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A SYSTEMATIC LITERATURE REVIEW OF GAME-BASED LEARNING AND GAMIFICATION RESEARCH IN ASIA

The synthesized findings and research gap

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Introduction

Over the past decade, the popularity of computer games has led to an explosion of numerous genres of game research and development. Games are also impacting on the landscape of education. The *Horizon Report 2014*, which predicts the landscape of emerging technologies in education, suggested that games and gamification (i.e., the incorporation of game elements in non-game contexts) are expected to be widely adopted in K–12 educational contexts within the next two to three years (Johnson, Adams Becker, Estrada, & Freeman, 2014). The *Horizon Report 2015* also featured digital badges, which are a component of gamification, on the long-term horizon, with the prediction that digital badges will be implemented widely to motivate, track, and visualize learning experiences (Johnson, Adams Becker, Estrada, & Freeman, 2015).

Despite the increasing interest in games and gamification in recent years, games in general still suffer from the prevalent public perception that gameplay is merely an entertainment medium. In particular, they are often criticized for their negative effects, such as game addiction, violent behaviors, and isolation in social life. With these conflicting views of games, it is worthwhile noting the recent trend in game design and development referred to as "serious games." The notion of serious games highlights the function and power of gameplay beyond merely an entertainment medium. Serious games are intended not only to entertain users but to have additional purposes, such as education, training, and social awareness. Existing meta-reviews of the effects of serious games suggest that games can be a viable learning approach in schools when there is a tight coupling between technology and pedagogy (e.g., Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Girard, Ecalle, & Magnan, 2013; Wouters, Van Nimwegen, Van Oostendorp, & Van Der Spek, 2013; Young et al., 2012).

However, little is known about the impact of games on Asian students and schools. Scholars have noted that Asian schools have unique characteristics that differ from those in Western schools. For instance, Zhang (2007) argues that, rooted in Confucian philosophy, the Eastern

cultural tradition has shaped a pedagogical culture in Asian schools that is group-based, teacher-dominated, and centrally organized. This implies that pedagogical innovations cannot neglect unique cultural dimensions, such as epistemic beliefs, cultural norms, and socio-economic backgrounds. This conjecture also leads to the question of how the notion of serious games, which has been coined and populated in Western cultural contexts, may be translated into Eastern cultural contexts, and especially in schools.

With this backdrop, the main purpose of this research is to conduct a systematic literature review of research studies on game-based learning and gamification conducted in Asian K–12 schools. Through this review, we intend to present a comprehensive analysis of what the body of accumulated research informs us of the impact of games in Asian educational settings and to draw implications for future research directions.

Theoretical background

From edutainment to serious games

Mayer (2011, p. 282) defines games as "artificial environments that are rule-based, responsive, challenging, and cumulative." Historically, the trajectory of educational games has moved from the traditional notion of edutainment to serious games, leveraging the power of social networks and information communication technologies to immerse users in situated, collaborative, and interactive experiences. The literature suggests that there have been three generations of educational games distinctively defined by the underlying pedagogical approaches in game design and purpose (Egenfeldt-Nielsen, 2007; Ulicsak, 2010). The first generation of educational games is generally described under the broad term of "edutainment," which refers to the combination of education and entertainment elements leveraging a variety of media and technological platforms. Under the strong influence of behaviorism, learning in edutainment games typically occurs by conditioning the link between the correct response and the stimuli with a reward system. Drill-and-practice games and brain training games (e.g., Math Blaster) fall into this category.

In the second generation, education games began to employ more cognitive and constructivist approaches to engage learners in gameplay. Simulation games and micro-worlds characterize the second generation of educational games that immerse players in multimodal interactive experiences. In these types of games, learning occurs not through a simple chain of reward-based systems, but through scaffolding, exploration, and problem-solving. In the third generation, education games are strongly influenced by socio-cultural and constructivist perspectives that consider meaningful social interaction and cultural elements as important considerations in game design and gameplay. In VentureSim, for instance, players can gain knowledge and skills in a simulated virtual environment.

Many educational games can be viewed as serious games, which emphasize the function and power of gameplay beyond merely an entertainment medium. However, when games are truly engaging, there can be a thin line between entertainment and learning. Indeed, what makes games good for learning is precisely the underlying mechanism of entertaining experiences. This leads to our next topic of discussion, namely the use of game mechanics or "gamification."

Gamification

Some critics argue that existing educational games tend to coerce players into "learning," thus negatively affecting their intrinsic motivation to engage in gameplay (Kirriemuir & McFarlane, 2004). In this regard, it is important to mention a recent trend in gamification in education.

What makes games a powerful learning tool is the use of game mechanics (i.e., gamification) to promote and sustain learners' engagement and motivation. In general, gamification is defined as "the use of game design elements in non-game contexts" (Deterding, Dixon, Khaled, & Nacke, 2011, p. 9). Zichermann (2011), a leading advocate of gamification, offers another definition, articulating the purpose of the gamified process, as follows: "Gamification can be thought of as using some elements of game systems in the cause of a business objective."

Despite the popular positioning of game mechanics, such as badges, points, and levels, as core features of gamification, it should be noted that there have also been debates about and growing resistance to the simplified conception of gamification. Critics of gamification, such as Bogost (2011) and Chorney (2012), challenge the rhetorical framing of gamification based on superficial features and mechanisms. They argue that the key mechanism underlying good games is not about points, badges, and levels, but rather about stories, content, and the experiences of playing games.

In the context of gamification and education, Nicholson (2012) elaborates the definition of gamification by highlighting meaning-making processes in ludic learning spaces. He suggests that, thus far, the use of game elements has focused mainly on external motivation with reward-based systems. The BLAP gamification refers to the acronym of the four commonly used reward-based elements, namely *badges*, *levels* and *leaderboards*, *achievements*, and *points*. However, Nicholson cautions against the excessive use of BLAP gamification strategies, especially when the essential goal of games is to change human behaviors and attitudes in the long term. Instead, he puts forth the notion of "meaningful gamification" – in other words, "the use of game elements to help someone find meaning in a non-game context, and . . . therefore a tool to help people learn by changing their perspectives on life" (Nicholson, 2012, p. 2). Tulloch (2014) challenges the contested debate around gamification and argues for the need for reconceptualization in the context of play and pedagogy. He suggests that gamification is not a simple set of techniques but rather "a pedagogic heritage, an alternative framework for training and shaping participant behaviour that has at its core the concepts of entertainment and engagement" (Tulloch, 2014, p. 317). In this view, gamification that capitalizes on voluntary participation and engagement in a ludic space can be understood as an alternative form of pedagogy, with the incorporation of the sophisticated mechanics of gameplay.

While gamification research in the field of education is at an early stage, the digital badge movement taking place in schools, organizations, and online environments in recent years signals the growing interest in gamifying learning experiences. As mentioned earlier, the 2015 version of the *Horizon Report* predicted that digital badges are likely to be adopted in K–12 schools within four to five years. Digital badges are increasingly recognized as alternative approaches to demonstrate students' achievements, incentives, and learning paths, which are traditionally measured through grades and credits (Johnson et al., 2015).

Are games effective for learning?

There is no doubt that games have become a major source of entertainment and leisure activities in the Net Generation's lives. Popular commercial games can be so engaging that gamers are able to spend long hours totally engrossed in their games, by entering a state of *flow* (Csikszentmihályi, 1991) in which game players are intrinsically motivated toward the game process. *Game-based learning* leverages the characteristics and principles of good gameplay design in order to intrinsically motivate and engage users in learning contexts. Gee (2014), in his famous book *What Video Games Have to Teach Us about Learning and Literacy*, argues that video games, if designed and used in the appropriate way, could teach people knowledge, skills, and attitudes that are difficult or challenging to develop in real situations.

"Are games effective for learning?" is an enduring question that has been debated for more than a decade. Several meta-review and meta-analysis studies have attempted to answer this question by synthesizing the vast amount of research on games and learning. For instance, the meta-review by Young et al. (2012) identified about 300 articles related to video games and their impact on academic achievements. The review revealed some evidence that video games were effective for language learning, history, and physical education, but less effective for science and mathematics. In another meta-analysis of serious games, Wouters et al. (2013) examined the effects of serious games on the cognitive and motivational dimensions in particular. They found that serious games could be effective under certain conditions, namely (1) when the game was supplemented with other instructional methods, (2) when multiple training sessions were provided, and (3) when players worked in groups.

The volume of meta-review research on gamification and learning is relatively lower than that of research on game-based learning and serious games. Hamari et al. (2014) conducted a literature review of empirical studies on gamification to unpack game mechanics that make learning more effective. Their review reveals that the efficacy of gamification is highly dependent on the context and the users. The review also pointed out the need to pay more attention to the potentially negative impacts of gamification, such as increased competition and the danger of extrinsic motivation. For instance, Hanus and Fox (2015) found that the effects of gamification on students' intrinsic motivation decreased over a 16-week course. Similarly, Koivisto and Hamari (2014) found that students' engagement and interest in a gamified system decreased over time.

Research question

The aim of this research is to address the following question: "What is the impact of game-based learning and gamification research conducted in Asian K–12 schools?" While several meta-reviews concerning the impact of games on learning exist, to our knowledge, there has been no attempt to synthesize the research studies conducted in the Asian region. As such, this research aims to systematically analyze the existing literature in the area of game-based learning and gamification conducted in Asian K–12 education contexts.

Method

Data collection: inclusion and exclusion criteria

The search and selection of articles for a systematic literature review was completed in two phases. The initial selection was done by searching databases indexing educational research articles, such as ERIC, Academic Search Premier, Education Research Complete, Science Direct, and the search engine Google Scholar, using a combination of keywords such as "game-based learning," "gamification," "computer games," "educational games," "online games," and "mobile games." The second phase involved identifying relevant articles that met our inclusion criteria of (1) studies conducted in Asian K–12 school settings (2) which reported on empirical evidence, (3) which focused on students' use of games, (4) where the research was published in the six years from 2010 to 2015, and (5) where peer-reviewed articles were published in English.

As this paper focuses on students' use of games/gamification and their impact on learning, we excluded opinion or conceptual papers; non-empirical papers, such as on game development without any supporting data; and research focusing on other participants, such as teachers' use of games. Using an ancestry approach, references in articles were also examined to identify

additional relevant articles. In the end, this process yielded 22 articles for the review, including 20 journal articles and two conference papers (see the Appendix for a list of reviewed articles).

Coding framework

The 22 papers meeting the inclusion criteria were analyzed using a coding framework with multiple dimensions, namely (1) the research contextual dimension, (2) the methodological dimension, (3) the game dimension, and (4) the outcome dimension. Initially, we adapted the coding framework proposed by Connolly et al. (2012) to fit into our research foci. Two coders, who are the authors of this chapter, coded the final set of papers independently. Using the constant comparison approach, problematic categories in the initial coding scheme were revised iteratively when any discrepancies between the coders were found. The final coding scheme is presented in Table 37.1. We provide detailed descriptions and rationales for the respective coding dimensions and categories.

Table 37.1 Coding framework

Dimension	*Category*	*Value*	
Research contextual dimension	Country	1	China
		2	Hong Kong
		3	Singapore
		4	Taiwan
	School type	1	Primary
		2	Lower secondary
		3	Upper secondary
	Subject discipline	1	Language
		2	Mathematics
		3	Science
		4	Social studies
		5	Health
Methodological dimension	Study design	1	Qualitative
		2	True experimental
		3	Quasi-experimental
		4	Weak experimental
		5	Descriptive
		6	Mixed method
Game dimension	Nature of game	1	Game-based learning
		2	Gamification
	Primary purpose of the game	1	Game for entertainment
		2	Game for learning
	Developers	1	Commercial
		2	Researchers
	Platform/delivery	1	PC
		2	Mobile
	Game Genre	1	Animated tutorial
		2	Board game
		3	Puzzle/Adventure
		4	Strategy/Role-playing
		5	Simulation

Dimension	*Category*	*Value*	
Outcomes	Learning	1	Cognitive
		2	Affective
		3	Psychomotor
	Impact	1	All positive
		2	Partially positive
		3	Negative

The "research contextual dimension" includes variables related to where a research study was conducted and under what contexts in schools. The three sub-subcategories are country, school type, and subject discipline:

- *Country*: Initially, we searched widely to include as many Asian countries as possible. However, our search yielded articles from only four countries, namely China, Hong Kong, Singapore, and Taiwan.
- *School type*: Given the different schooling systems across Asian countries, we defined a "lower secondary" equivalent to middle schools or junior high schools and an "upper secondary" equivalent to high schools or junior colleges. When authors did not specify a school type, we inferred it from the mean age of students. When the mean age was below 16 years old, it was considered that a school belonged to the lower secondary category.
- *Subject discipline*: This category refers to the subject disciplines or curricular area where gameplay or gamification was mainly integrated. While the coding scheme by Connolly et al. (2012) included eight subject areas, we reduced these to five, primarily by collapsing subjects like history and geography under social studies. This was done with the consideration that in primary school contexts, history and geography are generally taught as an integrated subject under social studies rather than as separate subject areas.

With regard to the "methodological dimension," the papers were coded in terms of the type of research design used, which, with reference to Cheung and Hew (2009), included (1) qualitative, (2) true experimental, (3) quasi-experimental, (4) weak experimental, (5) descriptive, and (6) mixed method designs. To begin with, each paper was categorized as either a quantitative or qualitative study. Qualitative study refers to the use of qualitative data for analysis, such as interviews, observations, and log data. Quantitative research design was categorized as true experimental, quasi-experimental, weak experimental, and descriptive:

- Both *true experimental research* and *quasi-experimental research* include experimental and control groups. A study was coded as true experimental only when authors explicitly mentioned that there was a random assignment to experimental conditions.
- *Weak experimental* refers to a research design with no control group involved, but one that is experimental in nature, such as one group pre-test and post-test design and post-test only design with multiple groups.
- *Descriptive study* refers to a research design where particular phenomena are described in a quantitative manner, but with no experimental conditions. Generally, a descriptive study uses surveys with descriptive and inferential statistics.
- *Mixed methods* refer to the research design where both qualitative and quantitative research methods are employed.

The "game dimension" refers to the nature and type of games used in each research study. Broadly speaking, they include the nature of the game, the primary purpose of the game, developers, platforms/delivery, and game genre:

- *Nature*: Initially, each research study was categorized depending on whether it focused on game-based learning or gamification.
- *Primary purpose of the game*: Next, each study was evaluated based on whether the game was designed originally for entertainment or learning.
- *Developers*: Similarly, each study was evaluated based on whether the game was developed originally as a commercial game by professional game designers or as an educational game by researchers.
- *Platform/delivery*: This category refers to the type of platforms through which the game is delivered. The delivery medium includes computers and mobiles. While the coding framework proposed by Connolly et al. (2012) includes more platform/delivery types, such as video console, second life, and alternate reality games (ARG), we found that these extra categories rarely appeared in the studies reviewed.
- *Game genre*: While several scholars propose a typology of games, the classification of the game genre is perhaps the most difficult category to code because of the overlapping nature of these genres. We found that the categorization of games by Connolly et al. (2012) was problematic for our review because several games these days appear to include more than one game attribute (of course, it is possible that there is one dominant genre of game). Hence, we collapsed some categories, such as puzzle and adventure, into one category and strategy and role-playing into another. Whenever information was available, we coded the game genre according to the term that authors specified in their article. When authors did not specify a game genre, we referred to the literature pertaining to typologies of game genres, such as Apperley (2006), Aldrich (2009), Bedwell et al. (2012), Lindley (2003), and Ulicsak (2010). The following are the descriptions of each game genre in our coding framework:
    - *Animated tutorials* tend to promote drill-and-practice and the delivery of factual information in explicitly instructional ways.
    - *Board games* involve moving pieces on a board according to pre-set rules.
    - *Puzzle/Adventure* includes games that involve the use of challenging tasks and quests. They may involve quests in animated adventures. These kinds of games are usually played by a single player, and the type of roles played is not significant.
    - *Strategy/Role-playing* generally includes games known as RPG (Role-Playing Game) and MMORPG (Massively Multiplayer Online Role Playing Game). In game narratives, there exist clear goals and rules specific to roles played. Role-playing games can also be strategic since players need to incorporate tactical movements and strategic decisions. The game can be played by single players or multiple players at the same time.
    - *Simulation* refers specifically to the genre of game that simulates real-life situations. Some overlaps may exist between simulation and strategy/role-playing games. We define simulation games based on an open-game structure which lacks goal-oriented activities and clear endings.

Lastly, the "outcomes dimension" analyzes the effects of games reported in each study with two sub-categories, namely learning and impact:

- *Learning*: Learning outcomes are based on Bloom's three domains of learning, namely *cognitive*, *affective*, and *psychomotor* domains (Bloom, Krathwohl, & Masia, 1984).

- *Impact:* The findings in each study were rated based on whether they reported mainly positive, negative, or mixed impacts of game-based learning or gamification.

Results

Research contextual dimension

Table 37.2 presents the results of the research contextual dimension. Geographically, the final set of 22 articles comes mainly from four countries: one from China, three from Hong Kong, seven from Singapore, and 11 from Taiwan. Significantly, the 11 articles produced in Taiwan constitute 50% of the total articles reviewed. While this trend may indicate that game-based learning research has been active in Taiwan, it should be noted that overall, we found that the same researchers tend to publish multiple articles from similar research projects or research contexts. Hence, a higher number of published articles alone may not be an indicator of a higher number of researchers or research programs on this topic in a particular country.

Despite our efforts to include a wide range of Asian countries in the review, we were unable to identify research studies conducted in developing countries. The study by Tian et al. (2010) was the only article that examined the effect of game-based learning in under-resourced areas. They developed two mobile group-learning games to teach children in Xin'an, an underdeveloped region in the Henan province in China, how to write Chinese characters. It is also interesting to note that the design of the two literacy games was culturally inspired by the analysis of traditional Chinese group games.

With respect to research settings, 13 articles out of 22 papers reported on studies conducted in primary schools. The number of research studies conducted in primary school contexts (13) was higher than that in secondary school contexts (9). On the whole, the trend indicates that games and gamification approaches have been employed in lower grade levels rather than higher grade levels in schools.

As shown in Figure 37.1, the results demonstrate that a majority of studies focused on the use of games and gamification in subject disciplines such as social studies (9) and science (9). Other subject areas include language (2), mathematics (1), and health (1). While not common, some researchers attempted to leverage the affordances of games in non-core subject disciplines in schools like citizenship education (Chee, Mehrotra, & Liu, 2013; Lim & Ong, 2012; Lim &

Table 37.2 Research context dimension

		Frequency	*Percentage (%)*
Country	China	1	4.5
	Hong Kong	3	13.6
	Singapore	7	31.8
	Taiwan	11	50.0
School type	Primary	13	59.1
	Lower secondary	7	31.8
	Upper secondary	2	9.1
Subject discipline	Language	2	9.1
	Math	1	4.5
	Science	9	40.9
	Social studies	9	40.9
	Health	1	4.5

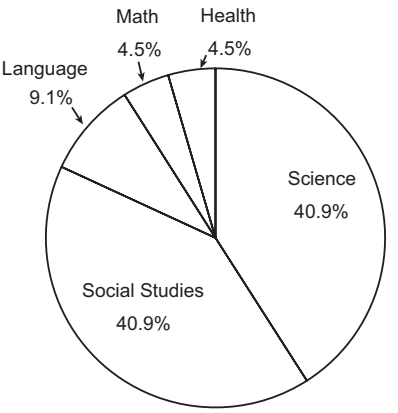

Figure 37.1 Subject discipline

Table 37.3 Methodological dimension

	Frequency	*Percentage (%)*
Qualitative	1	4.5
True experimental	1	4.5
Quasi-experimental	8	36.4
Weak experimental	3	13.6
Descriptive	3	13.6
Mixed method	6	27.2

Ong, 2014) and health education (Fan, Xiao, & Su, 2015). For instance, Lim and Ong (2012 & 2014) foregrounded the importance of citizenship education, known as National Education in Singapore schools, and examined how a video game called *The Rise of Li'Ttledot* could promote a sense of participatory citizenship among primary school students. In teaching core subjects like science, it appears that the researchers attempted to position games not as a tool simply imparting abstract knowledge but as a space for situating identities and disciplinary practices. This position is strongly emphasized in Chee and Tan's (2012) study, where they integrated the 3-D game *Legends of Alkhimia* into the chemistry curriculum in a Singaporean secondary school to support students in thinking and acting like chemists in the game environment.

Methodological dimension

Table 37.3 presents the results of the methodological dimension. Our review indicates a somewhat homogenous pattern across the 22 articles in terms of research design. It appears that the dominant methodological orientation is quantitative rather than qualitative. The research studies coded include one qualitative, 15 quantitative, and six mixed methods designs. Except for one qualitative study, the majority of the reviewed articles employed quantitative research methods. Approximately 70% of the reviewed articles employed true experimental or quasi-experimental research designs, indicating that researchers tend to have a strong preference for having a control group for comparison. The study by Hwang, Sung, Hung, Huang, and Tsai (2012) is a typical example of such a controlled research design. To examine the efficacy of the

personalized educational computer game on learning achievement, they designed two conditions: the experimental group where students learn with an adaptive educational game based on their learning styles and the control group where students learn with the same educational game but without adaptive features.

Six articles employed mixed methods, combining qualitative methods with either quasi-experimental or descriptive methods. Qualitative data were generally in the form of interviews with selected students. The only qualitative study was conducted by Jong and Shang (2015), in which they examined through a case study how four students with varying levels of game experiences and learning attitudes perceived the impact of game-based learning.

Game dimension

Table 37.4 presents the results of the game dimension. The vast majority of the reviewed articles focused on game-based learning. Despite the recent interest in gamification, we identified only three articles – Liu and Chu (2010), Su and Cheng (2015), and Boticki, Baksa, Seow, and Looi (2015) – which examined the impact of gamification in Asian educational contexts. Most studies on game-based learning used games originally developed by researchers for learning purposes. The exceptions were two instances of commercial games in Sun, Wang, and Chan (2011) and Yang (2012). Sun et al. (2011) used the *Professor Sudoku* game to teach mathematics. In Yang (2012), students in the Civics and Society course used *Tycoon City: New York* and *SimCity Societies* to solve complex problems in simulated environments.

The most popular platform for delivering games is the PC (15). The remaining seven papers dealt with mobile games. Tapping into the ubiquitous use of mobile devices, some studies, like Liu and Chu (2010) and Su and Cheng (2015), examined the potential impact of context-aware mobile games. For instance, the research study by Liu and Chu (2010) presents a treasure hunt game called *Campus Life* that helps students with a mobile device to practice English conversation skills with access to context-aware content materials.

Regarding game genres, the most popular genre is strategy/role-playing games (10), followed by puzzle/adventure games (7). There were two studies for which we were unable to

Table 37.4 Game dimension

		Frequency	*Percentage (%)*
Nature of game	Game-based learning	19	86.4
	Gamification	3	13.6
Primary purpose of game	Entertainment	1	4.5
	Learning	21	95.5
Developers	Commercial	2	9.1
	Researchers	20	90.9
Platform/Delivery	PC	15	68.2
	Mobile	7	31.8
Game genre	Animated tutorial	1	4.5
	Board game	1	4.5
	Puzzle/Adventure	7	31.8
	Strategy/ Role-playing	10	45.5
	Simulation	1	4.5
	Not identifiable	2	9.1

identify a game genre, owing to the lack of information on games provided in the articles. There was only one instance of a simulation game. Animated tutorial games for drill-and-practice or for reinforcing simple factual knowledge rarely appeared in the reviewed articles.

Outcomes

Table 37.5 presents the results of the outcomes dimension. One of the central aims of this review was to examine the impact of game-based learning and gamification with respect to student learning outcomes. The learning outcomes reported in the reviewed articles were categorized into cognitive, affective, and psychomotor domains. The results revealed that 15 out of the 22 articles reported learning outcomes in both cognitive and affective domains, followed by five articles in the affective domain only, and two articles in the cognitive domain only. Interestingly, there were no articles that reported on the impact of games in the psychomotor domain. Learning in the cognitive domain was typically measured through academic achievement tests measuring conceptual understanding and problem-solving skills. The variables in the affective domain include learning attitude, motivation, collaborative learning, and satisfaction. Researchers interested in the immersive nature of games on learning attempted to examine the notion of "flow" (Csikszentmihályi, 1991, 2000) as an important psychological construct in game-based learning (see Hwang, Wu, & Chen, 2012; Hsiao, Chang, Lin, & Hu, 2014; Hwang, Chiu, & Chen, 2015).

With regard to the impact of games on learning outcomes, 13 articles reported all positive findings, while nine articles reported partially positive findings. No single article reported only negative findings. This bias with regard to reporting positive findings may be linked to the nature of journal publications that tend to prefer reporting significant findings.

Discussion

Overall trends of educational game research in Asian K–12 education

What does the collective body of research studies concerning game-based learning and gamification in Asian K–12 education inform us of the effects of games for learning? We present the following response by synthesizing the research findings through this systematic literature review:

> *The research studies on game-based learning and gamification in Asian K–12 education have been conducted mainly in a small number of developed countries, in primary schools, in the*

Table 37.5 Outcomes

		Frequency	*Percentage (%)*
Learning	Cognitive only	2	9.1
	Affective only	5	22.7
	Cognitive + affective	15	68.2
	Psychomotor	0	0
Impact	All positive	13	59.1
	Partially positive	9	40.9
	Negative	0	0

subject areas of science and social studies. The effects of games on learning are measured in both cognitive and affective domains through quantitative measures, often involving a control group. Overall, the efficacy of games and gamification is positive.

Mayer (2011) categorizes research on educational games into three genres, namely (1) value-added research examining the question of "Which features improve the effectiveness of an educational game?", (2) cognitive consequences research examining the question of "What do people learn from playing a game?", and (3) media comparison research asking the question "Do people learn better with games or conventional media?" Adopting Mayer's categorization, we found that the vast majority of the research on educational games conducted in Asian K–12 schools falls into the cognitive consequences research and media-comparison categories. One of the major recurring themes in the 22 articles identified for this review is that games coupled with supporting pedagogical approaches can be effective for improving cognitive and affective dimensions of learning. Only a few research studies have looked into the deeper mechanisms of game features associated with learning efficacy.

One of the most notable trends revealed by this review is that there was no variety of game genres. Role-playing and strategy games were the most frequently occurring genre, possibly due to their emphasis on higher-order thinking skills, such as complex problem-solving and sophisticated decision-making skills. While we agree with the relevance of role-playing and strategy games for educational purposes, we also call for more research on a greater diversity of game genres.

Overall, we found that many of the articles reviewed in this study demonstrated a homogeneity in methodological approaches to game research. This is evident in the high number of experimental studies predominantly focusing on the use of games in science and social studies. This quantitative orientation in research methodology is somewhat inconsistent with the research study by Zhao et al. (2008), which highlighted Chinese researchers' deviation from empirical methods. Zhao et al. suggest that while the educational research in the Western epistemological tradition tends to take analytical empirical approaches, educational research in the Chinese tradition is more inclined toward holistic and dialectical approaches. We found this difference between Eastern and Western cultures not to be the case, at least for the topic of educational game research. We speculate two possible reasons for this phenomenon. The first is that the dominance of experimental research examining the impact of games on the cognitive domain in controlled settings may reflect the classroom culture in Asian schools, which advocates high academic achievement. Another potential reason is that researchers tend to pursue a research agenda in order to demonstrate the link between games and academic results, given that games in Asian cultures tend to be banned in schools or to convey negative connotations such as aggressive behaviors and addiction.

While we believe that empirical evidence is critical in making valid scientific arguments concerning the efficacy of games, the high reliance on experimental research for media-comparison purposes may lead to lost opportunities to unpack important implementation issues in schools. Learning with games is a complex process since the use of games in schools often comes into conflict with existing teaching and learning practices. Squire (2006, p. 24) argues that "games embody values (collaborative learning, learning through failure, personalized learning) that are at odds with the grammar of formal schooling." We also concur with the view by Klopfer and Squire (2008, p. 224) that "game experience is a function of the classroom culture and context plus the software." However, little research in our review adopted iterative, responsive, and descriptive approaches to deal with the complexity of integrating games in the traditional classroom culture and context. The only exception was the design-based research by Boticki et al.

(2015), which examined the impact of virtual badges over a one-year period. By considering how gamifying learning experiences unfolded across multiple locations for a longer period, they were able to unpack how primary school students in Singapore participated in the gamified mobile learning platform across formal and informal settings.

Research gaps and recommendations for future research

The following recommendations have been formulated through our review to better understand and evaluate the impact of games and gamification as learning tools in the K–12 education context in Asia.

1 Examine the impact of games and gamification through diverse research methods

The papers selected for this review were not diverse in terms of methodological approaches. The results show that the reviewed articles tended to use a quasi-experimental design while qualitative research was relatively uncommon. While we agree that the experimental research design with a control group can provide strong evidence about the impact of games on learning outcomes, we are equally concerned about the implications of the lack of methodological diversity. In recent years, several scholars have started unpacking the criticality of informal learning spaces and their impact on social learning processes. This review recommends that researchers need to explore diverse research methods in order to better understand the impact of games on the new generation of Asian learners, beyond school contexts.

2 Conduct longitudinal studies that examine the impact of game-based learning and gamification across timescales and multiple spaces

In our review, we found only one article that collected data in a longitudinal study (Boticki et al., 2015). Most studies examined the effects of games during a short intervention period, from two days to a few weeks. While longitudinal research is labor- and data-intensive and involves methodological challenges, we believe that research studies which go beyond short-term interventions are necessary to better understand how the new generation of learners accept, utilize, or misuse games. In particular, with the increase in mobile games, it is now possible to play games across different contexts. It would be useful to examine how students play games in various physical and virtual spaces beyond school curricula hours and to trace their cognitive and attitudinal changes over a longer period of time.

3 Provide lessons learned for scalability and sustainability

Despite the public concern associated with the negative impacts of games, we were surprised to find that the majority of papers in this review reported positive outcomes. While it is encouraging to see the positive impacts of games and gamification, we can also learn from studies which report negative impacts or potential issues of games and gamification. Consistent with Connolly et al. (2012), there were few examples of commercially developed games used in the intervention. Given that most commercial games lack customization features, it is possible that researchers prefer to have their own games developed in a way that is consistent with their research goals. While we support the importance of research-informed game development, it is

questionable as to how the issues of scalability and sustainability of such games were addressed after research interventions.

Zhang (2010) argues that one of the core reasons that new technologies cannot play transformative roles in schools is associated with the ritualization and lethal mutation of learning innovations in implementation. One of the key attributes of design-based research is to provide thick descriptions about implementation paths and lessons learned, which can inform researchers taking similar research trajectories of valuable information about potential implementation challenges (Collins et al., 2004). As such, we recommend that researchers provide thick descriptions about research implementation processes and share lessons learned with the research community. In this way, it will be possible to identify unique challenges in Asian schools and for Asian researchers to make collective efforts towards resolving such issues.

4 Conduct research studies in resource-poor and under-developed countries

As mentioned earlier, this review found only one instance of the use of educational computer games in an under-developed region. It is possible that computer games with several hardware and software requirements are not viable in countries or regions with low technical infrastructure. Nevertheless, gamification, non-digital games, and mobile games require relatively fewer technical set-ups and can be integrated easily into the existing socio-technical structure of many resource-poor and under-developed countries. For instance, the Accenture report (2013) highlighted that the impact of gamification is particularly promising in Southeast Asia because of the high penetration of smartphones and the popularity of online games among the younger generation.

Limitations

Some limitations of the current review should be noted. First, the reviewed articles were limited by the search terms, the databases, the journals, and the publication language. Hence, some caution is required when extrapolating the results to other contexts of research foci. In particular, language barriers are a major issue for conducting this type of systematic literature review, as we are confined to the range of research databases and search engines available in English only. As a result, it is possible that we missed out on a number of important research studies on game-based learning and gamification conducted in other countries because they were published in local languages, and not in English.

Conclusion

About a decade ago, Squire (2006) argued that gameplay should be framed as a designed experience, and called for a shift of focus *from content to context*. Our literature review suggests that such a shift from content to context in educational game research in Asian K–12 is still in transition. While the overall findings in the reviewed articles advocated the positive efficacy of games on learning outcomes, we identified some research gaps, including the lack of diversity in subject disciplines and game genres, the dominance of the media-comparison experiment, and the issues of sustainability and scalability.

The contribution of this review is that it synthesizes the research findings of game-based learning and gamification with a particular focus on their efficacy in the Asian K–12 context. Hew et al. (2016) argue that research on game mechanics tends to be dominated by researchers

from Europe and North America. Thus, we call for more research into non-digital games and gamification in Asian educational contexts. This is particularly important when considering the high percentage of under-developed and developing countries in the Asia region. Finally, given the high-cost infrastructure required for integrating digital games into schools, we recommend that more researchers need to explore the affordance of low-cost solutions from appropriate technology perspectives in under-explored areas.

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Appendix
SUMMARY OF RESEARCH STUDIES REVIEWED

	Study	*Country*	*Purpose*	*Method*	*Game Genre (name)*	*Learning Domain*
1	Gwee, Chee, and Tan (2010)	Singapore	To explore the characteristics of patterns of participation in social and gameplay spaces outside the classroom of ten 15-year-olds	Descriptive	Strategy/Role Playing (Statecraft X)	Affective
2	Liu and Chu (2010)	Taiwan	To investigate how ubiquitous games influence English learning achievement and motivation through a context-aware ubiquitous learning environment	Mixed method	Puzzle/ Adventure	Cognitive & Affective
3	Tian et al. (2010)	China	To construct effective mobile learning games using culturally inspired traditional Chinese group games	Mixed method	Animated tutorial (Drumming Stroke)	Cognitive & Affective

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	Study	*Country*	*Purpose*	*Method*	*Game Genre (name)*	*Learning Domain*
4	Marsh, Nickole, Klopfer, Chuang, Xuejin, Osterweil, and Hass (2011)	Singapore	To shed light on the effectiveness of puzzle and narrative-based games in engaging students, their learning experience and understanding in a Singapore high school	Weak Experimental	Puzzle/ Adventure (Waker)	Cognitive & Affective
5	Sun, Wang, and Chan (2011)	Taiwan	To classify built-in critical features, frustration control and demonstration scaffolds, and to investigate their effects on player/learner behaviors	Weak Experimental	Puzzle/ Adventure (Professor Sudoku)	Cognitive
6	Chee and Tan (2012)	Singapore	To explicate the learning program with an educational game for 13 to 14-year-olds to foster the learning of chemistry through inquiry	Weak Experimental	Strategy/ Role-playing (Legend of Alkhimia)	Cognitive & Affective
7	Hwang, Wu, and Chen (2012)	Taiwan	To investigate how online games influence students' learning performance and flow experience	Quasi-experimental	Board game	Cognitive & Affective
8	Hwang et al. (2012)	Taiwan	To explore the effectiveness of a personalized game-based learning approach based on the sequential/global dimension of the learning style	Quasi-experimental	Strategy/ Role-playing	Cognitive & Affective

	Study	Country	Purpose	Method	Game Genre (name)	Learning Domain
9	Lim and Ong (2012)	Singapore	To investigate the use of a bespoke video game 'The Rise of Li' Ttledot' in promoting a sense of participatory citizenship among young learners	Mixed method	Strategy/ Role-playing (The Rise of Li'Ttledot)	Affective
10	Yang (2012)	Taiwan	To investigate the effectiveness digital game-based learning on students' problem solving, learning motivation, and academic achievement	Quasi-experimental	Simulation (Tycoon City: New York, SimCity Societies)	Cognitive & Affective
11	Chee, Mehrotra, and Liu (2013)	Singapore	To describe the Statecraft X game-based learning program that blends performative game-based learning with dialogic pedagogy in the context of citizenship education	Quasi-experimental	Strategy/Role-playing (Statecraft X)	Cognitive & Affective
12	Sung and Hwang (2013)	Taiwan	To develop a collaborative game-based learning environment by integrating a grid-based Mindtool to facilitate the students to share and organize what they have learned during the gameplaying process	Quasi-experimental	Strategy/ Role-playing (Repertory grid-assisted collaborative educational game)	Cognitive & Affective

(*Continued*)

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	Study	Country	Purpose	Method	Game Genre (name)	Learning Domain
13	Hsiao et al. (2014)	Taiwan	To examine how different instructional strategies affected the students' creativity and their performance on manual skills	Quasi-experimental	Puzzle/ Adventure (ToES)	Cognitive & Affective
14	Hwang, Hung, and Chen (2014)	Taiwan	To propose a peer-assessment-based game development approach for improving students' learning achievements, motivations and problem-solving skills	Quasi-experimental	Puzzle/ Adventure (Student designed games)	Cognitive & Affective
15	Jong (2014)	Hong Kong	To identify the effect of the online game-based virtual learning environment on facilitating elementary students to pursue social inquiry learning and hence attain collaborative knowledge building	Descriptive	Strategy/Role-playing (Learning Villages)	Affective
16	Lim and Ong (2014)	Singapore	To investigate the use of game 'The Rise of Li' Ttledot' as an intervention that leverages game-based learning in citizenship education	Mixed method	Strategy/ Role-playing (The Rise of Li'Ttledot)	Affective

	Study	*Country*	*Purpose*	*Method*	*Game Genre (name)*	*Learning Domain*
17	Su and Cheng (2015)	Taiwan	To investigate how a gamified learning approach influences science learning, achievement and motivation, through a context-aware mobile learning environment, and explains the effects on motivation and student learning	True Experimental	N/A	Cognitive & Affective
18	Boticki et al. (2015)	Singapore	To examine SamEx, a mobile learning system used in formal and informal learning in a primary school in Singapore with a focus on self-directedness, quality of contributions, and answers to contextual question prompts	Descriptive	N/A	Cognitive & Affective
19	Fan et al. (2015)	Taiwan	To discuss the correlations among learning styles, meaningful learning, and learning achievement in comprehension with gamification learning	Quasi-experimental	Puzzle/ Adventure (Mobile Meaningful Blood Circulation Learning System)	Cognitive & Affective

(*Continued*)

(Continued)

	Study	Country	Purpose	Method	Game Genre (name)	Learning Domain
20	Hwang et al. (2015)	Taiwan	To evaluate the effects of the proposed approach on the inquiry-based learning performances of students with different learning styles	Mixed method	Puzzle/ Adventure	Cognitive & Affective
21	Jong (2015)	Hong Kong	To compare the pedagogical effectiveness of VISOLE and the traditional classroom teaching approach, in terms of students' knowledge acquisition with respect to a formal curriculum	Mixed method	Strategy/Role-playing (Farmtasia)	Cognitive
22	Jong and Shang (2015)	Hong Kong	To probe into the impeding phenomena emerging from the course of students' learning on the implementation of VISOLE	Qualitative	Strategy/Role-playing (Farmtasia)	Affective