2010	0.26 [0.14, 0.38]*	3.62	Suh and Wagner, 2017	0.67 [0.30, 1.04]*	3.06
Heterogeneity: τ^2=0.03, I^2=85.56%, H^2=5.92	0.27 [0.13, 0.42]*		Lou et al., 2013	0.30 [0.20, 0.40]*	4.75
Test of $\theta_i=\theta_j$: Q(5)=43.16, p=0.00			Heterogeneity: τ^2=0.02, I^2=63.09%, H^2=2.71	0.37 [0.22, 0.52]*	
Achievement-related gamification			Test of $\theta_i=\theta_j$: Q(4)=8.85, p=0.06		
Chen et al., 2022	0.66 [0.32, 0.99]*	3.54	Achievement-related gamification		
Chen et al., 2022	0.95 [0.54, 1.38]*	3.49	Oliveira and Kang, 2021	0.55 [0.41, 0.68]*	4.56
Chen et al., 2022	0.16 [0.11, 0.21]*	3.63	Petter et al., 2020	-0.04 [-0.09, 0.01]	4.90
Duong and Thi, 2022	0.39 [0.17, 0.61]*	3.59	Chen et al., 2019	0.11 [0.06, 0.17]*	4.89
Krath and von Korflesch, 2021	0.13 [0.04, 0.22]*	3.63	Chen et al., 2019	-0.33 [-0.55, -0.11]*	4.07
Oliveira and Kang, 2021	0.20 [0.05, 0.34]*	3.62	Chen et al., 2019	0.19 [0.10, 0.29]*	4.76
Cavusoglu et al., 2020	0.78 [0.72, 0.83]*	3.63	Chen et al., 2019	-0.11 [-0.19, -0.03]*	4.82
Goes et al., 2016	-1.96[-0.99, -2,73]	0.19	Chen et al., 2019	-0.01 [-0.02, 0.01]	4.96
Khansa et al., 2015	2.35 [2.15, 2.54]*	3.60	Wei et al., 2015	2.47 [0.75, 4.19]*	0.34
Khansa et al., 2015	-0.26 [-0.71, 0.18]	3.47	Wei et al., 2015	0.05 [-0.00, 0.09]	4.91
Wei et al., 2015	3.82 [0.48, 7.17]*	0.98	Lou et al., 2013	0.09 [0.01, 0.16]*	4.83
Wei et al., 2015	-0.08 [-0.16, -0.00]	3.63	Heterogeneity: τ^2=0.05, I^2=98.37%, H^2=61.21	0.08 [-0.07, 0.22]	
Lou et al., 2013	0.03 [-0.04, 0.10]	3.63	Test of $\theta_i=\theta_j$: Q(9)=123.79, p=0.00		
Li et al., 2012	3.86 [3.74, 3.98]*	3.62	Overall		
Li et al., 2012	3.94 [3.34, 4.48]*	3.37	Heterogeneity: τ^2=0.06, I^2=97.48%, H^2=39.66	0.23 [0.13, 0.33]*	
Li et al., 2012	0.81 [0.71, 0.92]*	3.62	Test of $\theta_i=\theta_j$: Q(24)=384.34, p=0.00	Test of group differences: Q(2)=8.51, p=0.01	
Heterogeneity: τ^2=0.03, I^2=81.58%, H^2=5.43	1.08 [0.35, 1.78]*				
Test of $\theta_i=\theta_j$: Q(14)=34.44, p=0.00					
Overall					
Heterogeneity: τ2=1.07, I2=99.65%, H2=289.84	0.63 [0.25, 1.02]*				
Test of θi=θj: Q(28)=4593.41, p=0.00	Test of group differences: Q(2)=7.57, p=0.00				

Note: Significant effect size with 95% CI *.

Table 3. Results of random-effects restricted maximum-likelihood (REML) model.

heterogeneity test for the subgroup model to check whether there are group differences. Since P(Q)<0.05 in the subgroup heterogeneity test results, this means that group differences exist between different kinds of gamification's effects on quantity or quality of knowledge-sharing.

4.2 Main effect

As shown in Table 4, all of the gamification types have an overall positive effect on both quantity and quality of knowledge-sharing, but gamification can be more effective regarding enhancing knowledge-sharing quantity. To be more specific, social-related gamification only has a positive and significant effect on quality of knowledge-sharing; immersion-related gamification has a positive and significant effect on both quantity and quality of knowledge-sharing; achievement-related gamification's effect on quality of knowledge-sharing is not significant, but it has the strongest positive and significant effect on quantity of knowledge-sharing.

	Social-Related Gamification	**Immersion-Related Gamification**	**Achievement-Related Gamification**	**Overall**
	Effect Size with 95% CI	Effect Size with 95% CI	Effect Size with 95% CI	Effect Size with 95% CI
Quantity of Knowledge-Sharing	0.13 [-0.01, 0.27]	0.27* [0.13, 0.42]	1.06* [0.35, 1.78]	0.63* [0.25, 1.02]
Quality of Knowledge-Sharing	0.31* [0.16, 0.46]	0.37* [0.22, 0.52]	0.08 [-0.07, 0.22]	0.23* [0.13, 0.33]

Note: Significant effect size with 95% CI *.

Table 4. Meta-regression estimates of REML model results.

4.3 Moderating effect

We conducted a meta-regression analysis to investigate the moderating influence of platform type on the efficacy of gamification. The findings (presented in Table 5) demonstrate that platform type significantly diminishes the effectiveness of gamification in enhancing the quantity of knowledge-sharing. We also test the moderating effect of platform type on each kind of gamification. From the results, we can find that the negative moderating effect on overall gamification is mainly caused by the negative moderating effect on achievement-related gamification. Furthermore, platform has a significant negative moderating effect on immersion-related gamification, and no significant moderating effect on social-related gamification. These findings indicate that in public platforms, achievement-related gamification is more effective in increasing the quantity of knowledge-sharing, while in organizational platforms, immersion-related gamification is more effective. Overall, gamification is more effective in increasing the quantity of knowledge-sharing in public platforms.

The findings presented in Table 5 indicate a significant positive moderating effect of knowledge-sharing platform type on the association between gamification and the volume of knowledge-sharing. Regarding the moderating effect on three gamification types, we also find that the positive moderating effect on social-related gamification and immersion-related gamification mainly contribute to the positive moderating effect on overall gamification, while platform type has no significant moderating effect on achievement-related gamification. These findings indicate that in public platforms, gamification that mainly includes social-related gamification and immersion-related gamification is more effective in increasing the quality of knowledge-sharing overall.

4.4 Publication bias

To evaluate the validity of our results, an analysis was conducted to estimate the potential impact of publication bias. Referring to the approaches employed in Van Berlo et al. (2021), Egger's correlation test (Sterne and Egger, 2005) and a rank correlation test (Begg and Mazumdar, 1994) were employed to examine the relationship between the effect sizes and studies. Our analysis (as presented in Table 5)

reveal that the majority of the test statistics were significant, indicating an absence of publication bias in our estimates. Notably, the publication bias test of the moderating effect on the relationship between immersion-related gamification and quantity of knowledge sharing is not passed, since the p value is more than 0.1, which may be caused by limited sample size. Although there were two non-significant results in the heterogeneity tests for moderating effects, these can be disregarded given the lack of significance in the two moderating effects. In summary, our findings do not provide any indication that publication bias may have influenced our estimations, thus underscoring the robustness of our results.

Knowledge-Sharing		Platform Type		Heterogeneity		Publication Bias	
	Coefficient	Public	Organization	I^2	P(Q)	Z	P
Social-Related Gamification							
Quantity	0.073	(—)	(—)	0.82	0.367	1.79	0.074
Quality	0.119***	(↘)	(↗)	115.11	0.000	5.79	0.000
Immersion-Related Gamification							
Quantity	0.207***	(↘)	(↗)	14.32	0.000	1.39	0.164
Quality	0.259**	(↘)	(↗)	6.62	0.010	2.45	0.014
Achievement-Related Gamification							
Quantity	-0.588***	(↗)	(↘)	219.11	0.000	18.28	0.000
Quality	0.004	(—)	(—)	0.55	0.456	5.23	0.000
Overall							
Quantity	-0.215***	(↗)	(↘)	13.44	0.000	1.78	0.075
Quality	0.216***	(↘)	(↗)	12.68	0.000	12.68	0.000

Note: P < 0.05*; P < 0.01**; P < 0.001 ***. The p values of coefficient are the p value of heterogeneity as well. "↗" means this type of platform has a positive moderating effect; "—" means this type of platform has no moderating effect; "↘" means this type of platform has a negative moderating effect on the relationship between gamification and knowledge-sharing.

Table 5. Moderating effects and heterogeneity estimates.

5 Discussion on Key Findings

Key Finding 1. *Overall, gamification can be a useful approach for promoting knowledge-sharing.* Through meta-analysis, this research offers empirical support regarding the overall efficacy of gamification in enhancing knowledge contributions within the existing body of literature. We found that overall, gamification has positive effects on both the quantity and quality of knowledge contribution. These findings support our expectation that gamification can promote knowledge-sharing behaviors. Many prior studies indicate that gamification can be a powerful method to increase knowledge-sharing (Hamari et al., 2016; Suh et al., 2022). Although some studies point out that gamification may have a negative effect on knowledge contribution (Chen et al., 2022; Duong and Thi, 2022), our meta-regression results prove that gamification can have a positive effect on knowledge contribution overall.

Key Finding 2. *Among the three gamification categories, immersion-related gamification is more likely to enhance both quality and quantity of knowledge contribution*. More concretely, immersion-related gamification can simultaneously enhance the quantity and quality of knowledge contribution, while social-related gamification only influences the quality of knowledge contribution, and achievement-related gamification only influences the quantity of knowledge contribution. Nevertheless, there are certain outcomes that do not align with our initial expectations. Based on the findings, there is still a lack of clarity whether social-related gamification can increase the quantity of knowledge contribution and achievement-related gamification can increase the quality of knowledge contribution. To explain why social-related gamification has no significant effect on quantity of knowledge-sharing, maybe we ignore the fact that each person's time and energy is limited. Considering that social-related gamification makes contributors care more about the quality of the knowledge they share, the effectiveness for social-related gamification on the quantity of knowledge contribution could not be significant, as was expected. Regarding the absence of significant effect of achievement-related gamification on quality of knowledge contribution, we speculate that achievement-related gamification may lead individuals' attention

towards achievement rewards rather than a sharing behavior itself. In that case, individuals will share more low-quality knowledge to meet the requirements of quantity to win the rewards, which is supported by other studies (Lu et al., 2020).

Key Finding 3*. Compared to public platforms, organizational platforms diminish gamification's impact on knowledge-sharing quantity, but enhance its effect on knowledge-sharing quality.* Through an analysis of the platform's influence as a moderator of the effectiveness of gamification, the research provides compelling empirical proof of a connection between a susceptibility to gamification dependent on the platform and the knowledge-sharing behaviors of individuals. We find that organizational platforms mitigate the effectiveness of gamification, especially achievement-related gamification, on quantity of knowledge-sharing, which coincides with other studies (Suh et al., 2022). Oppositely in organizational platforms, the overall gamification including social-related gamification and immersion-related gamification is more effective in increasing the quality of knowledge-sharing than that in public online platforms. Notably, in organizational platforms, immersion-related gamification can be more effective in increasing both the quantity and quality of knowledge-sharing. What's more, since the two main effects are not significant, there is no significant moderating of platform type on the relationship between social-related gamification and quantity of knowledge-sharing, or the relationship between achievement-related gamification and quality of knowledge-sharing.

6 Conclusions, Contributions and Limitations

The present study contributes to the theoretical and empirical understanding of different gamification features, and also their role in the field of knowledge management. More specifically, immersion-related gamification can increase both the quantity and quality of knowledge contribution, while social-related gamification only influences the quality of knowledge contribution and achievement-related gamification only influences the quantity of knowledge contribution. Moreover, through the meta-regression of the relationship between gamification and knowledge-sharing, the paper offers important insights about the moderating effect of platforms. Drawing on a decade of empirical research, this study contributes to the overall understanding of gamification and knowledge-sharing in different contexts. Online platforms can mitigate the effectiveness of achievement-related gamification on the quantity of knowledge-sharing, but can enhance the effectiveness of overall gamification on the quality of knowledge-sharing. Of note, in organizational platforms, immersion-related gamification can be more effective in increasing both the quantity and quality of knowledge-sharing. Several main implications can be drawn from these meta-analysis results.

6.1 Theoretical contributions

On one hand, our results provide strong evidence for the use of gamification as an enhanced motivation mechanism for knowledge-sharing from prior literature, and a deeper understanding of different types of gamification features. Based on our research results, we emphasize the significance of establishing a clear conceptual and operational differentiation among various gamification features, which supports the previous gamification classification and the underlying mechanisms of different gamification features (Koivisto and Hamari, 2019; Xi and Hamari, 2019). In addition, this study provides important insights into the design and implementation of gamification interventions for knowledge-sharing in different contexts. Although gamification is an effective information system design, it is not a master key for promoting knowledge-sharing, and it is important to consider which specific gamification feature is most appropriate for a given context. Moreover, our findings provide further empirical evidence supporting the Self-Determination Theory and SOR framework in the field of IS.

On the other hand, the results also provide empirical evidence of the moderating effect of social network types (platform types: public – weak tie vs. organization – strong tie) on the effectiveness of gamification. We find that weak social ties may limit the effectiveness of different information system designs on individuals' motivation or engagement, but stimulate the individuals' contribution. More concretely, an external social network (i.e., an online platform where people can share knowledge publicly) can mitigate the effectiveness of achievement-related gamification on the quantity of

knowledge-sharing, but also enhance the effectiveness of overall gamification on the quality of knowledge-sharing. Of note, in internal social networks (i.e., organizational platforms where people share knowledge restrictedly), immersion-related gamification can be more effective in increasing both the quantity and quality of knowledge-sharing. This study contributes to the theoretical understanding of the effects of social ties in gamification and knowledge-sharing, and provides guidance for future research on social network effect in this area.

6.2 Practical implications

This meta-analytic review also provides several important implications for practice, such as gamification designers, and platform and organizational managers. First, the study identifies specific gamification features that can enhance knowledge-sharing behaviors in different contexts. The meta-analysis results highlight the potential of immersion-related gamification, which seems to be most liked by individuals among the three types of gamification. Despite the difficulties and high costs associated with the design, it is recommended to invest in the development of immersion-related gamification features. In addition, although social-related gamification and achievement-related gamification are widely used, gamification designers should be cautious about over-relying on these features. Second, the findings suggest that different platform types may require different gamification strategies to achieve optimal outcomes. It is important to select effective gamification design strategies based on the organization vision or the platform strategy goals. The gamification can be more effective in organizations to increase the quality of knowledge contribution than seen in external online platforms. When it comes to quantity of knowledge contribution, there seems no significant difference between external online platforms and internal organization platforms, which means gamification can be effective in both conditions. People are less susceptible to the effectiveness of gamification, especially in relation to achievement-related gamification on quantity of knowledge-sharing, in organizational platforms. At the same time, in the public online platform, gamification would be less effective in increasing the quality of knowledge-sharing than when employed in organizational platforms.

6.3 Limitations

Even though the meta-analytic review was conducted rigorously by referring to the PRISMA guidelines, there remain a few limitations that could be explored in future studies, potentially offering avenues for further research. Similar to most of the literature which employed meta-analytic review methods, as is common in meta-analyses, some relevant papers were unable to be included due to the lack of required empirical results reported. For our current study, eligible studies had to provide essential information including sample size, statistical data (e.g., coefficients and standard errors), and details that could enhance estimations or facilitate moderation testing such as clear descriptions of relevant contexts. One possible future agenda is that researchers may combine the meta-analytic method with other literature review methods such as systematic, narrative, scoping review, in order to provide a more comprehensive and general picture regarding e.g., the adopted method, theories, specific gamification features, and knowledge-sharing outcomes in the extant literature. Although 25 studies may not be considered as a large sample size, it is commonly accepted as suitable for conducting meta-analysis. Regarding meta-analysis; the quality and relevance of the included studies is more important than the specific number of studies. However, the sample size might have been influenced by our search strategy of selecting Scopus due to the consideration of ensuring the quality of the reviewed studies. Accordingly, we encourage future researchers conducting similar search procedures to use multiple databases. In addition, we find that gamification has been investigated in regard to influencing knowledge contribution, co-innovation, value co-creation, and so on, but the number of such studies is still limited. We encourage researchers to further explore the combination or interaction effects of different gamification types, and so expand the scope of knowledge outputs.

Acknowledgments

This work has been supported by the Foundation for Economic Education under Grant No. 210301 (GAMETH); Business Finland under Grant No. 6742/31/2023 (MetaMarketing); and Academy of Finland under Grant No. 337653 (UNITE Flagship).

References

Abubakar, A. M., Elrehail, H., Alatailat, M. A. and Elçi, A. (2019). "Knowledge management, decision-making style and organizational performance," *Journal of Innovation & Knowledge* 4(2), 104-114.

Allal-Chérif, O., Lombardo, E. and Jaotombo, F. (2022). "Serious games for managers: Creating cognitive, financial, technological, social, and emotional value in in-service training," *Journal of Business Research* 146, 166-175.

Baas, J., Schotten, M., Plume, A., Côté, G. and Karimi, R. (2020). "Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies," *Quantitative science studies* 1(1), 377-386.

Baer, R. A. (2003). "Mindfulness training as a clinical intervention: A conceptual and empirical review," *Clinical Psychology: Science and Practice* 10(2), 126.

Barile, S., Grimaldi, M., Loia, F. and Sirianni, C. A. (2020). "Technology, value co-creation and innovation in service ecosystems: Toward sustainable co-innovation," *Sustainability* 12(7), 2759.

Bauer, J. C., Linzmajer, M., Nagengast, L., Rudolph, T. and D'Cruz, E. (2020). "Gamifying the digital shopping experience: games without monetary participation incentives increase customer satisfaction and loyalty," *Journal of Service Management*, 31(3), 563-595.

Begg, C. B. and Mazumdar, M. (1994). "Operating characteristics of a rank correlation test for publication bias," *Biometrics* 50(4), 1088-1101.

Bijmolt, T. H. and Pieters, R. G. (2001). "Meta-analysis in marketing when studies contain multiple measurements," *Marketing Letters* 12(2), 157–169.

Bock, G.-W., Zmud, R. W., Kim, Y.-G. and Lee, J.-N. (2005). "Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate," *MIS Quarterly* 29(1), 87-111.

Bouwen, R. and Taillieu, T. (2004). "Multi-party collaboration as social learning for interdependence: Developing relational knowing for sustainable natural resource management," *Journal of Community & Applied Social Psychology* 14(3), 137-153.

Brown, J. S. and Duguid, P. (1991). "Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation," *Organization Science* 2(1), 40-57.

Cavusoglu, H., Li, Z. & Kim, S.H. (2021). "How do virtual badges incentivize voluntary contributions to online communities?," *Information & Management* 58(5), 103483.

Chen, L., Baird, A. and Straub, D. (2019). "Why do participants continue to contribute? Evaluation of usefulness voting and commenting motivational features within an online knowledge community," *Decision Support Systems* 118(1), 21-32.

Chen, L., Baird, A. and Straub, D. (2022). "The impact of hierarchical privilege levels and non-hierarchical incentives on continued contribution in online Q&A communities: A motivational model of gamification goals," *Decision Support Systems* 153, 113667.

Cheng, Y. M. (2023). "How different categories of gamified stimuli affect massive open online courses continuance intention and learning performance? Mediating roles of internal experiences," *Social Science Computer Review* 41(2), 495-527.

Chou, Y. K. (2020). *The Octalysis Framework for Gamification & Behavioral Design*. URL: https://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/.

Constant, D., Sproull, L. and Kiesler, S. (1996). "The kindness of strangers: The usefulness of electronic weak ties for technical advice," *Organization Science* 7(2), 119-135.

Deci, E. L. and Ryan, R. M. (1985). "The general causality orientations scale: Self-determination in personality," *Journal of Research in Personality* 19(2), 109-134.

Deterding, S., Dixon, D., Khaled, R. and Nacke, L. (2011). "From game design elements to gamefulness: Defining "gamification"," In *Proceedings of the 15th International Academic In proceedings of MindTrek Conference: Envisioning Future Media Environments*, 9-15.

Duong, N. T. and Thi, T. D. P. (2022). "The influence of perceived social loafing on knowledge sharing intentions among college students," *Образование и Наука* 24(5), 41-63.

Eisend, M. and Hermann, E. (2019). "Consumer responses to homosexual imagery in advertising: A meta-analysis," *Journal of Advertising* 48(4), 380-400.

Feng, Y., Yi, Z., Yang, C., Chen, R. and Feng, Y. (2022). "How do gamification mechanics drive solvers' Knowledge contribution? A study of collaborative knowledge crowdsourcing," *Technological Forecasting and Social Change* 177, 121520.

Feroz, H. M. B., Zulfiqar, S., Noor, S. and Huo, C. (2022). "Examining multiple engagements and their impact on students' knowledge acquisition: The moderating role of information overload," *Journal of Applied Research in Higher Education* 14(1), 366-393.

Friedrich, J., Becker, M., Kramer, F., Wirth, M. and Schneider, M. (2020). "Incentive design and gamification for knowledge management," *Journal of Business Research* 106, 341-352.

Goes, P. B., Guo, C. and Lin, M. (2016). "Do incentive hierarchies induce user effort? Evidence from an online knowledge exchange," *Information Systems Research* 27(3), 497-516.

Gold, A. H., Malhotra, A. and Segars, A. H. (2001). "Knowledge management: An organizational capabilities perspective" *Journal of Management Information Systems* 18(1), 185-214.

Hamari, J. (2019) "Gamification," in G. Ritzer and C. Rojek (eds) *The Blackwell Encyclopedia of Sociology*, New York: John Wiley.

Hamari, J., Koivisto, J. and Sarsa, H. (2014). "Does gamification work?–A literature review of empirical studies on gamification," In *Proceedings of 47th Hawaii International Conference on System Sciences*, 3025-3034.

Hamari, J., Sjöklint, M. and Ukkonen, A. (2016). "The sharing economy: Why people participate in collaborative consumption," *Journal of the Association for Information Science and Technology* 67(9), 2047-2059.

Hammedi, W., Leclercq, T., Poncin, I. and Alkire, L. (2021). "Uncovering the dark side of gamification at work: Impacts on engagement and well-being," *Journal of Business Research* 122, 256-269.

Hock-Doepgen, M., Clauss, T., Kraus, S. and Cheng, C. F. (2021). "Knowledge management capabilities and organizational risk-taking for business model innovation in SMEs," *Journal of Business Research* 130, 683-697.

Högberg, J., Hamari, J. and Wästlund, E. (2019). "Gameful Experience Questionnaire (GAMEFULQUEST): An instrument for measuring the perceived gamefulness of system use," *User Modeling and User-Adapted Interaction* 29(3), 619-660.

Holzer, A., Kocher, B., Bendahan, S., Vonèche Cardia, I., Mazuze, J. and Gillet, D. (2020). "Gamifying knowledge sharing in humanitarian organisations: A design science journey," *European Journal of Information Systems* 29(2), 153-171.

Huotari, K. and Hamari, J. (2012). "Defining gamification: A service marketing perspective," In *Proceeding of the 16th International Academic MindTrek Conference*, 17-22.

Jang, S., Kitchen, P. J. and Kim, J. (2018). "The effects of gamified customer benefits and characteristics on behavioral engagement and purchase: Evidence from mobile exercise application uses," *Journal of Business Research* 92, 250-259.

Jin, X.-L., Zhou, Z., Lee, M. K. and Cheung, C. M. (2013). "Why users keep answering questions in online question answering communities: A theoretical and empirical investigation," *International Journal of Information Management* 33(1), 93-104.

Kang, M. (2018). "Active users' knowledge-sharing continuance on social Q&A sites: Motivators and hygiene factors," *Aslib Journal of Information Management* 70(2), 214-232.

Khando, K., Gao, S., Islam, S. M. and Salman, A. (2021). "Enhancing employees information security awareness in private and public organisations: A systematic literature review," *Computers & Security* 106, 102267.

Khansa, L., Ma, X., Liginlal, D. and Kim, S. S. (2015). "Understanding members' active participation in online question-and-answer communities: A theory and empirical analysis," *Journal of Management Information Systems* 32(2), 162-203.

Krath, J. and von Korflesch, H. (2021). "Designing gamification and persuasive systems: A systematic literature review," In *Proceedings of the 5th International GamiFIN conference*,100-109.

Koivisto, J. and Hamari, J. (2019). "The rise of motivational information systems: A review of gamification research," *International Journal of Information Management* 45, 191-210.

Lee, C. S., Goh, D. H. L., Chua, A. Y. and Ang, R. P. (2010). "Indagator: Investigating perceived gratifications of an application that blends mobile content sharing with gameplay," *Journal of the American Society for Information Science and Technology* 61(6), 1244-1257.

Li, Z., Huang, K.-W. and Cavusoglu, H. (2012). "Quantifying the impact of badges on user engagement in online Q&A communities," In *Proceedings of the International Conference on Information Systems*, 1-10.

Lou, J., Fang, Y., Lim, K. H. and Peng, J. Z. (2013). "Contributing high quantity and quality knowledge to online Q & A communities," *Journal of the American Society for Information Science and Technology* 64(2), 356-371.

Luarn, P., Chen, C. C. and Chiu, Y. P. (2023), "Enhancing intrinsic learning motivation through gamification: A self-determination theory perspective," *International Journal of Information and Learning Technology* 40 (5), 413-424.

Majchrzak, A., Faraj, S., Kane, G. C. and Azad, B. (2013). "The contradictory influence of social media features on online communal knowledge sharing," *Journal of Computer-Mediated Communication* 19(1), 38-55.

McKenna, K. Y., Green, A. S. and Gleason, M. E. (2002). "Relationship formation on the Internet: What's the big attraction?," *Journal of Social Issues* 58(1), 9-31.

Mullins, J. K. and Sabherwal, R. (2020). "Gamification: A cognitive-emotional view," *Journal of Business Research* 106, 304-314.

Oliveira Jordao do Amaral, I. and Kang, M. (2021). "Gamification effects on users' motivation to contribute knowledge in a Portuguese Q&A community," *Aslib Journal of Information Management* 73(4), 578-599.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A. and Brennan, S. E. (2021). "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," *International Journal of Surgery* 88, (doi: 10.1016/j.ijsu.2021.105906).

Pandey, V. and Ansari, S. (2023). "Impact of game design elements on actual usage vs future use intentions of mobile payment app users: A motivation based approach," *Information Systems Frontiers* 1-27.

Paré, G., Tate, M., Johnstone, D. and Kitsiou, S. (2016). "Contextualizing the twin concepts of systematicity and transparency in information systems literature reviews," *European Journal of Information Systems* 25, 493-508.

Petter, S., Barber, C. S. and Barber, D. (2020). "Gaming the system: The effects of social capital as a resource for virtual team members," *Information & Management* 57(6), 103239.

Qian, T. Y., Matz, R., Luo, L. and Xu, C. (2022). "Gamification for value creation and viewer engagement in gamified livestreaming services: The moderating role of gender in esports," *Journal of Business Research* 145, 482-494.

Reis, L., Mercer, K. and Boger, J. (2021). "Technologies for fostering intergenerational connectivity and relationships: Scoping review and emergent concepts," *Technology in Society* 64, 101494.

Ryan, R. M. and Connell, J. P. (1989). "Perceived locus of causality and internalization: Examining reasons for acting in two domains," *Journal of Personality and Social Psychology* 57(5), 749.

Ryan, R. M. and Deci, E. L. (2000). "Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being," *American Psychologist* 55(1), 68.

Ryan, R. M. and Deci, E. L. (2020). "Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions," *Contemporary Educational Psychology* 61, 101860.

Sailer, M., Hense, J. U., Mayr, S. K. and Mandl, H. (2017). "How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction," *Computers in Human Behavior* 69, 371-380.

Schmidt, F. L. (2015). "History and development of the Schmidt–Hunter meta-analysis methods," *Research Synthesis Methods* 6(3), 232-239.

Silic, M. and Back, A. (2017). "Impact of gamification on user's knowledge-sharing practices: relationships between work motivation, performance expectancy and work engagement," In *Proceedings of the 50th Hawaii International Conference on System Sciences*, 1-11.

Stasewitsch, E. and Kauffeld, S. (2022). "Knowledge transfer in a two-mode network between higher education teachers and their innovative teaching projects," *Journal of Learning Analytics* 9(1), 93-110.

Sterne, J. A. and Egger, M. (2005). "Regression methods to detect publication and other bias in meta-analysis. Publication bias in meta-analysis: Prevention," *Assessment and Adjustments*, 99-110.

Suh, A. and Wagner, C. (2017). "How gamification of an enterprise collaboration system increases knowledge contribution: An affordance approach," *Journal of Knowledge Management* 21(2), 416-431.

Suh, A., Cheung, C. M. and Lin, Y. (2022). "Meaningful engagement with a gamified knowledge management system: Theoretical conceptualization and empirical validation," *Industrial Management & Data Systems* 122(5), 1355-1383.

Syrjälä, H., Kauppinen-Räisänen, H., Luomala, H. T., Joelsson, T. N., Könnölä, K. and Mäkilä, T. (2020). "Gamified package: Consumer insights into multidimensional brand engagement," *Journal of Business Research* 119, 423-434.

Trang, S. and Weiger, W. H. (2021). "The perils of gamification: Does engaging with gamified services increase users' willingness to disclose personal information?," *Computers in Human Behavior* 116, 106644.

Tong, C., Tak, W. I. W. and Wong, A. (2015). "The impact of knowledge sharing on the relationship between organizational culture and job satisfaction: The perception of information communication and technology (ICT) practitioners in Hong Kong," *International Journal of Human Resource Studies* 5(1), 19.

Van Berlo, Z. M., van Reijmersdal, E. A. and Eisend, M. (2021). "The gamification of branded content: A meta-analysis of advergame effects," *Journal of Advertising* 50(2), 179-196.

Van Den Hooff, B. and De Ridder, J. A. (2004). "Knowledge sharing in context: The influence of organizational commitment, communication climate and CMC use on knowledge sharing," *Journal of Knowledge Management* 8(6), 117-130.

Van Toorn, C., Kirshner, S. N. and Gabb, J. (2022). "Gamification of query-driven knowledge sharing systems," *Behaviour & Information Technology* 41(5), 959–980.

Wasko, M. M. and Faraj, S. (2005). "Why should I share? Examining social capital and knowledge contribution in electronic networks of practice," *MIS Quarterly* 29(1), 35-57.

Wei, X., Christiano, E. R., Yu, J. W., Wagner, M. and Spiker, D. (2015). "Reading and math achievement profiles and longitudinal growth trajectories of children with an autism spectrum disorder," *Autism* 19(2), 200-210.

Weretecki, P., Greve, G., Bates, K. and Henseler, J. (2021). "Information management can't be all fun and games, can it? How gamified experiences foster information exchange in multi-actor service ecosystems," *International Journal of Information Management* 61, 102391.

Werbach, K. and Hunter, D. (2012). *For the win: how game thinking can revolutionize your business*.

Xi, N. and Hamari, J. (2019). "Does gamification satisfy needs? A study on the relationship between gamification features and intrinsic need satisfaction," *International Journal of Information Management* 46, 210-221.