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Systematic Review of Gamification Research in IS Education: A Multi-method Approach

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Abstract:

Gamification refers to the use of game mechanics and game dynamics in non-gaming environments and contexts. Gamification is increasingly gaining attention among system designers across various industries especially in education due to the benefits associated with its implementation. The adoption of gamification in information systems (IS) education is promising for engaging and motivating students to complete their degree programs. Call for research in this area is particularly on the increase in the IS field. Accordingly, we need to organize the aggregation of research in this area and use common terminologies to promote progressive research practice in the field. In this paper, we use a multi-method approach to systematically review existing research on gamification in IS education to identify common terminologies, identify trends in topics studied, highlight understudied areas, and, thus, present opportunities for future research. The multi-method approach combines classical systematic review method and social network analysis to provide additional insight into the knowledge structure of researchers involved in the gamification of IS education. This review also highlights possible interventions that can improve student retention in IS education through the design of effective gamified courses.

Keywords: Gamification, Game Elements, Motivation, Engagement, Game Dynamics, Game Mechanics.

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1 Introduction

Gamification describes the application of game principles and game-design elements (i.e., game mechanics and dynamics) in non-game contexts to foster problem solving and promote desired behaviors (Zichermann & Cunningham, 2011). Game mechanics are the base components of games such as points, levels, badges, virtual gifts, and leaderboards that translate inputs into outputs (Hunicke, LeBlanc, & Zubek, 2004). Game dynamics are a game's elements (e.g., rewards, status, achievements, self-expression, competition, and altruism) that govern how players interact with game mechanics (Bunchball, 2010). Researchers have recently successfully implemented game design mechanics in e-commerce, healthcare, marketing, and education contexts (De-Marcos, Domínguez, Saenz-de-Navarrete, & Pagés, 2014; Stott & Neustaedter, 2013). We have evidence of the effectiveness of gamification in changing peoples' behaviors, increasing engagement, and helping people learn new problem-solving skills (Burke, 2014). In essence, gamification focuses on not only promoting fun in an activity but also creating an unobservable connection between an individual's intrinsic affective values and that activity (Werbach & Hunter, 2012).

Increasing learners' motivation, participation, and engagement are some of the biggest challenges facing education in general (Zepke & Leach, 2010). These challenges involve the difficult task of accommodating student's individual needs in the traditional classroom setting. Games tailor difficulty progression to individuals differently and can also motivate students to learn in new ways and enjoy tasks that they would otherwise perceive as boring and difficult (Hanus & Fox, 2015). The main purpose of gamification in information systems (IS) education is to foster the same motivation and engagement that gamers have towards games in students and their approach to learning (Cheong, Filippou, & Cheong, 2014). An important aspect of the IS field involves educating IS concepts through academic programs in higher institutions to develop future researchers and professionals to sustain the field. Hence, we need to adopt gamification to captivate the interest of students in the field to retain them and motivate them to pursue a career in the IS field.

Although gamification has numerous benefits, its implementation in education can be complex. Merely adding game features to existing educational processes may lead to shallow or no outcomes; therefore, one needs to take care when applying certain gamification mechanics in an academic context (Cheong et al., 2014). Researchers have shown that gamification can lead to learning outcomes that provide affordances for motivational, psychological, and behavioral changes (Hamari, Koivisto, & Sarsa, 2014). One cannot simply deploy a gamified system to produce these behavioral outcomes; rather, one needs to understand the characteristics of the intended users and their perception of the gamification concept (Cheong et al., 2014; Hamari et al., 2016).

Gamification presents an interesting area of research for IS researchers due to the central role that game-based technology plays in affecting target behavioral changes among users. Recently, major IS conferences such as the Americas Conference on Information Systems (AMCIS) and International Conference on Information Systems have started publishing papers on gamification. For instance, in 2016, AMCIS included several tracks with panel discussions as an opportunity to extend the call for gamification research among IS researchers. While the call for gamification research has grown, we lack consensus on the ontology of the terminologies used in the literature (Lee & Hammer, 2011). Furthermore, researchers have conducted few reviews on gamification research so far (Boyle et al., 2014)—especially in the area of IS education. We need systematic reviews to create a common operating ontology of terminologies used in the domain and to identify research opportunities and patterns (Bandara, Miskon, & Fielt, 2011; Webster & Watson, 2002).

We contribute to advancing our understanding of gamification by systematically reviewing gamification research in IS education offered both in traditional face-to-face settings and in online environments from January, 2008, to January, 2017. We focus on studies that have gamified IS education either by directly using game elements in IS courses or teaching IS concepts in either a traditionally delivered (i.e., face-to-face) or online delivery method. We used an approach prescribed by Zhang and Li (2005) and validated in other (including IS) studies (Cao, Basoglu, Sheng, & Lowry, 2015; Zhang, Li, Scialdone, & Carey, 2009) in addition to an innovative use of social network analysis (SNA) to conduct our review. In this study, we: 1) identify current patterns in gamification research as it relates to learning in the IS context and to 2) highlight opportunities that exist from previously unstudied areas. We address the following research questions:

RQ1: What range of topics does current IS education gamification literature cover?

RQ2: What methods does IS education gamification research predominantly use?

RQ3: What theories does IS education gamification research use?

RQ4: Does IS education gamification research contain collaborative strategies that are important for brokering ideas across the research domain?

In answering these questions, we document the nomenclature that gamification research in IS education uses, provide a foundation for a common use of terminologies, and provide a clear target for future studies in this area.

This paper proceeds as follows. In Section 2, we present frequently used terminologies in the gamification research domain as background information. In Section 3, we present the methodology we used to classify publications collected in our sample. In Section 4, we present our results: specifically, we classify the publications using schemes from prior systematic review studies. Finally, in Section 5, we discuss the patterns we found and opportunities for future research in gamification and learning.

2 Background

2.1 Domain Terminologies in Gamification Research

Researchers have often described gamification with different terms that range from game-based learning to serious games and educational games. While these terms are closely related to gamification, they differ in their purpose and instructional goals. Some publications in our collection used the terms gamification, game-based learning, serious games, and educational games interchangeably and did not clearly define them. We collected and sorted other keywords from the papers in our review to identify the most frequently used ones: game-based learning, serious games, game mechanics, and game dynamics. We clearly define these terms along with other key terms in our collection below.

Game-based learning describes an instructional technique that uses several approaches to integrate games into instructional contents such as incorporating the characteristics of computer games to teaching and learning to engage students and positively influence learning outcomes (Hamari & Nousiainen, 2015).

Serious games constitute a large portion of the keywords in our dataset. They refer to games primarily designed for use in areas such as education, healthcare, and in the military for reasons other than fun or entertainment. Serious games are used for training purposes, attitude and behavior modification, and skill development (Susi, Johannesson, & Backlund, 2007).

Game mechanics describes the rules and base components of a game. The concept comprises the basic actions a player can take while playing a game, players' behaviors and control mechanisms, and the effect their actions have on the game (Hunicke et al., 2004).

Game dynamics refers to the run-time behavior of game mechanics in response to player inputs. These dynamics work to create the fun experience a player feels in the course of playing a game (Hunicke et al., 2004).

3 Methodology

We used mixed methodologies to conduct the systematic review for this study. First, we used the conventional methodology for identifying patterns and opportunities for a given research area based on topics covered in the existing literature which is on the increase in IS research (Bélanger & Crossler, 2011; Cao et al., 2015). Systematic reviews require a detailed annotated bibliography of studies that meet the sampling requirements stipulated by the scope of the research topics of interest (Zhang & Li, 2005). We generated our bibliography by searching for papers in top-ranking IS journals and IS conference proceedings from online databases and indices using a collection of keywords such as gamification, game elements, gamify, and others. Thereafter, we developed a set of classification schemes based on Zhang and Li (2005), which we used to categorize the papers according to their topics and methods. Following Cao et al.'s (2015) approach, we also identified theories used in gamification research and the variables explored.

Researchers have demonstrated the viability of using social network analysis (SNA) as a literature review methodology to reveal knowledge networks that are otherwise hidden (Liu, Bollen, Nelson, & Van de Sompel, 2005). The structure of these hidden networks can reveal patterns and research opportunities

that can be useful for gamification research in IS education. Accordingly, in addition to the conventional approach, we also used UCINET, a well-known SNA tool, and NETDRAW, a network visualization tool, to construct and view the authors-by-country network of the papers collected for this study.

3.1 SNA Scores Measured

Following the approach in prior studies that have used SNA as the methodology for reviewing the literature (Khan & Wood, 2016), we report on measures about the collaboration network and the nodes (authors). At the network level, we measure components, density, average degree, clustering coefficient, and diameter. A component forms when there is a link between any two nodes in a sub-network. Density measures the ratio of actual connections to potential connections in a network. Average degree centrality measures the average number of interactions between nodes in the network. Clustering coefficient measures the probability that nodes will form clusters. The diameter of a network is the longest path between any pair of nodes in the network (Borgatti, Everett, & Freeman, 2002).

At the node level, we report centrality measures in accordance to prior studies to include degree, betweeness, and eigenvector centralities. Degree centrality measures the number of nodes connected to each node. Betweeness centrality measures the extent to which a node is centrally located in the network to bridge subnetworks. This measure helps one understand the flow of information in the network. Eigenvector centrality measures the importance of a node in the network through the node's connection to an important node. An important node is one with high degree centrality. Hence, a connection to a highly central node presents opportunities to extend access to other nodes in the network. We also gathered authors' country of residence for analysis.

3.2 Journal Selection Criteria

We began with the top eight IS journals recognized as elite journals in the IS field: *MIS Quarterly* (*MISQ*), *Information Systems Research* (*ISR*), *Journal of Management Information Systems* (JMIS), *Journal of the Association for Information Systems* (*JAIS*), *European Journal of Information Systems* (*EJIS*), *Information Systems Journal* (*ISJ*), *Journal of Information Technology* (*JIT*), and *Journal of Strategic Information Systems* (*JSIS*). However, only *ISR* and *JAIS* contained published papers on gamification (especially in the educational context). Thus, we expanded our journal outlet to include *Journal of Computer Information Systems* (*JCIS*) and *Journal of Information Systems Education* (*JISE*) since both journals have published some gamification studies. The Australian Business Deans Council's quality journal list considers *JCIS* an A journal, and IS researchers recognize *JISE* as a reputable journal for IS pedagogy and curriculum studies.

To extend our reach and gather a meaningful dataset for analysis, we examined major IS conference proceedings available in the Association for Information Systems e-library such as International Conference on Information Systems (ICIS), Americas Conference on Information Systems (AMCIS), Pacific Asia Conference of Information Systems (PACIS), European Conference on Information Systems (ECIS) and Hawaii International Conference on System Sciences (HICSS). Considering the small number of papers we found in these major AIS conferences, we decided to include papers from other IS conferences found in the AIS and ACM libraries such as Mediterranean Conference on Information Systems (MCIS), UK Academy for Information Systems Conference (UKAIS), Southern Association for Information Systems Conference (SAIS), Midwest Association for Information Systems Conference (MWAIS), International Conference on Information Resources Management (CONF-IRM), Business & Information Systems Engineering (BISE), International Conference on Informatics Education and Research (SIGED: IAIM), and Human Factors in Computing Systems (CHI). All the selected journals and conferences explore latest technological trends in teaching and learning while emphasizing the application of contemporary technology to IS education.

3.3 Approach to Searching for Papers

We searched papers published from January, 2008, to January, 2017. We choose 2008 as the starting year since gamification research started appearing in that year in top academic journals from relevant fields such as IS, education, and technology-mediated learning. We searched for papers using keywords directly associated with gamification (e.g., gamification, gamify, game elements, game mechanics, game dynamics, e-learning, serious games) and keywords peripherally associated with it (e.g., motivation and engagement). Because the AIS and ACM libraries contain a comprehensive list of papers also indexed in reputable databases for academic publications, we used them to search for papers. Table 1 summarizes

the number of papers we found in each journal and conference proceedings. We coded and categorized each paper in the collection based on the classification schemes adapted from Zhang and Li (2005) and Zhang et al. (2009).

Table 1. Publications in Selected Journals from 2008 to 2016

Journal / conference proceedings	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
ISR	0	0	0	0	0	0	0	0	1	1
JCIS	0	0	0	0	0	0	0	0	1	1
JISE	0	0	0	0	0	0	1	1	0	2
ICIS	0	0	0	0	1	1	0	2	1	5
AMCIS	0	0	0	0	0	0	1	1	2	4
PACIS	0	0	0	0	0	3	0	1	4	8
ECIS	0	0	0	0	0	0	1	2	2	5
HICSS	0	0	0	0	0	0	1	1	1	3
MCIS	0	0	0	0	0	0	1	1	0	2
UKAIS	0	0	0	0	0	0	0	2	0	2
SAIS	0	0	0	0	0	1	0	1	0	2
MWAIS	0	0	0	0	0	0	0	0	1	1
CONF-IRM	0	0	0	0	0	0	0	0	1	1
BISE	0	0	0	0	0	0	1	0	0	1
SIGED: IAIM	0	0	0	0	0	1	0	0	0	1
CHI	0	0	0	1	0	1	0	0	0	2
Total	**0**	**0**	**0**	**1**	**1**	**7**	**6**	**12**	**14**	**41**

3.4 Topic Classification Scheme for Gamification Research

Table 2 describes the research topics classification scheme we adapted from prior research (Zhang et al., 2009; Zhang & Li, 2005) and each topic's description. The IT artifact in this study is the use of electronic game elements in the delivery of IS courses or concepts in online and face-to-face contexts. Following the approach that prior research has used (Zhang et al., 2009; Zhang & Li, 2005), our classification focused on the factors that influence the development and use of gamification, its application programs, and its impact. In accordance with other review studies, we included a general category for other papers that did not fit into the other three categories to cover citation analyses, literature reviews, research comments, and editorials. TP1 and TP2 address the exploration of possible issues that one might encounter when developing gamified courses. TP3 and TP4 address research on issues that one might encounter after deploying gamified courses. We adapted the topic subcategories mostly from Zhang and Li (2005) and Zhang et al. (2009) and from our assessment of the papers in the review.

3.5 Method Classification Scheme for Gamification Research

We adapted an approach that prior research has used (Zhang et al., 2009; Zhang & Li, 2005) to classify the gamification research studies into two categories: empirical and non-empirical. The empirical papers focused on systematic observations and used primary data, while the non-empirical papers focused mostly on concepts, theoretical frameworks, and models. We modified and combined some of the subcategories with others based on reviewing the papers we collected.

3.6 Coding and Analysis

We coded the papers we collected using the schemes and descriptions from Tables 2 and 3. All three authors participated in coding the papers, and we conducted an inter-rater reliability test to assess agreement and consistency between coders. At the onset of the coding process, the authors coded 10 papers together to establish agreement on the coding results and address observed discrepancies. Then one of the coders coded the rest of the papers. At the end of the coding process, all three coders recoded random numbers of papers to ensure reliability in the coding results. We obtained a final consensus with inter-rater reliability scores of at least 0.98 among coders for the final data set. We also documented the study variables (independent and dependent variables), theories used, control elements and the findings from each paper at this stage. Appendix A summarizes all the papers we coded and included in our review.

Table 2.Topic Classification Scheme (Adapted from Zhang & Li, 2005, p. 240; Zhang et al. 2009, p. 61)

ID	Category		Description
TP1	Factors influencing gamification		Concerned with factors/issues that influence the development and use of gamification.
	TP1.1	Development of gamified classes	Concerned with factors that influence the development of gamification, such as the use of badges, points, levels, leaderboards, etc.
	TP1.2	Use of gamification	Concerned with various technical or social/behavioral factors that influence the use (adoption) of gamification.
	TP1.3	Other	Other topics related to the factors that influence gamification.
TP2	Application programs of gamification		Concerned with specific application programs (implementations) of gamification on learning management systems such as Blackboard and Moodle; discusses their implications, introduces relevant business models, or outlines possible challenges of such application programs.
TP3	Impact of gamification		Concerned with the effects of gamification on learners and instructors; examines the impact of gamification on users such as users' attitudes, emotions, learning, cognitive belief and behavior and the impact on students' performance.
	TP3.1	Cognitive belief and behavior	Self-efficacy, perception, belief, expectation, intention, behavior, acceptance, adoption, resistance and use.
	TP3.2	Attitude	Attitude, satisfaction, retention, preference.
	TP3.3	Learning	Learning models, learning processes.
	TP3.4	Performance	Performance, productivity, effectiveness, efficiency.
	TP3.5	Interpersonal relationships	Leadership, influence, interdependence, tension, conflict, agreement/disagreement.
	TP3.6	Motivation	Intrinsic motivation, extrinsic motivation, flow, enjoyment.
	TP3.7	Engagement	Increase/decrease in student's participation, engagement.
	TP 3.8	Other	Other topics related to the impact of gamification.
TP4	General topics		Concerned with general research issues about gamification.
	TP4.1	Citation analysis	Research papers that use gamification analysis method to analyze references/citation network.
	TP4.2	Literature review, overview and research comments	Conceptual papers that review, comment on, and discuss research on gamification.
	TP4.3	Other	Other topics concerning general issues in gamification.

Table 3. Method Classification Scheme (Adapted from Zhang & Li, 2005, p. 241; Zhang et al., 2009, p. 62)

ID	Category		Description	
ME1	**Non-empirical (theories)**			
	ME1.1	Conceptual orientation	Proposes, presents, or describes frameworks, conceptual models, conceptual overviews, or theories.	
	ME1.2	Illustration	Presents opinions supported by examples or personal experiences and describe specific tools, techniques, methods, or models technically or methodologically.	
	ME1.3a	Theoretical analysis	Refers to models developed for analyzing gamification.	
	ME1.3b	Applied concepts	Presents some concepts or framework and describe their application.	
	ME1.4	Design Science	Designs or develops prototypes, instantiations, artifacts.	
	ME1.5	Other	Other non-empirical methods.	
ME2	**Empirical (systematic observations)**			
	ME2.1	**Quantitative**		
		ME2.1.1	Gamification analysis	Observes and analyzes structural features of a gamified course; no manipulation of variables.
		ME2.1.2	Experiment	Manipulates independent variables in either a laboratory setting or in a natural setting.
		ME2.1.3	Field study	Involves experimental design but no experimental controls; carried out in natural settings (e.g., in the classrooms); no manipulation of independent variables,
		ME2.1.4	Survey	Involves a large number of observations with no manipulation of variables.
			ME2.1.4a	Sample survey.
			ME2.1.4b	Systematic survey, systematic review of literature.
		ME2.1.5	Instrument development	Develops instrument/measurement or classification scheme: validate instruments.
		ME2.1.6	Simulation	Executes and tests artifact (model) with artificial data.
		ME2.1.7	Secondary data	A study that uses existing organizational and business data (e.g., financial and accounting reports, archival data, published statistics).
	ME2.2	**Qualitative**		
		ME2.2.1	Case study	Investigates one or a few cases in detail from either a positivist or an interpretive perspective.
		ME2.2.2	Interview (/focus group)	Conducted on an individual or group basis.
	ME2.3	Other	Empirical methods not described above.	

4 Discussion of Systematic Review Results

Once we classified the papers based on their topics and methods, we conducted a frequency analysis to identify the trend of the categories and place each into its appropriate period (i.e., January, 2008, to January, 2017). Next, we reviewed each paper to identify patterns/noteworthy observations and opportunities for future studies. In Tables 4 and 5, we analyze our findings and summarize their frequencies based on topic, method, and theory. We assigned unique categories to each paper reviewed. We assigned most papers to more than one category because they focused on multiple subject topics and research methodologies. The penultimate and last (i.e., the final two) columns in both tables represent how often each topic was examined according to the total number of times all topics were examined (i.e., 82) and to the total number of papers (i.e., 41), respectively.

Table 4. Topic Classification Results

Topics			08	09	10	11	12	13	14	15	16	Total	% by # topics	% by # papers
TP1	Factors influencing gamification													
	TP1.1	Development of gamified classes	0	0	0	0	1	1	2	6	4	14	17%	34%
	TP1.2	Use of gamification	0	0	0	1	0	1	0	4	1	7	9%	17%
	TP1.3	Other	0	0	0	0	1	0	0	0	0	1	1%	2%
Total			**0**	**0**	**0**	**1**	**2**	**2**	**2**	**10**	**5**	**22**	**27%**	**54%**
TP2	Application programs of gamification		0	0	0	0	0	0	0	1	1	2	2%	5%
Total			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2%**	**5%**
TP3	Impact of gamification													
	TP3.1	Cognitive belief and behavior	0	0	0	0	0	2	2	0	6	10	12%	24%
	TP3.2	Attitude	0	0	0	0	0	0	0	0	2	2	2%	5%
	TP3.3	Learning	0	0	0	0	0	2	0	0	2	4	5%	10%
	TP3.4	Performance	0	0	0	0	0	4	1	0	2	7	9%	17%
	TP3.5	Interpersonal relationships	0	0	0	0	0	1	0	0	1	2	2%	5%
	TP3.6	Motivation	0	0	0	0	0	3	2	3	3	11	13%	27%
	TP3.7	Engagement	0	0	0	0	1	3	0	3	7	14	17%	34%
	TP3.8	Other	0	0	0	0	0	0	0	0	0	0	0%	0%
Total			**0**	**0**	**0**	**0**	**1**	**15**	**5**	**6**	**23**	**50**	**61%**	**122%**
TP4	General topics													
	TP4.1	Citation analysis	0	0	0	0	0	0	0	0	0	0	0%	0%
	TP4.2	Literature review, overview and research comments	0	0	0	0	0	0	3	3	2	8	10%	20%
	TP4.3	Other	0	0	0	0	0	0	0	0	0	0	0%	0%
Total			**0**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**2**	**8**	**10%**	**20%**
All topics total			**0**	**0**	**0**	**1**	**3**	**17**	**10**	**20**	**31**	**82**	**100%**	**200%**

As for the number of papers that examined each topic, we found that TP3 was the most dominant category: 26 papers (63% of the papers in our collection) examined topics in this category. TP1 was the second most dominant category: 17 papers (41%) examined topics in this category. A much fewer number of papers examined topics in the TP2 (two papers or 5% of the papers in our collection) and TP4 topic categories (eight papers / 20% of the papers in our collection). We discuss each topic in more detail in Sections 4.1 to 4.4.

4.1 Observations and Opportunities for Topic 1: Development of Gamification

4.1.1 TP 1.1: Factors that Influence the Development of Gamification

Observations: First, we found a pattern in the number of publications that appeared each year. We found only one paper in each year from 2012 to 2014, six papers in 2015, and four papers in 2016. The increase

from 2015 suggests that researchers have begun to show more interest in sharing their experiences and findings on the design of gamified courses.

Second, we found that earlier studies in this category focused on conceptualizing the design of gamified courses whereas later ones developed design principles. For instance, Kankanhalli, Taher, Cavusoglu, and Kim (2012) described gamification as a new paradigm to engage students in the online learning environment. They preliminarily reviewed gamification concepts and sample applications by analyzing their goals, composition, benefits, and impact. Further, they enunciated possible theories that one can apply to effectively understand the three themes outlined in the study: motives, design techniques, and outcomes of gamification. Likewise, Cheong, Filippou, and Cheong (2013c) examined learners' perceptions of gamification in learning as an antecedent to the development of a gamified system that focused on improving student learning outcomes. They reported that students are highly receptive to the idea of learning through gamified courses. Similarly, Cheong, Filippou, and Cheong (2014) studied the perceptions of undergraduate students on the development of a learning system using game elements. They questioned students about their gaming experiences, their expectations of gamification in education, and their opinions on the usefulness of specific game elements to increase enjoyment in a gamified course. Wu and Wang (2014) specifically analyzed the effect of different gamification elements on learners in a model-verification study that examined the development of a gamified mobile platform designed to facilitate learning performance.

Third, we found that two studies in 2015 (El-Masri, Tarhini, Hassouna, & Elyas, 2015; Helms, Barneveld, & Dalpiaz, 2015) that implemented the design science research approach to develop recommendations for designing gamified courses. El-Masri et al. (2015) identified seven design principles of gamified education platforms that, if satisfied, could benefit students and instructors. Similarly, Helms et al. (2015) developed a taxonomy of game elements for designing class-based or computer-based trainings to increase engagement and motivation in students. They showed that gamification is useful for delivering training lessons and that it may have varying performance outcomes for different learners.

Fourth, we found studies that examined the use of technology as either a host (e.g., learning management systems (LMS) (Schöbel, Söllner, & Leimeister, 2016)) or a facilitator (e.g., intelligent virtual assistant (Vermeulen, Gain, Marais, & Odonovan, 2016)). Researchers also demonstrated the benefit of integrating multiple open source materials into courses to promote engagement and performance. Similarly, Silva-Coira, Cortiñas, and Pedreira (2016) demonstrated the use of virtual technologies to augment the effectiveness of gamification in an online course.

Fifth, we found studies that mentioned the importance of considering the unintended consequences of a course's specific components. For instance, Vermeulen et al. (2016) followed a dialectical approach to show the relations between gamification concepts and identified inadvertent unethical consequences to and from students. In doing so, they unveiled gamification's manipulative potential.

Sixth, some studies discussed the need to account for learners' preferences and response to the different sources of stimuli in a gamified course. For instance, Liu and Stacey (2015) examined the design process of intrinsic gamification. They argued that simplicity is an essential mechanic for developing a successful gamified course system. They also highlighted the need to balance extrinsic and intrinsic sources of motivation when designing a gamified course so that neither overwhelms the other.

Opportunities: we identified several future research opportunities from the papers in this category. For example, Kankanhalli et al. (2012) noted that, although each individual's motives and behaviors differ, people are naturally inclined towards rewards and incentives. Hence, future research should focus on understanding the different segments of learners in gamified environments as a means to tailor incentives that best motivate learners in each segment to learn such that learner motivation can evolve from extrinsic to intrinsic motivation over the course of time.

Similarly, Schöbel et al. (2016) suggest that gamified environments can feature different competitive structures and cooperative dynamics. They called for future studies to analyze user preferences to properly match gamification elements to the cooperative and competitive configurations of learners during the development of gamified classes. Cheong et al. (2014) also recommend longitudinal studies to identify the game elements that can impact student learning better than others. They further proposed that future studies should consider integrating gamified educational prototype schemes that can give valuable assessment information to students about their learning progress and improve gamified systems based on feedback obtained from instructors and students.

Kokkinaki, Christoforos, and Melanthiou (2015) called for the need to substantiate the degree to which gamification improves the learning process and to investigate how it can be developed in an effort to promote all facets of the general pedagogical strategy. Additionally, they noted that we need more research to investigate how to develop gamified classes so that they inhibit opportunistic behaviors and encourage only the desired behaviors in learners.

4.1.2 TP 1.2: Technical or Social/Behavioral Factors that Influence the Use (Adoption) of Gamification

Observations: From the technical perspective, we found that some researchers (e.g., El-Masri et al., 2015; Helms et al., 2015) followed the design science approach to identify design features that appeal to learners and, thus, would encourage them to adopt gamified courses. The adoption of gamified classes depends on course developers' use of gamification elements that are effective for learning (Deterding, Dixon, Khaled, & Nacke, 2011).

With respect to behavioral factors, Buckley (2015), in an empirical inventory of gamification components, identified the context-sensitivity aspect of gamification and demonstrated differential effects in the application of different types of gamification components. They further suggested that gamification has a temporal effect on learning and is effective for modifying short-term intentions but challenging for modifying long-term goals. Likewise, Teh, Schuff, Johnson, and Geddes (2013) investigated the conditions and types of mechanisms that foster engagement and help-seeking practices. They outlined the need to understand individual learners' characteristics to increase the adoption potential of gamified courses.

Opportunities: considering learners' (and perhaps instructors') needs and preferences, the studies we found indicate the need to strategically consider what gamification elements one includes in courses. Future research could examine what needs and preferences are more suitable for gamification elements. Such an endeavor would inform the taxonomy of gamification elements (Helms et al., 2015) and user preferences that can be useful as a template for developing gamified courses.

We found that research still needs to explore the social and behavioral factors that affect the adoption of gamification. Furthermore, research needs to examine the collaborative effect of gamification and demographic factors such as gender and culture and socio-economic factors such as income level. Finally, we need more studies that involve the use multiple feedback channels for students and instructors and the iterative evolution of game elements considering the value in promoting transparency and managing expectations among students and instructors.

4.1.3 TP 1.3: Other Topics Related to the Factors Influencing Gamification

Observations: we grouped only one study (Kankanhalli et al., 2012) under this category. The authors reviewed gamification concepts and sample applications associated with gamification and possible theoretically motivated factors that may influence the gamification of courses. They also laid out pertinent research questions on various aspects of gamification and provided direction for using theoretical frameworks to identify gamification determinants.

Opportunities: we need more studies to focus on measurable qualities of instructors to evaluate their perception and engagement with game elements in their course. One can then regress such qualities on student performances or learning outcomes to assess the extent to which an instructor's perception or engagement with game elements influences student performance or learning outcomes.

Further, we need research to further investigate the possible unintended consequences that may result from the use of gamified components in the classroom. As learners enjoy the use of the gamified components of a course, they may become psychologically dependent on their use of those components, which could lead to problematic behaviors. IS researchers can use existing frameworks (e.g., D'Arcy, Gupta, Tarafdar, & Turel, 2014) to uncover these behaviors and their antecedents in the education context.

4.2 Observations and Opportunities for Topic 2: Application Programs of Gamification

Observations: we grouped only two studies in this category. First, contrary to the status quo in gamification research, Schöbel et al. (2016) conducted a literature review to analyze and test which gamification elements and bundles LMS users most prefer with a focus on increasing engagement and motivation. They also investigated the number and combination of gamification elements users would implement in a learning management system. They found that LMS users prefer a bundle and combination of four gamification elements (i.e., levels, points, status, and goals) and that these elements are more important to users than leaderboards and badges. Additionally, the authors found that LMS users like to compete against themselves rather than other users, which indicates that the interaction between game elements' components and how well they align with the gamified system's objectives shape a student's experience (Cheong et al., 2014).

Second, Frost, Matta, and MacIvor (2015) gamified a course that used a non-commercial LMS designed in-house and reported to have been in use for over ten years in their college. They found similar findings to Schöbel et al. (2015) in that the application of game elements alone—regardless of the type of LMS used (whether proprietary or developed in-house)—does not directly affect learning outcomes. This finding indicates that the interaction between game elements' components and how well they align with the gamified system's objectives shape a student's experience (Cheong et al., 2014).

Opportunities: the researchers encouraged the need to consider user preferences rather than assume the "one-size-fits-all" approach that push popular elements (e.g., leaderboards and badges) on learners. Such an approach can limit gamifcation's effectiveness due to a mismatch in its goal and users' preferences.

Considering that we found only two papers for this category, one published in 2014 and the other in 2016, we have reason to believe research in this area is in its nascent stage and holds diverse opportunities with both open source and proprietary LMS in the future. Additionally, the two studies we found identified some topics in this area that future studies could examine. For instance, future research needs to examine the ways and means of incorporating game elements into learning management systems and the integration concerns that stifle the implementation of gamification plugins in LMS.

Most studies have looked at gamification have used high-level constructs such as game mechanics, game dynamics, and game components. Their results indicate that components by themselves do not produce effective learning outcomes. However, instructors could possibly perceive these components as effective if the components are used to support specific learning goals for each student. Future studies should consider the temporal introduction of game dynamics or components as a form of intervention to create an adaptive learning experience for each learner in LMS.

Further, research needs to examine what impact implementing gamification into courses has on users and the instructional design of game elements on learners' experience using other LMS because no study has integrated both well.

4.3 Observations and Opportunities for Topic 3: The Impact of Gamification

4.3.1 TP3.1: Cognitive Belief and Behavior

Observations: the papers in this category used distinct approaches to study the impact of gamification. For example, Cheong, Cheong, and Filippou (2013a) examined the effect of a gamified activity on learning. They found that participants believed that gamification improved their self-efficacy and productivity. However, Santhanam, Liu, and Shen (2016) investigated the effect of different competitive structures on cognitive outcomes and found that not all competition structures are the same and would not fit in all instances. These studies explain the mixed results commonly obtained from the effect of competitive game mechanics in technology-based learning.

Some other papers showed that students are open to learning with a gamified course and have a strong desire for social interaction. For instance, Cheong et al. (2013c) examined students' perception of gamification in learning before designing a gamified course to enhance learning. They recommended that gamified courses should effectively focus on providing feedback and progression mechanism to learners. Likewise, Pelopida and Kokkinaki (2014) focused on the initial development and implementation of a

gamified e-course on anti-plagiarism. Results from both studies indicate that learners perceive game elements in learning well and believe that gamification elements positively impact cognitive processes.

In addition, one study examined the development of an effective learning environment to enhance learning outcomes through mobile gamification. Specifically, Wu and Wang (2014) applied gamification pedagogy to a coursework to identify the different elements that promote cognitive belief and behavior in learners and proposed a new pedagogical paradigm that encourages situated mobile learning. Some studies also adapted course modules to individual learners' styles. For example, Schöbel and Söllner (2016) developed a framework to adapt user motivation patterns and preferences when integrating game elements into learning management systems.

Finally, other papers in this category investigated the concept of gamification in a different context with respect to how it influences behavioral outcomes by examining the link between design elements, psychological effects, and behavioral outcomes. For instance, Tang and Prestopnik (2016) analyzed the effects of meaningful framing of tasks and game elements on learners' behaviors in the development of a gamified information system. On improving study habits using a behavioral change framework that incorporates social motivation and gamification, Filippou, Cheong, and Cheong (2014) proposed a framework for educators to promote effective learning environments and change students' study behaviors.

Opportunities: based on the studies we placed under this category, several avenues remain open to enrich our understanding of gamification in the IS education context. First, there is promise in implementing gamified mobile learning as a paradigm shift from the current pedagogical practice. Using the literature on mobile technology as a theoretical framework, studies could explore antecedents, consequences, and conditions under which gamified mobile learning is effective. In an effort to extend the awareness of this area of research, conferences could organize workshops to invite scholars to deliberate on how to develop a research agenda around this topic.

Furthermore, future studies need to examine how user characteristics interact with game elements to influence their cognitive and psychosocial behaviors. Cheong et al. (2013a) implemented gamification in IT courses to target the bottom layer of Bloom's hierarchy, which focuses on the fundamentals of learning. They encouraged future research to focus on using different approaches such as triangulation to ascertain if gamification elements promote learning and to determine other ways to implement gamification in the educational context such that it facilitates learning at the upper levels of Bloom's hierarchy (such as promoting higher-order thinking capabilities).

We also found that research has insufficiently studied how gamification elements connect to each other and their contribution to higher-order objectives that are beyond the immediate classroom environment. We invite researchers to explore mechanisms through which this concept can be implemented with game elements to foster learning.

Similarly, Pelopida and Kokkinaki (2014) and Santhanam et al. (2016) called for future studies to investigate the degree to which gamification effects students' cognitive behaviors and highlighted the need to apply the appropriate theoretical approaches to the variations in gamification design with respect to learners' cognitive beliefs.

4.3.2 TP3.2: Attitude

Observations: the two papers in this category appeared in 2016 and presented an approach that focused on developing frameworks for matching user preferences to game elements. Schöbel and Söllner (2016) discussed the development of a gamification methodology that adapts unique specifications of different game elements to specific user motivational patterns. They created a framework for designing game elements that can be adapted to the different motivational structures of learners such that each learner's inducement level can be motivated as well. Similarly, Schöbel et al. (2016) demonstrated that most LMS users preferred gamification elements that offer direction for learning improvements on specific activities, such as levels, points, goals, and status, while other elements such as badges and leaderboards did not rank high on their preference list.

Opportunities: Schöbel et al. (2016) proposed the need to evaluate LMS users' preferences when aiming to design an effective gamified system since matching game elements to individual user preferences can make LMS more effective and improve retention. In addition, they suggested that gamification elements that target individual learning growth (without considering the progress of other users) should be

integrated into LMS. Future studies also need to examine the opportunities that cooperative dynamics have for reinforcing the alliance between learners in LMS and the relevance of competition and cooperation in education (Schöbel et al., 2016). Future research should consider exploring the vast possibilities involved in adapting gamification elements to individual users' preferences (Schöbel & Söllner, 2016).

4.3.3 TP3.3: Learning

Observations: we found that many papers in this category moved from theoretically studying gamification elements and its usefulness to using a design science approach to develop artifacts integrated with gamification elements that appeal to learners. For instance, Freeman and Freeman (2013) discussed the importance of the strategic application of gaming elements to facilitate experience and learning. Based on the backdrop of andragogy, they investigated the purpose and pertinence of gamifying learning processes in higher education and concluded that all gamification elements can be effective for influencing learning processes. Furthermore, Cheong, Cheong, and Filippou (2013b) and Botha and Herselman (2016) designed and implemented an instantiation of a gamified system to improve students' learning experiences. Botha and Herselman (2016) further presented innovative ways for instructors and subject experts to use gamification to support knowledge content creation and integration. Kuem, Wu, Kwak, Deng, and Srite (2016) examined the influence of gamification in group-based trainings and learning activities. They projected the potential success in learners' intention to learn about ERP systems.

Opportunities: although gamification techniques are beginning to mature, we still need more precise tools for evaluating the role of gamification in learning models and processes. Cheong et al. (2013b) and Botha and Herselman (2016) suggested the need for education experts to consider building systematically coordinated tools that can be embedded into learning environments to improve learning models and processes.

4.3.4 TP3.4: Performance

Observations: the techniques the papers in this category used varied significantly. Many papers focused on the effects of different gamification elements on students' performance in various contexts and in addition to other benefits that can be derived from gamification. Marshburn and Henry (2013) developed a model to compare the efficacy of gamification across online and traditional delivery modes. They found gamification to support expert coordination processes and performance in virtual environments better than in face-to-face environments.

Elsewhere, Wu and Wang (2014) enumerated diverse attributes that academic instructors can adopt to shape learning performance in mobile gamification. On the other hand, Monu and Ralph (2016) emphasized the relevance of considering how the design pattern and appeal of a gamified activity relates to the assigned tasks. They provided evidence that shows that incorporating limited narrative mechanics into a gamified activity does not improve learning effectiveness.

Using design science research to incorporate gamification into learning activities and quick quizzes—a gamified approach for enhancing learning—Cheong et al. (2013a, 2013b) developed a hands-on heuristic approach that used gamification to facilitate learning performance. They observed that including gamification elements such as progress bar enhanced students' performance and activity-completion rate.

Additionally, Shen, Liu, Santhanam, and Evans (2016) examined the effect of individual characteristics on learning performance. For instance, they found gender to moderate competitive learning and academic performance in gamified technology-mediated learning environments.

Mekler, Brühlmann, Opwis, and Tuch (2013) examined the implementation of gamification to promote the affective value of gamified components. They found that one needs to provide points in addition to meaningful framing (providing users with information of how points are valuable to higher order goals) to improve learners' performance.

Opportunities: we found no study that examined the effect of gamification on productivity. Monu and Ralph (2016) called for subsequent studies to examine the momentary and durable effects of competition aesthetics and its delivery on student performance. They emphasized the importance of additional investigation into the relationship between changes in gamification design, game appeal, and their effectiveness in education. Likewise, Shen et al. (2016) called on future research to analyze the relationship between individual differences and game elements on student performance and productivity.

Marshburn and Henry (2013) encouraged future researchers to use longer experimental periods and other methods besides self-reported data to explore the effects of team interaction on team performance in gamified environments.

4.3.5 TP3.5: Observations: Interpersonal Relationships

Observations: the two papers in this category tested the effectiveness of gamification on team coordination and interconnection. Marshburn & Henry (2013) found gamification to improve coordination processes in co-located and online software development teams. Similarly, Kallookaran and Robra-Bissantz (2016) implemented an artifact in a gamified learning environment to give learners the opportunity to familiarize themselves with their peers. They found that gamification promotes interpersonal relationships and interaction among previously unacquainted learners.

Opportunities: the two studies confirmed that gamification promotes interpersonal relationships among learners. This finding provides support for a positive unintended consequence of gamification that one can capitalize on as a strategy to encourage interpersonal relationships among otherwise timid participants. Henceforth, researchers can pay attention to the various exhibition of this tendency in their gamification studies. Furthermore, Kallookaran and Robra-Bissantz (2016) pointed out that more research needs to examine how to improve interpersonal relationships between students and how to take advantage of the effect of the alliances formed in gamified learning environments to advance learning outcomes. We found few studies in this research area, and no research has yet examined how gamification addresses cognitive conflict, tension, agreement, or interdependence in the learning context.

4.3.6 TP3.6: Motivation

Observations: we observed that a good number of the papers grouped under this category did not focus solely on the impact of game elements (mechanics and dynamics) or motivation alone but conjointly studied the effect of these elements on motivation together with students' engagement, which indicates that research has often assessed the impact of gamification on motivation and engagement together. According to theories on motivation, learners with the most interest and engagement in the learning process generally learn better and succeed more (Deci & Ryan, 1985). Motivation causes an increase in the amount of time and effort people spend on activities relevant to their needs and goals and, ultimately, their cognitive processes (Csikszentmihalyi & Nakamura, 1989; Eccles & Wigfield, 1985; Ormrod, 2008). Depending on the context, as student motivation increases, learning achievements also increases; similarly, intrinsic motivation influences learning achievements (Su & Cheng, 2015). We made four noteworthy observations in the papers that explored the influence of gamification on IS learners' motivation.

First, we found a group of papers that posited that some game elements are more effective for motivating learners. For instance, Mekler et al. (2013) experimentally examined how points and meaningful framing motivates learners. Both points and meaningful framing independently and in consolidation equally increased intrinsic motivation in an online image-annotation task. Similarly, Cheong, Cheong, et al. (2013a) developed an approach to examine the effect of gamification on students' motivation to learn. Furthermore, Cheong et al. (2013b) investigated the effect of leaderboards and progress bars on students' motivation and found gamification to be an effective tool for increasing motivation in learners. Additionally, findings from integrating open educational resources to foster serious games and gamification design principles suggests that gamified learning interventions such as video clips, animation, and educational games in an online course effectively strengthen students' motivation and learning potential (Kokkinaki et al., 2015).

Second, a group of papers accentuated the importance of recognizing that individual characteristics can determine the effectiveness of game elements. For instance, Codish and Ravid (2014) found that, through gamification, personality appeared to have a possible influence on enjoyment. Findings from this study suggest that game mechanics influence learners differently. The authors also demonstrated that, even though game mechanics are effectual for increasing enjoyment, an interaction between game mechanics and different personality types can decrease or produce different degrees of enjoyment in learners.

Third, we found papers that highlighted the need to carefully consider how one integrates game elements into learning activities and the possible adverse effects of each game element on learning. For example, Helms et al. (2015) advised that, despite the potential benefits that gamification has on modifying learners' motivation, one needs to systematically implement game elements into learning activities to avoid the risk

of focusing students' attention on game elements rather than the intended learning goals. Consistent with these findings, Hamari et al. (2014) reported that gamification can be useful for training purposes and can positively influence learners' motivation levels if properly implemented.

Lastly, Filippou et al. (2014) proposed a framework that educators can use to elicit social networking triggers to encourage positive learning habits in students. This framework is extremely useful in learning environments because it can give instructors the opportunity to better organize the learning environment such that it meets students' expectations and initiate new schemes to intensify students' learning prospects.

Opportunities: consistent with findings from Hamari et al. (2014), researchers should consider using extant literature in this stream of research to study gamification's impact on student motivation via meta-analyses, proper trials, and appropriate sample sizes. Future research should also conduct longitudinal studies to measure the effects of game elements such as points, badges, rewards, leaderboards, and progress bars on the perceived playfulness of learners (Codish & Ravid, 2014).

Additionally, future studies can expand on the various possibilities that exist in this research stream that may advance the design and implementation of gamified courses and their effect on the intrinsic and extrinsic motivation of students (Shen et al., 2016). Furthermore, unifying gamification theories and design science research approach can result in tools that simultaneously increase student motivation and enjoyment and benefit instructors (Cheong et al., 2013b).

4.3.7 TP3.7: Engagement

Observations: studies in this category primarily examined whether gamification leads to increase or decreased participation and engagement. Several papers in this category found that gamification led to increased participation in learning activities. For example, several researchers (e.g., Cheong et al., 2013a, 2013b; Freeman & Freeman, 2013; Kokkinaki et al., 2015) embedded gamification into online course designs in different dimensions and found that it increased engagement levels among learners. Additionally, Kallookaran and Robra-Bissantz (2016) found that gamification also led to better participation and engagement with course content and with learning activities among students in a face-to-face class context.

Other papers described fascinating ways by which the competitive structure of game elements influences learning outcome. For example, Tomaselli, Sanchez, and Brown (2015) found the challenge of completing a task was a stronger source of motivation for user engagement than competing against peers. However, self-efficacy beliefs and learner engagement increased when learners felt they were competing against a lower-skilled competitor. Santhanam et al. (2016) also found that competitive game designs can improve students' engagement and that the selection of competitive game designs should be based on the primacy of the intended outcomes.

Some papers examined the effect of personal characteristics on engagement in gamified courses. Shen et al. (2016) found that males engaged more in a competitive learning context than females, which indicates that student's personal differences such as gender and achievement goals are important factors that one must consider when designing gamified courses.

Furthermore, some studies examined how stimuli from social connections improves learners' participation and engagement and with course contents; for example, Filippou et al. (2014) discussed strategies that one can use to better engage students in gamified learning interventions.

Finally, we found studies that focused on identifying psychological factors that may mediate the influence of gamification on engagement. For example Suh, Wagner, and Liu (2016) found evidence for the mediating effect of autonomy, competence, relatedness, and enjoyment on user engagement in a gamified course.

Opportunities: first, little research has theoretically explored the influence of gamification on learning and engagement in team-based projects in the IS education context. We need studies to examine the combination of game elements and their implementation across multiple tools to facilitate learning core IS topics. For instance, are leaderboards and badges more effective for project teams in a systems analysis and design course compared to an ERP course?

Second, there are opportunities to tap into online social media sites for sources of motivation to encourage class engagement. A recent study demonstrated the efficacy of Twitter to promote course

engagement beyond the classroom, and it also showed that Twitter outperformed traditional LMS in terms of engagement and overall course performance (Osatuyi & Passerini, 2016). Thus, researchers could explore other ways to use social media sites to encourage course participation and engagement in IS courses.

Third, although several studies examined what influence gamifying IS courses had on users' engagement levels with them, research that used engagement theories would shed more light on the different types of engagement. For instance, engagement theory posits that one can assess engagement across several levels such as with the content, with the platform, with the content provider, and with other learners (Kearsley & Shneiderman, 1998).

4.4 Observations and Opportunities for Topic 4: General Topics on Gamification

4.4.1 TP4.2: Literature Review, Overview, and Research Comments

Observations: in TP4, we found papers only in the 4.2 category (i.e., literature reviews, overviews, and research commentaries), which indicates that only review papers examined general gamification research issues in IS education. For example, Wulf, Blohm, Leimeister, and Brenner (2014) described the extent to which integrating gamification into Web-based online courses can foster effectiveness and efficiency in learning. Additionally, some studies conducted evaluative reports that questioned the efficacy of gamification in the educational context (e.g., Hamari et al., 2014; Schöbel & Söllner, 2016). These studies concluded that some essential conditions exist that have the capacity to promote or hinder the effectiveness of gamification in IS education. Correspondingly, Putz and Treiblmaier (2015) called for the need to create a theory-based research agenda to explore gamification in IS education. Other studies (e.g., Dey & Eden, 2016) analyzed the novelty of gamification of IS education and suggested that it is simply a re-branding of existing concepts (Bui, Veit, & Webster, 2015).

Opportunities: few studies have conducted research corresponding to how we classified the general topics on gamification except for the sparse number of literature reviews and overviews. Moreover, we found no citation analyses despite the ample number of gamification papers available to support constructive citation analysis. However, researchers (see Khan & Wood, 2016, for a full review) have demonstrated the use of citation analysis as a useful technique for identifying collaborative patterns among researchers in the same domain. Such structural understanding can provide an aerial view of the domain, which can inform studies in the different areas of research.

Furthermore, more research needs to examine congruence/divergence of effective strategies/mechanisms in online versus traditional course delivery modes and adopt more mature theoretical frameworks to conduct gamification research in IS education.

4.5 Patterns and Opportunities for Methods in Gamification Research

Table 5 describes the research methods used in the papers we collected. To reiterate, the penultimate and last (i.e., the final two) columns represent how often each method was used according to the total number of times all methods were used (i.e., 71) and to the total number of papers (i.e., 41), respectively.

Non-empirical research (e.g., conceptual orientation, illustration, applied concepts, design science) accounted for 30 percent of the gamification research we found; in particular, conceptual orientation and design science have gained more attention than the others. Quantitative empirical research (such as experiments and surveys) seems to be rising with the highest numbers recorded in 2016. This stream of empirical research was also the most prevalent: it accounted for 70 percent of the existing research on gamification, which is consistent with the findings from other studies (e.g., Cao et al., 2015; Zhang et al., 2009) that have demonstrated the rising prevalence of quantitative empirical research in the IS field. From our observation, few publications used qualitative empirical research methods (e.g., case studies, interviews) even though they produce a more detailed and in-depth analysis.

We found only one paper that used secondary data to examine gamification. However, this research method has the potential to provide extensive data needed for gamification research and clarifications on the research focus. In line with recommendations from other studies (e.g., Cao et al., 2015), future studies should adopt a multi-method qualitative research approach or a mixed-methods approach, the latter of which involves synthesizing both qualitative and quantitative paradigms/methodologies.

Table 5. Method Classification Results

Methods			08	09	10	11	12	13	14	15	16	Sum	% by # of M	% by # of P
ME 1	Non-empirical													
ME1.1	Conceptual orientation		0	0	0	0	1	0	2	1	2	6	8%	15%
ME1.2	Illustration		0	0	0	0	0	1	0	1	1	3	4%	7%
ME1.3a	Theoretical analysis		0	0	0	0	0	0	0	1	2	3	4%	7%
ME1.3b	Applied concepts		0	0	0	0	0	0	0	0	0	0	0%	0%
ME1.4	Design science		0	0	0	0	0	1	1	3	2	7	10%	17%
ME1.5	Other		0	0	0	1	0	0	0	1	0	2	3%	5%
Non-empirical total			**0**	**0**	**0**	**1**	**1**	**2**	**3**	**7**	**7**	**21**	**30%**	**51%**
ME2	Empirical													
ME2.1	Quantitative													
ME2.1.1	Gamification analysis		0	0	0	0	0	0	0	0	0	0	0%	0%
ME2.1.2	Experiment		0	0	0	0	0	5	3	4	6	18	25%	44%
ME2.1.3	Field Study		0	0	0	0	0	0	0	0	0	0	0%	0%
ME2.1.4	Survey													
	ME2.1.4a	Sample survey	0	0	0	0	0	4	4	3	9	20	28%	49%
	ME2.1.4b	Systematic survey	0	0	0	0	0	0	0	0	0	0	0%	0%
ME2.1.5	Instrument development		0	0	0	0	0	0	0	1	3	4	6%	10%
ME2.1.6	Simulation		0	0	0	0	0	0	0	0	1	1	1%	2%
ME2.1.7	Secondary data		0	0	0	0	0	0	0	0	1	1	1%	2%
	Quantitative total		*0*	*0*	*0*	*0*	*0*	*9*	*7*	*8*	*20*	*44*	*62%*	*107%*
ME2.2	Qualitative													
ME2.2.1	Case study		0	0	0	0	0	0	0	3	0	**3**	4%	7%
ME2.2.2	Interview/focus group		0	0	0	0	0	0	0	3	0	**3**	4%	7%
ME2.3	Other		0	0	0	0	0	0	0	0	0	0	0%	0%
	Qualitative total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*6*	*0*	*6*	*8%*	*15%*
Empirical total			**0**	**0**	**0**	**0**	**0**	**9**	**7**	**14**	**20**	**50**	**70%**	**122%**
Total			**0**	**0**	**0**	**1**	**1**	**11**	**10**	**21**	**27**	**71**	**100%**	**173%**

4.6 Observations and Opportunities for Theory Development in Gamification Research

Figure 1 shows what theories the studies in our sample used in a word cloud. Along with the theories, we also identified the relevant independent variables, control elements, and dependent variables (see Appendix A). In general, only 17 papers out of the 41 papers included were grounded in theory. We observed that social theories (e.g., theories that support psychological processes such as social exchange theory, social capital theory, social cognitive theory), cognitive theories (e.g., cognitive evaluation theory, cognitive load theory, Kolb's experiential learning theory, Lave's situated learning theory, Constructivist theories of learning), and behavioral theories (such as self-determination theory (SDT), flow theory, uses and gratifications theory) were most dominant among the theoretical frameworks that the gamification research used.

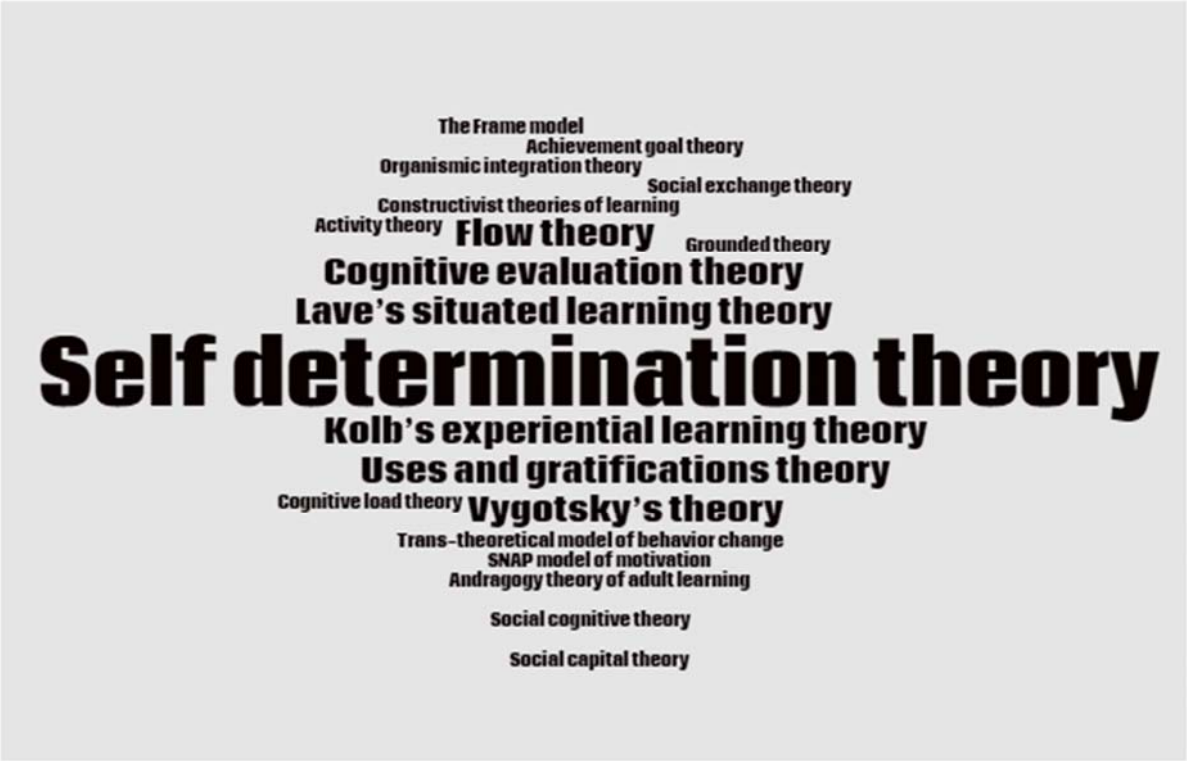

Figure 1. A Word Cloud Illustration of Theories Used in Gamification Research

As Figure 1 shows, self-determination theory, a theory of motivation (Ryan & Deci, 2000), was the most prominent. Some recent studies exclusively used SDT exclusively to examine gamification (e.g., Liu & Stacey, 2015; Schöbel & Söllner, 2016), whereas earlier studies (e.g., Cheong et al., 2013c; Kankanhalli et al., 2012) combined this theory with other theories, such as the cognitive evaluation theory (Deci & Ryan, 1985).

Although some of the publications lacked a theoretical basis, more than half of the papers had at least one or more strong and clearly defined independent variables, control elements, and/or dependent variables. Only conceptual papers (such as literature reviews and overviews) lacked these elements because they only reviewed or discussed the gamification phenomena.

5 Observations based on SNA Results

We also created an author network of IS education gamification studies, which we color coded by the authors' countries (see Figure 2). The nodes (n = 175) in the network represent authors, and the links between them represent co-authorship connections. In total, there were 52 female authors (represented as circles) and 123 male authors (represented as squares).

Table 6 summarizes the network scores we measured. In total, we found 175 nodes (authors) connected by 557 edges. We observed 62 components in the data in total. There was one isolate (i.e., single-authored paper) present in the data. The average degree was 2.114, which translates to co-authorships each author engaged in. The network density was 1.2 percent with a high clustering coefficient value of 0.842 and diameter of 3. These results indicate that collaborations occurred mostly in isolated clusters of at least two co-authors compared to the fewer isolated clusters in other IS communities. However, the nascence of gamification in IS research and specifically in IS education may explain the "foraging" approach where collaborators are exploring arable areas of gamification research.

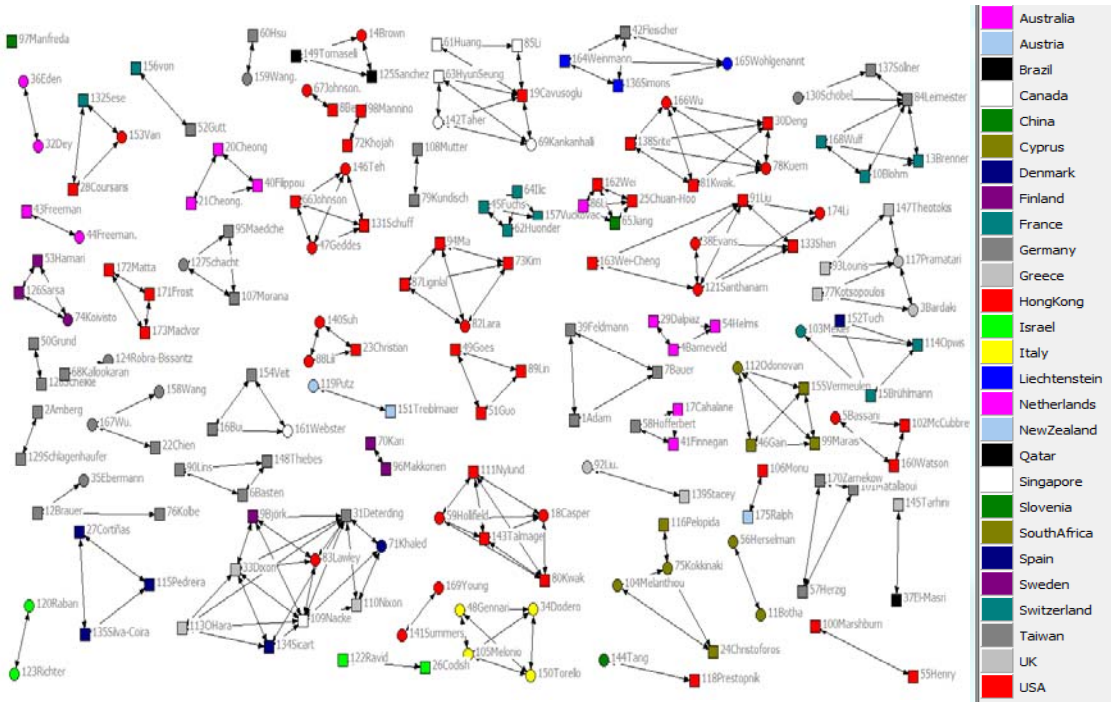

Figure 2. A Co-authorship Network Color coded by Authors' Country

Table 6. Network Measures

Network measures	Scores
Components	62
Average degree	2.114
Density	0.012
Clustering coefficient	0.842
Diameter	3
Nodes	175
Edges	557

At the node level, the authors came from a total of 27 individual countries based on their location when they published their studies (see Table 7). As one can see, most authors resided in the USA, Germany, and Australia; the fewest resided in France, New Zealand, Qatar, Slovenia, and Sweden.

As Table 8 illustrates, the results of the top five authors in terms of centrality scores indicate that Nacke and Deterding led across all the dimensions reported. Interestingly, although we found only two authors from Canada, one of them (Nacke) had the highest centrality measures and was, therefore, the most important scholar in the network of IS education gamification researchers. Nacke was connected to authors from five other countries, which avails him the opportunity to broker knowledge across geographical boundaries and potentially across topical areas as well. We observed a similar pattern with Deterding (the second of the top five authors). Consequently, international collaborations can be beneficial for gamification research in IS education as it avails scholars with varying pedagogical standards to exchange interesting ideas that will lead to a global yet concise understanding of the topic.

Table 7. Authors' Papers by Country

Country	Number of authors' papers
USA	53
Germany	44
Australia	22
Switzerland	12
Hong Kong	8
UK	8
Finland	7
South Africa	6
Taiwan	6
Cyprus	5
Greece	5
Singapore	5
Canada	4
Israel	4
Italy	4
Denmark	3
Liechtenstein	3
Netherlands	3
Spain	3
Austria	2
Brazil	2
China	2
France	1
New Zealand	1
Qatar	1
Slovenia	1
Sweden	1

Table 8. Top Five Authors in terms of Centrality Scores

Degree	Betweeness	Eigenvector
Nacke	Nacke	Nacke
Deterding	Deterding	Deterding
Dixon	Cavusoglu	Dixon
Cavusoglu	Leimeister	O'Hara
Leimeister	Pramatari	Sicart

5.1 Opportunities based on SNA Results

We can increase the network density of IS education gamification research if authors collaborate across countries. Thus, we need boundary spanners to connect subnetworks in the IS education gamification research domain. The move to increase research participation in international IS conferences indicates a progressive initial step that should be sustained to grow this area of research. Studies can examine the implications of international collaborative efforts on expanding gamification research in IS education.

Researchers in regions not represented in our data can explore this research area to provide multiple perspectives on gamification design, implementation, and use. For instance, studies can examine how contextual factors such as digital divide in emerging and developing nations inhibits or promotes gamification of IS courses and in the educational context in general.

The use of SNA as a methodology for conducting literature review is useful in revealing trends that one would have otherwise missed by using only the traditional systematic approach. Hence, we echo the call from previous studies (e.g., Khan & Wood, 2016) that researchers should consider using SNA as a viable literature methodology by itself or in addition to any conventional systematic approach as we did.

6 Conclusion

We report on a systematic review of gamification research specifically in IS education. With this study, we highlight the need to apply common terminologies in gamification research to bring uniformity to the research area. Using a multi-method approach, our results highlight various trends, observations, and understudied areas ripe for future research. Our observations also provide "best practices" and suggest improvements for future research endeavors. We found that most gamification studies have focused on the impact of gamification and the factors that influence gamification. Further, most studies used empirical, quantitative methods that included experiments followed by surveys. Although top journals emphasize theoretical rigor in their publications, few papers demonstrated a strong theoretical base.

Overall, our observations provide several opportunities for future research in this area. To answer RQ1 (i.e., topics covered), we found that most studies on the use of gamification in education described game mechanics and dynamics and reiterated their possible use in the educational context. We need more exploratory and confirmatory research to provide empirical validation of the proposed influence and relationship of game elements on learning outcomes in the IS education context. Furthermore, our results indicate that one needs to strategically and adaptively implement game elements and game dynamics for gamification to be effective in the learning context. Research on how gamification influences the instructor is extremely scarce. However, research into how instructors perceive the idea of gamifying a course may be instrumental to its success in influencing learning effectiveness for learners. As for RQ2 (i.e., methods covered), we call on researchers to consider using multi-level and multi-method approaches, which may provide more detailed explanations of gamification's influence on improving learning effectiveness. For instance, future studies can consider examining the significance of learner and instructor preparedness on certain performance outcomes.

From a theoretical perspective, to answer RQ3 (i.e., theories used), several studies conducted experiments to test the capability of game elements or game dynamics on student performance without grounding the studies in strong theoretical models. While this approach provides initial findings for understanding gamification in higher education, we call for studies grounded in strong theoretical models other than those currently used. For instance, models on technology adoption from IS, cost-benefit models from economics, and other theories in psychology may help explain gaps in the current gamification research stream. Consequently, with new and insightful explanations, researchers can develop new theories to explain how gamification influences learning dynamics in the education of IS courses in online and face-to-face course delivery settings.

Finally, the SNA results provide answers to RQ4 (i.e., collaborative strategies for brokering knowledge in the IS education gamification network). Our results show that international collaborations were the most essential means of exchanging knowledge on IS education gamification. We need to continually support efforts to share ideas and findings of IS gamification studies from different contexts across the world.

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Appendix A: Summary of All Gamification Papers Included in This Review

Table 5. Method Classification Results

Citation	Journal	Topic	Mthdgy.	Ind. var.	Cntrl. elem.	Dep. var. predicted/outcomes	Theory / model used
Deterding et al. (2011)	CHI	TP1.2	ME1.5	N/A	N/A	N/A	N/A
Kankanhalli et al. (2012)	ICIS	TP1.1, TP1.3, TP3.7	ME1.1	N/A	N/A	N/A	Self-determination theory, social exchange theory, social capital theory, uses and gratifications theory
Teh et al. (2013)	ICIS	TP1.2	ME2.1.2, ME2.1.4a	Challenge, competition, progression, feedback (absolute score or leaderboard display)	No feedback	Users' motivation, attitude, enjoyment	N/A
Mekler et al. (2013)	CHI	TP3.4, TP3.6	ME2.1.2	Points (points vs. no points), meaningful framing (framing vs. no framing).	No points, no framing	Intrinsic motivation	N/A
Marshburn & Henry (2013)	SAIS	TP3.4, TP3.5	ME2.1.2	Team interaction (gamified introduction)	No introduction, controlled introduction	Expertise location, team collaboration, team performance	N/A
Cheong et al., (2013a)	PACIS	TP3.1, TP3.4, TP3.6, TP3.7	ME2.1.2, ME2.1.4a	Gamified learning activity, game mechanics (competition, feedback (as a form of scaffolding of student learning)), game dynamics (time constraints: time based points system), personalized leaderboards.	N/A	Student enjoyment and engagement, impact on learning	N/A
Freeman & Freeman (2013)	SIGED: IAIM	TP3.3, TP3.7	ME1.2	N/A	N/A	N/A	Andragogy theory of adult learning, Constructivist theories of learning
Cheong et al. (2013c)	PACIS	TP1.1, TP3.1	ME2.1.4a	N/A	N/A	N/A	Self-determination theory (consists of cognitive evaluation theory (CET), which explains intrinsic motivation, and the organismic integration theory (OIT), which details extrinsic motivation
Cheong et al., (2013b)	PACIS	TP3.3, TP3.4, TP3.6, TP3.7	ME1.4, ME2.1.2, ME2.1.4a	Point system, progress bars, leaderboards, feedback	N/A	Game experience, motivated better performance, engagement, learning effectiveness	N/A
Filippou et al. (2014)	PACIS	TP3.1, TP3.6, TP3.7	ME2.1.2, ME2.1.4a	Social networking and gamification triggers	ME 2.1.5	Motivation	Trans-theoretical model of behavior change (TTM): pre-contemplation, contemplation, preparation, action, maintenance and termination and the SNAP (smoking, Not SMOKING, attempting to stop, planning to stop)s: model of motivation
Cheong et al. (2014)	JISE	TP1.1 TP4.2	ME 2.1.4a	N/A	N/A	N/A	N/A

Table 5. Method Classification Results

Codish & Ravid (2014)	ECIS	TP3.6	ME2.1.2, ME2.1.4a	Game elements e.g. feedback in the form of grades (points), verbal and written (badges) recognitions in the form of appraisal letters, extra bonus points (rewards), leaderboard, progress bar	N/A	Students' perception of playfulness	N/A
Frost et al. (2015)	JISE	TP2	ME 2.1.2, ME 2.1.4a	Game dynamics	Leaderboard, avatars, storyline, medals, lives, positive grade growth	Motivation, relatedness, competence, autonomy, interest, satisfaction, perception, learning	Self-determination theory
Hamari et al. (2014)	HICSS	TP3.6, TP4.2	ME1.1	Examined motivational affordances	N/A	Examined psychological/behavioral outcomes from gamification	N/A
Pelopida & Kokkinaki (2014)	MCIS	TP3.1	ME1.4, ME2.1.2, ME2.1.4a	Challenges, rewards, social influences, plagiarism specific self-expressing and self-assessment activities	N/A	User behavior, cognitive process	Vygotsky's (1978) theory of the "zone of proximal development", Kolb's (1984) experiential learning theory, Lave's (1990) situated learning theory
Wulf et al. (2014)	BISE	TP4.2	ME1.1	N/A	N/A	N/A	N/A
Wu & Wang (2014)	AMCIS	TP1.1, TP3.1, TP3.4	ME2.1.2, ME2.1.4a	Gamification pedagogy on situated learning	N/A	Cognitive load, learners' gratification, performance	Uses and gratifications theory, cognitive load theory
Schlagenhauf & Amberg (2015)	ECIS	TP4.2	ME1.5	N/A	N/A	N/A	Grounded theory
El-Masri et al. (2015)	ECIS	TP1.1, TP1.2	ME1.4	N/A	N/A	N/A	Flow theory
Helms et al. (2015)	PACIS	TP1.1, TP1.2, TP3.6, TP3.7	ME1.4, ME2.2.1, ME2.2.2	N/A	N/A	N/A	N/A
Buckley (2015)	UKAIS	TP1.1, TP1.2	ME2.1.2	N/A	N/A	N/A	N/A
Casper et al., (2015)	SAIS	TP1.2	ME2.1.5	N/A	N/A	N/A	N/A
Putz & Treiblmaier (2015)	AMCIS	TP4.2	ME1.3a	N/A	N/A	N/A	N/A
Liu & Stacey (2015)	UKAIS	TP1.1, TP3.6	ME2.2.1, ME2.2.2	N/A	N/A	N/A	Self-determination theory
Bui, Veit, & Webster (2015)	ICIS	TP4.2	ME1.1	N/A	N/A	N/A	N/A
Tomaselli et al. (2015)	ICIS	TP3.7	ME2.1.2, ME2.1.4a	Playing, mastering, competing (perceived playfulness, mastery gamefulness, performance gamefulness)	N/A	User engagement	N/A
Kokkinaki et al. (2015)	MCIS	TP1.1, TP3.6, TP3.7	ME1.4, ME 2.1.2, ME2.1.4a, ME2.2.2	Challenges, rewards, social influences, plagiarism specific self-expressing and self-assessment activities	N/A	Satisfaction, user behavior, cognitive process	Vygotsky's (1978) theory of the "zone of proximal development, Kolb's (1984) experiential learning theory, Lave's (1990) situated learning theory

Table 5. Method Classification Results

Matallaoui, Herzig, & Zarnekow (2015)	HICSS	TP1.1	ME1.2, ME2.2.1	Achievements (identifier, achievement unlocking-logic (trigger, conditions, count, pre-requirements), reward (points)	N/A	N/A	N/A
Monu & Ralph (2016)	AMCIS	TP3.4, TP3.7	ME1.4, ME2.1.2, 2.1.4a	Group (treatment or control with narrative mechanics), the score players received within the game, amount of time per week participants spend playing video games, aesthetics: competition, fantasy and challenge	Questions presented without any narrative context	Participant's test scores (performance), appeal and learning effectiveness	N/A
Dey & Eden (2016)	PACIS	TP4.2	ME1.3a	N/A	N/A	N/A	N/A
Shen et al. (2016)	PACIS	TP3.4, TP3.6, TP3.7	ME2.1.2, ME2.1.4a	User characteristics (cognitive style, personality profiles, and demographic variables- gender), game design elements (competition), and task characteristics (achievement goals- performance-avoidance goals, performance-approach goals)	No-competition, competition—losing	Intrinsic and extrinsic motivation, which ultimately leads to different experiential (desirable psychological experiences, such as aesthetic or sensual pleasure or experiential feelings of engagement, enjoyment, and flow) and instrumental outcomes (behavioral outputs, such as system use or improvements in productivity and learning outcomes)	Achievement goal theory
Schöbel & Söllner (2016)	ECIS	TP3.1, TP3.2, TP3.6	ME2.1.4a	Gamification elements - Autonomy: individualistic challenges, competence (comparison), relatedness, related competence	N/A	Motivation to use a system and the use of an information system (motivational affordance: Behavioral outcomes express themselves through psychological outcomes which are reduced to motivational affordance)	Self-determination theory
Silva-Coira et al. (2016)	PACIS	TP1.1	ME2.1.5	N/A	N/A	N/A	N/A
Vermeulen et al. (2016)	HICSS	TP1.1, TP1.2	ME1.3a, ME2.1.2 (participatory design), ME2.1.4a	N/A	N/A	N/A	Activity theory
Botha & Herselman (2016)	CONF-IRM	TP1.1, TP3.3	ME2.1.5, ME2.1.6	Adequate scaffolding, clear learning path with interim learning goals articulated as badges: 13 compulsory badges and 5 challenge badges (The compulsory badges are the ICT4RED badge, Jigsaw, Storytelling, Roleplay, Learning Stations, Educational Content creator, Mind mapping, Flipped Classroom, Game Based Learning, Filed Trips, Gallery Walk, Mobile Skills and Reflective Practitioner. The optional badges are E-mail, Twitter, App Evaluation, Assessment and Blog Collaborator)	N/A	Teaching and learning outcomes	N/A
Kuem et al. (2016)	MWAIS	TP3.1, TP3.3	ME1.2	N/A	N/A	N/A	N/A

Table 5. Method Classification Results

Schöbel et al. (2016)	ICIS	TP1.1, TP2, TP3.1, TP3.2, TP4.2	ME2.1.4a	Goals, time pressure, points, badges, status, leaderboard, level, virtual character, loss aversion, virtual goods	N/A	User preferences	N/A
Tang & Prestopnik (2016)	ECIS	TP3.1, TP3.7	ME1.1, ME2.1.2, ME2.1.4a	Meaningful framing of the game and of the task	N/A	Users' participation, engagement and behaviors	N/A
Kallookaran & Robra-Bissantz (2016)	AMCIS	TP3.5, TP3.7	ME 1.4, ME2.1.5	Gamification(extrinsic motivation through rewards - points)	N/A	Decrease anonymity	The frame model
Santhanam et al. (2016)	ISR	TP3.1, TP3.7	ME2.1.2, ME2.1.4a	Competition, competitive structures (facing a higher-skilled, lower-skilled or equally-skilled competitor)	Individual differences, prior knowledge	Self-efficacy, learning outcomes, engagement	Flow theory, social cognitive theory
Suh et al. (2016)	JCIS	TP3.7	ME1.1, ME2.1.4a, ME2.1.7	Game dynamics: Leaderboards to facilitate competition among users and virtual goods and items to help users create virtual selves (e.g., avatars) and express their emotions using emoticons	Age, gender, and education levels	user engagement	Cognitive evaluation theory

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