A scoping review of digital game-based technology on English language learning

Abstract

Learning with games has been increasing in practice, but review studies of the features and learning outcomes involving digital games to develop language learning are scarce. This scoping review investigates the current practices of digital game-based language learning to support English language learning, in terms of participants' characteristics, methodological features, gaming characteristics, and an association between game availability and gaming characteristics. Our results indicate: (1) vocabulary is the most dominant practiced language skills; (2) methods employed were primarily quantitative with researcher-designed tests; (3) commercial games contain the most elements of a good game; (4) use of good gaming elements is inconsistent among digital games. We provide strategies for educational researchers to improve their rigor in research, along with explicit criteria that digital game designers can apply toward language-learning game development. As educational technology continues to transform language learning, we emphasize the need for continued research and development that investigates how gaming elements in mobile learning environments may improve language-learning outcomes.

Keywords: digital games, gaming elements, language learning, scoping review

Introduction

Over the past few decades, the advancement of technologies has brought new possibilities for learning into the educational context (Reynolds & Anderson, 2015; Shadiev, Hwang, Huang & Liu, 2018). According to Richey, Silber, and Ely (2008), educational technology refers to the development and practice of physical technologies (e.g., equipment, devices) and software for educational purposes. With specific regard to technologies found within the educational context, the intended purpose is to provide educational learning support. Utilizing technologies can contribute to a more efficient teaching and learning process (Richey et al., 2008).

Digital Game-based Learning

Among the studies on educational technologies, digital game-based learning (DGBL) has received escalating attention. DGBL refers to a digital and playful activity, which contains educational objectives and assessment/evaluation (Hung et al., 2018; Ke, 2016). Specifically, DGBL aims to help learners overcome possible barriers such as anxiety, low motivation, understanding difficulties, low engagement and the lack of interaction, and achieve educational purposes (Bork, 2012; Hung, Chang, & Yeh, 2016; Sung & Hwang, 2013; Yang, Quadir, Chen, & Miao, 2016; Yükseltürk, Altiok, & Baser, 2018). Recent studies have confirmed the effectiveness of utilizing DGBL in different subjects such as mathematics (e.g., Fokides, 2018; Kiili, & Ketamo, 2018), science (e.g., Anderson, & Barnett, 2013; Bunch, Robinson, Edwards, & Antonenko, 2014; Webb, Bunch, & Wallace, 2015), and engineering (Joiner et al., 2011).

Digital Game-based Language Learning

Research has emphasized the benefit of applying various language acquisition theories to improving our understanding of digital game-based language learning (DGBLL), such as second

language acquisition within the context of socio-cultural theory (Pavlenko & Lantolf, 2000) and Krashen's hypothesis of lowering affective barriers to language learning (Krashen, 1982). Learners may benefit from the experience of playing games while learning because they are acquiring target knowledge in an interactive manner that is also motivating. According to Klimova and Kacet (2017), DGBLL facilitates the language learning process by: 1) providing visual and auditory exposure to the target language; 2) emphasizing specific language knowledge (e.g., vocabulary and grammar); and 3) promoting engagement/involvement in language learning and practice.

The use of digital game-based language learning (DGBLL) to support English as a second language (ESL) and English as a Foreign Language (EFL) learners is not a new approach to address how educational technology can support language learning. Over the past the decade, although some of the studies yielded mixed results (e.g., Jalali & Dousti, 2012; Lucht & Heidig, 2013), more studies reported that DGBLL was effective for English language learning in vocabulary (e.g., Ebrahimzadeh, 2017; Jensen, 2017), pragmatics (e.g., Peterson, 2012; Shirazi, Ahmadi, & Mehrdad, 2016), grammar (Cornillie, Van Den Noortgate, Van den Branden, & Desmet, 2017; Mehrpour & Ghayour, 2017), writing (Allen, Crossley, Snow, & McNamara, 2014; Lin et al., 2018), and speaking (Hwang, Hsu, Lai, & Hsueh, 2017).

Although extensive empirical evidence of DGBLL has been collected, there is a paucity of reviews with a focus on DGBLL (e.g., Chiu et al., 2012; Hung et al., 2016; Hung et al., 2018; Jabbari & Eslami, 2018; Peterson, 2016), especially on the learning of English as a second/foreign language. It is important to canvas the literature on how DGBLL has been used to develop ESL and EFLs' learning, particularly because increasing attention has been given to language learning with the use of digital games over the implementation of non-digital strategies (Boyle et al., 2016; Hung, Yang, Hwang, Chu, & Wang, 2018).

Previous Reviews

Over the past decade, there has only been one meta-analysis on DGBLL (Chiu, Kao, & Reynolds, 2012) and another by Tsai and Tsai (2016) on Massively Multiplayer Online Role-Playing Games (MMORPG). In addition, three systematic reviews on DGBLL (Hung, Chang, & Yeh, 2016; Hwang & Wu, 2012; Klimova & Kacet, 2017) and one review on MMORPGs (Peterson, 2016) were performed. We were only able to identify two scoping reviews (Hung et al., 2018; Jabbari & Eslami, 2018) on DGBLL (See Table 1).

[insert Table 1 here]

Chiu, Kao, and Reynolds (2012) performed a *meta-analysis* of 14 published and unpublished studies, spanning 2005 to 2010, to assess the overall effectiveness of DGBLL in the EFL setting. Results revealed a large positive effect size for published studies and a small effect size for unpublished studies. Despite the variance in the effect sizes, authors reported an overall medium effect size of using DGBLL for learning English. Additional findings showed that compared to drill and practice games, results from meaningful and engaging games yielded a larger effect size. Based on this conclusion, Chui et al. (2012) advocate for the development of more games with meaningful interaction and engagement components. Considering that language learning requires meaning negotiation and communication, DGBLL studies need to address two significant components: meaningful use of the language in different situations and interaction. Although authors identified and discussed the effectiveness of digital games in learning English as a foreign language, finds might be biased due to the limited number of selected articles and relatively short time period. Specifically, only 14 articles between 2005 and 2010 were included.

Thus, findings from this meta-analysis should be further explored with more recently published studies.

In another *meta-analysis* on the effectiveness of digital games for L2 vocabulary learning, Tsai and Tsai (2017) found DGBLL to be more effective than traditional instructional methods in learning vocabulary in L2. This meta-analysis included 26 studies published from 2001 to 2017. They proposed a framework of four conditional research designs (comparing groups of playing digital games with various control groups) to disclose possible expositions for the diversity and to make connections between the specific learning mechanism and the research evidence. Specifically, authors classified selected articles into four conditions: 1) playing an off-the-shelf game; 2) playing the same game with one feature added or changed; 3) playing a digital game; and 4) others. Results demonstrated medium to large overall effect sizes in condition 1, 2 and 3. Additionally, authors also identified the moderator effect of game type (i.e. drill vs task-based) in condition 1 and 2. Nevertheless, authors acknowledged that more studies should be included to confirm the effectiveness of using digital games for learning L2 vocabulary. In this case, the limited number of studies in each condition might not be sufficient to demonstrate solid and reliable research evidence.

Hung et al. (2016) conducted a *literature review* investigating the trends in existing studies on DGBLL from 2010-2014. The review focused on five research aspects on DGBLL: the percentage of published articles; research methods; target language; language learners; and digital game availability (i.e., off-the-shelf, self-developed and others). Results from reviewing 589 studies revealed that: a) DGBLL accounted for only a small percentage of published studies in *four journals*; b) most relevant studies on DGBLL utilized both quantitative and qualitative methods; c) digital games were commonly employed for English learning; d) most studies

recruited higher education learners; and e) off-the-shelf games, especially MMORPG, were commonly utilized for language learning. However, one limitation of this literature review is the number of selected journals. Studies were identified from four academic journals: *Language Learning & Technology*, *Computer Assisted Language Learning*, *ReCALL*, and *CALICO*. Authors suggested to conduct future literature reviews on DGBLL with a larger journal pool and expanded time area (Hung et al., 2016).

From 10 learner-based studies based on cognitive and sociocultural theories of second language acquisition, Peterson (2016) identified that playing MMORPGs enhances a learner's ability to dialogue in their second language. The dialogue elements included teamwork, support, and mutual understanding. Peterson's (2016) analysis demonstrated that playing MMORPGs facilitates conditions to support growth within the zone of proximal development. In addition, MMORPGs provided learners interactive opportunities to acquire knowledge and practices in a given language context. Given that the research is mainly focused on language learners at intermediate level and only 10 studies were selected, the author suggested that findings should be discussed with expanded learner groups, language backgrounds and more relevant research.

One of the two *scoping reviews* on the topic of DGBLL was completed by Hung et al. (2018) analyzing articles from 2007 to 2016. Authors explored five major aspects of existing research on DGBLL to include research approaches, digital game availability (i.e., off-the-shelf, self-developed and others), target language and language learners, research evidence, and significant associations among these aspects. After analyzing 50 selected studies, the authors reported an overall positive impact of digital games on language learning and confirmed findings from Hung et al.'s earlier literature review (2016). The authors also identified more detailed insights to contribute to the existing research on DGBLL (Hung et al., 2018). Results revealed that

personal computers were the dominant platforms for digital language learning. Furthermore, a majority of related research involved participants with different language proficiency levels, and language proficiency levels were significantly associated with game genre, game availability, and game platform. As for limitations, authors addressed that studies in this scoping review were limited to selected journals and the time period. Therefore, future reviews should include more studies in multiple journal sources with a longer time period.

Another *scoping study* investigated the effectiveness of MMORPGs in the second language learning setting (Jabbari & Eslami, 2018). Authors analyzed 31 relevant studies from 2006 to 2015 and concentrated on research goals, topics, methods, and outcomes. Results demonstrated that the majority of the selected studies on MMORPGs were qualitative and utilized interviews, observations, chat logs, and questionnaires as their data collection sources. Additionally, existing studies focused more on L2-related motivational, affective factors, L2 skills (e.g., vocabulary), and communicative competence. Authors also claimed that, given the design of a supportive, safe and interactive environment, MMORPGs were effective for enhancing the target language development. Although the effectiveness of using MMORPGs for L2 learning was identified, authors admitted that findings might be partial with limited numbers of quantitative research.

Among the existing reviews with a focus on DGBLL, only Chiu et al. (2012) specifically addressed the effectiveness of DGBLL on English as a foreign language. With more empirical evidence accumulated to support the effectiveness of DGBLL in English language learning (e.g., Ebrahimzadeh, 2017; Peterson, 2012; Jensen, 2017; Lin, Hwang, Fu, & Chen, 2018), a comprehensive scoping study is needed to explore the design and methodology in research on DBGLL in English language learning and to evaluate findings of using digital games in learning English as a second or foreign language.

Research Questions

With regard to English learning, DGBLL varies in accordance with educational objectives (e.g., vocabulary, reading, and writing) and is designed for a specific target population (e.g., education level, language proficiency level). In view of the lack of research synthesizing existing empirical evidence on DGBLL and English language learning, our scoping review aims to provide a comprehensive evaluation and bring clarity to using digital games as an English-learning tool. In addition, limited research investigated gaming elements contained within DGBLL. Thus, examining core elements addressed by digital games for English language learning provides digital designers and educational researchers with tangible evidence to improve the design of DGBLL and the rigor within related educational research practices. Therefore, the present scoping review aims to investigate: 1) study design; 2) methodology; 3) game practices; 4) game outcomes; and 5) game elements through synthesizing findings from existing research on DGBLL in English language learning. The current study is guided by the following research questions:

- What were the substantive features of the included studies, such as publication information, instructional context, and learners' background?
 - What were the methodological features of the included studies, such as the research methods employed, data collection approaches, and sample size?
 - How did DGBLL for ELLs align with language learning skills (listening, speaking, reading, writing, vocabulary, grammar, and pragmatics)?
 - What is the impact of DGBLL on ELLs learning outcomes?
 - What game elements were implemented to support ELLs?
 - What pedagogical role did DGBLL serve in the ELL instruction?
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Method

Due to the broad, descriptive nature of our research questions, a scoping review was the most appropriate research synthesis method. **What is meta-analysis and systematic review?** A scoping review synthesizes studies that use different types of research designs without appraising the quality of the included studies (Arksey & O'Malley, 2005).

Arksey and O'Malley's (2005) scoping study framework guided the design of this review. After identifying the research questions, we comprehensively searched for studies and selected studies based on explicit inclusion and exclusion criteria. Then, the relevant study features were extracted from the included studies for analysis.

Study Search

We searched eight databases focused on education, linguistics, computing, and interdisciplinary subjects to cover all aspects of the topic. These databases were ERIC (EBSCO), Education Source (EBSCO), PsycINFO (EBSCO), Linguistics and Language Behavior Abstracts (ProQuest), IEEE Xplore Digital Library, ACM Digital Library, Academic Search Ultimate (EBSCO), and Scopus. We developed the original search in ERIC utilizing subject terms and keyword searching in the title and abstract fields. The search was structured around three main concepts: games, technology, and English language learners. The Boolean operator OR was used between synonyms of each concept, and the Boolean operator AND was used to combine the search terms for each of the three main concepts (see Appendix A: ERIC search string). The search was modified for each database. The period for the search was limited to January 2000 to August 2018 because DGBLL developed quickly after 2000.

Inclusion and Exclusion Criteria

Included studies met the following four criteria.

1. The included studies examined digital gameplay by ELLs. Articles were excluded if they were not about digital gameplay or if they did not include ELLs.
2. The included studies were published in a peer-reviewed journal from January 1, 2000 to August 31, 2018 and were available in English. Secondary data analyses, literature reviews, dissertations, book chapters, and conference papers were excluded.
3. Included studies were limited to those, which reported empirical evidence—qualitative or quantitative—on student learning outcomes. Articles were excluded if they reported teachers' change of perception throughout the digital gameplay. Articles that focused solely on game development or game design were also excluded. Though the factors as affective factors and language learning strategies are of critical importance, this scoping study aimed to focus on the effect of digital game-based technology on ELLs' language learning.
4. Any type of English language learner was considered in the current study, to include those learning English as a second language or learning English as a foreign language. Samples contained high achieving, low achieving, and/or low socioeconomic status ELLs from early childhood to adulthood.

Coding Scheme

We designed a detailed coding form to organize study coding and facilitate information retrieval. The coding form covered each study's substantive and methodological features. Since the focus of the study is digital gameplay on ELLs' language acquisition, we also categorized digital games.

Substantive features of the studies. Substantive features of the studies included the major characteristics of the studies, such as publication information, language skills, academic language, learning context, learner profile, language proficiency, and education level.

By coding the journal title and publication year, we aim to identify the major journals contributing to the field and view the publication trends of DGBLL within ELL language learning.

Language skills were categorized according to the academic measures administered in the included studies. Language skills includes students' improvements in listening, speaking, reading, writing, vocabulary, grammar, pragmatics (e.g., the ability to express one's intentions appropriately during communication), and overall proficiency. If the study included more than one skill, we coded it as mixed. Academic languages in this study were coded as Science, Technology, Engineering, and Mathematics, Business English, and Medical English.

The learning context was identified based on whether the learners were learning English as a second language (ESL) in an English-speaking country or they were learning English as a foreign language (EFL). The origins of countries were also specified in the EFL learning context.

The education levels included in the studies were divided by early childhood (pre-k), elementary (k-6), secondary (7-12), higher education, and adult education (adults who receive language training). We also classified the ELLs' language proficiency as beginner, intermediate, advanced, and mixed. If studies specified the ELLs' profile (e.g., the gender of the participants, if the participants were disabled readers), we also coded those characteristics.

Methodological features of the studies. Methodological features of the studies included research methods, data collection approaches, sample size, and test outcome measures.

Research methods were defined by three approaches: quantitative (with statistical procedures), qualitative (without statistical procedures), and a combination of the two labeled as mixed-method. We define qualitative research as “a set of complex interpretive practices” because this method “does not belong to a single discipline” and does not “have a distinct set of methods or practices” (Lincoln & Denzin, 2011, p. 6). Based on these definitions, if the study was primarily qualitative but contained descriptive statistics, it was coded as mixed-method. Data collection approaches included test, survey/questionnaire, interview, researcher observation/ field notes, and student work examples. We also documented the sample size within the selected studies. For test outcome measures, we classified the studies into standardized outcome measures and researcher-designed outcome measures.

Categorization of digital games. Categorization of digital games centered on the theme of the gaming platform, game availability, game elements, and DGBLL pedagogical use. Adhering to the coding scheme of Hung et al. (2018), we categorized game platforms as video consoles, personal computers, and mobile devices and classified game availability as commercial games, freely available games, and serious (researcher-designed) games.

Diversified viewpoints exist about what key elements a good game should have. To be classified as good digital games, Gee (2009) thought that they need to have six key properties such as an underlying game goal to which the player is emotionally attached and experiences that offer good learning opportunities. Playability of the game and motivation are also often used to describe good games (e.g., Fabricatore, Nussbaum, & Rosas, 2002; Yee, 2006). We adopted the core elements of good games from Shute and Ke (2012) to search for key game elements in the ELL field. It is a widely-used criteria and also suitable to ELL field. They claimed that a well-designed game should contain the following seven core elements: 1) interactive problem solving; 2) specific

goals/rules; 3) adaptive challenges; 4) control; 5) ongoing feedback; 6) uncertainty; and 7) sensory stimuli. If the games require the players to solve problems or quests, involving ongoing interaction between the player and the game, we coded that it consists of the element of interactive problem solving. Even though the goals in games may be implicit or explicit, it could be coded as specific goals/rules if the games set the goals for the players, assisting them focus on what to do and when. If the games balance difficulty levels to corresponding to players' abilities, it is coded to contain the element of adaptive challenges. If the games allow the players' to have an influence on the environment of games and the learning experience, it is coded as containing the element of control. If the games provide timely feedback to players, we coded it as ongoing feedback. If the games could invoke engagement of the players and the outcome of the games are unpredictable, the games accommodate the element of uncertainty. If the games employ graphics, sounds, and other means to evoke the senses of the players, it comprises the element of sensory stimuli.

The codes for pedagogical use were adapted from Schmid et al. (2014). Their study coded the pedagogical uses of technology to four categories: promoting communication, providing cognitive support, facilitating information search, and enhancing content presentation. To adjust the pedagogical uses for ELLs' language learning and accommodating the information of the included studies, we adopted two categories to describe how DGBLL was used in ELL instruction: cognitive support and communication support. Cognitive support refers to the use of DGBLL as a tool to facilitate student learning. Communication support is defined by the use of DGBLL to support communication between the students and the instructor. When DGBLL had multiple pedagogical uses, we coded it as mixed.

Data Collection and Data Analysis

Our process for searching, screening, and including eligible articles in this scoping review is presented in Figure 1. After deduplication, the database searches retrieved 2,038 results. First, two researchers screened the titles and abstracts of the articles referring to the inclusion criteria. Following this initial phase, more than 90% of the articles were rejected. Second, two researchers screened the full text of the remaining 151 articles to determine if the articles met the inclusion criteria. After the full text screening, 59 articles met the inclusion criteria and were included in this study.

[insert Figure 1 here]

We coded each of the articles in Microsoft Excel using the developed coding scheme. To calibrate the coding, three researchers initially coded each of the 59 articles independently. Then, two other researchers verified the first researcher's initial coding. The inter-rater reliability of the coding was 89.6%. Disagreements were resolved through discussion until we reached 100% agreement.

Results and Discussion

Findings about the Substantive Features of the Studies

Journal information. The analysis of the publication year of the included studies revealed a burgeoning trend in gamification research with ELLs. Out of the 59 included studies, eight studies were published between 2000 and 2010, 27 studies between 2011 and 2015, and 24 studies between 2016 and 2018. All the 59 included studies were published in 33 peer-reviewed journals. The number of articles included in the review are listed in Table 2.

[insert Table 2 here]

ELL characteristics. Seven studies (11.86%) were conducted within an ESL setting and 52 studies (88.14%) took place in an EFL setting. Figures 2 and 3 present the distribution of the countries in an ESL and EFL research context, respectively. English speaking countries involved were the U.S. ($n= 5$, 71.43%), Canada ($n= 1$, 14.29%), and Malta ($n= 1$, 14.29%). In contrast, in the EFL research context, the majority of the studies were conducted in Taiwan ($n= 15$, 28.85%), Iran ($n= 8$, 15.38%), and Japan ($n= 5$, 9.62%).

[insert Figure 2 and Figure 3 here]

In terms of learners' education level, the most common educational level of learners examined in game-based research was elementary education ($n= 19$, 32.20%), followed by higher education ($n= 18$, 30.51%) and secondary education ($n=15$, 25.42%). Four studies (6.78%) recruited adult learners (e.g., Wu, Chen & Huang, 2014), and two studies (3.39%) involved Pre-K children (Butler, Someya, & Fukhara, 2014; Ghaemi & Ebrahimi, 2015). There were two studies (3.39%) that recruited students at different educational levels (Butler et al., 2014; Vandercruysse, Vandewaetere, Cornillie, & Clarebout, 2013). Previous studies indicated that research studies on digital games were mainly conducted with university students (e.g., Hwang & Wu, 2012; Hung et al., 2018). Our results indicated a different trend with DGBLL with a focus on English learning. The distribution of learners' educational levels is illustrated in Figure 4.

[insert Figure 4 here]

As for language proficiency, only 28 (47.46%) out of 59 studies specified their participants' English proficiency level. Among these studies, 11 studies (39.29%) involved English beginners (e.g., Bakar & Nosratirad, 2013), 13 studies (46.43%) included intermediate learners (e.g., Letchumanan, Tan, Paramasivam, Sabariah, & Muthusamy, 2015), two (7.14%) had advanced

learners (Bytheway, 2014; Miller & Hegelheimer, 2006), and the two remaining studies (7.14%) involved learners at different English proficiency levels (Ebrahimzadeh, 2017; Peterson, 2012). Our finding that more than half of the reviewed studies did not report the learners' English proficiency level indicates the lack of rigor in reporting English language learning research. It is significant to report the language proficiency levels component in language teaching because the proficiency level is strongly associated with teaching design and practice (Brown & Lee, 1994; McKay, 2002). Teaching language learners at various proficiency levels requires different teaching objectives, techniques, activities, and assessments. As for DGBLL, game design and practice should consider language proficiency level as one essential aspect because reporting language proficiency levels can provide more insight on how language learners at different levels respond to distinct features of digital games.

English language learning. One of our research questions addresses the effect of gamification on ELLs' language learning in terms of listening, speaking, reading, writing, vocabulary, grammar, pragmatics, and overall English proficiency. Table 3 demonstrates the relationship between each language skill and the game-based learning outcomes. The most frequently investigated area in DGBLL with ELLs is vocabulary ($n = 28$, 47.46%), followed by learners' overall English language proficiency ($n = 9$, 15.25%), pragmatics ($n = 5$, 8.47%), grammar ($n = 3$, 5.08%), writing ($n = 2$, 3.39%), and speaking ($n = 1$, 1.69%). For instance, Jensen (2017) examined the relationship between young children's English vocabulary gains and the amount of time spent on educational gameplay. Overall English language proficiency was the second highest focus of ELLs' skills by researchers (e.g., Mohsen, 2016; Suh, Kim, & Kim, 2010), followed by studies which purported to address pragmatics within digital games (e.g., Peterson, 2012; Shirazi, et al., 2016). Infrequently addressed were the enhancement of ELLs' grammar (e.g.,

Cornillie, et al., 2017; Mehrpour & Ghayour, 2017; Singaravelu, 2008), writing (e.g., Allen, et al., 2014; Lin, et al., 2018), and speaking (e.g., Hwang, Hsu, Lai, & Hsueh, 2017). No studies within our scoping review identified the intention to improve ELLs' reading skills through DGBLL. However, 10 studies examined more than one language skill (e.g., Chang, Shih, & Chang, 2017; Rico, Agudo, & Sanchez, 2015). For example, Chang and colleagues (2017) evaluated the effectiveness of using a mobile instructional game on university students' English language learning, where the outcomes measured vocabulary, grammar, reading, and writing.

[insert Table 3 here]

Considering all of the 59 studies examined in our scoping review, nearly 80% ($n = 47$) reported a positive impact of DGBLL experiences on ELLs' English language acquisition (e.g., Franciosi, 2017; Yip & Kwan, 2006). No negative results were detected. About 8% of the studies did not find a statistically significant effect of DGBLL on language learning. For instance, Jalali and Dousti (2012) investigated the effects of educational computer games on Iranian elementary students' vocabulary and grammar gains and found no statistically significant difference in the improvement of both language skills between the control and experimental groups. Another 10% of the studies yielded mixed results. For example, Lucht and Heidig (2013) compared the effectiveness of an exer-learning game (e.g., HOPSCOTCH) and teacher-centered teaching on elementary school students' English vocabulary acquisition. The teacher-centered group were able to recognize more words than the HOPSCOTCH group, while the HOPSCOTCH group performed better in terms of translation and spelling.

Findings about the Methodological Features of the Studies

Research methods. As part of our analysis, we also identified the type of research methods used within each of the 59 included studies (Figure 5). Collectively, the majority of the included studies employed a quantitative methodology ($n = 34$, 57.63%), followed by a mixed-method approach ($n = 22$, 37.29%). Only a few studies only employed qualitative methods ($n = 3$, 5.08%). This finding is contradictory with Hung et al.'s (2018) DGBLL scoping review finding that mixed methods were most prevalent. We believe their finding of a dominance of mixed-methods is understandable because their review not only focuses on language acquisition, but also on the psychological states of learners, participatory behaviors, and contemporary competences.

[insert Figure 5 here]

Data collection techniques. Among the quantitative data that were collected, test ($n = 31$, 52.54%) was the most commonly used data collection technique, followed by survey ($n = 14$, 23.73%), student artifacts ($n = 5$, 8.47%), and field notes ($n = 4$, 6.78%). Of the studies using a mixed-method research approach, all categories of data collection were found, and again, test was used most frequently ($n = 17$, 28.81%), followed by survey ($n = 12$, 20.34%), interview ($n = 7$, 11.86%), field notes ($n = 7$, 11.86%), and student artifacts ($n = 5$, 8.47%). With regard to the qualitative studies, data were collected using interviews ($n = 2$, 3.39%), field notes ($n = 2$, 3.39%), survey ($n = 1$, 1.70%), and student artifacts ($n = 1$, 1.70%). Approximately two-thirds of the studies ($n = 39$, 66.10%) used more than one data collection technique.

Sample size. Reporting sample size is important because studies that include a smaller sample tend to report larger effect sizes, thereby producing potential bias (Slavin & Smith, 2009). Small samples contain less than 100 participants, medium sample sizes between 100-250, and a large sample size has more than 250 participants (Slavin & Smith, 2009). In accordance with these sample size indicators, among the 59 studies, 74.58% ($n = 44$) contained a small sample size,

20.34% were a medium sample size ($n = 12$), and only 5.08% qualified as having a large sample size ($n = 3$). This indicates that educational researchers should attempt to recruit more participants to get a larger sample size..

Test type. To examine test outcome measures, we sorted data by whether the test was standardized or designed by the researcher. Of the 59 studies, 10.17% did not report the test outcome measure. However, 66.10% of tests were designed by the researcher ($n = 39$), 22.03% used a standardized test ($n = 13$), and 1.69% used both test types ($n = 1$). Though we recognize the need for researchers to construct their own test to measure a very specific learning construct, we caution the reported effectiveness of researcher-designed tests compared to standardized assessments, which are “developed by psychometricians and usually includes psychometric information on reliability, validity, and reference group norms” (Johnson & Christensen, p. 202).

Findings about the Digital Games

Game characteristics. Digital games can act as revolutionary learning tools to scaffold purposeful learning. Good games should possess specific core elements to achieve this goal. We adopted Shute & Ke’s (2012) concept, which focuses on the seven core elements of well-designed digital games, and we coded the included games to identify what game elements were dominant in the ELL field.

Even though 11 studies (18.64%) did not describe their game, we were able to examine the other 48 studies for the game they used to facilitate English language acquisition. As illustrated in Figure 6, the most common gaming element was specific goals ($n = 48$, 100%), followed by sensory stimuli ($n = 46$, 95.83%), ongoing feedback ($n = 43$, 89.58%), interactive problem-solving ($n = 41$, 85.42%), uncertainty ($n = 34$, 70.83%), control ($n = 32$, 66.67%), and adaptive challenges

($n = 25$, 52.08%). The uneven distribution of the core elements of good games indicates there is much room for improvement among researchers and developers regarding DGBLL to support language acquisition. Based on the examination of the gaming elements among the 48 studies, we conclude that approximately 80% include games with specific goals, sensory stimuli, ongoing feedback, and interactive problem-solving.

[insert Figure 6 here]

Despite the inconsistencies among game element features, all 48 studies have games that contain a specific goal, which is an essential element for language acquisition. As a result of including this element, all of the specified games (100%) set up rules to follow with goals to achieve, which facilitated learners' focus on the purpose of the game and navigation within the game. Of the games that contained sensory stimuli, these digital games took advantage of the combination of graphs, sounds, and/or storyline to engage the learners. Ongoing feedback and interactive problem solving were the next two elements, covered by more than 80% of examined studies. This indicates that most of the digital games used in ELL field provide timely feedback to learners about their performance. These games also provide chances for the learner to interact with the game, usually involving the solution of a series of problems or quests.

Based on our analysis of game elements within DGBLL in the ELL field, we recommend improvements among the following aspects: uncertainty, control, and adaptive challenges. Digital games in the ELL field might focus too much on facilitating learning and neglect the uncertainty of the games. A good game should arouse suspense so that it can effectively engage the learners, but only 70.83% of the included games covered the element of uncertainty. Only 66.67% and 52.08% of the included games covered the elements of control and adaptive challenges, respectively. According to Shute & Ke (2012), well-designed games should allow the learners'

control over gameplay, the game environment, and the learning experience. Simultaneously, a good game should match learners' abilities by making the challenges adaptive.

Game availability and game platforms. With regard to game availability and game platforms, seven articles (11.86%) did not provide enough information about the games and were categorized as unspecified. Consistent with Hung and colleagues' (2018) scoping review, researcher-developed games are prevailing in the ELL field. Twenty-two games (37.29%) were identified as researcher-developed games for English language acquisition. For instance, an intelligent tutoring system known as the Writing Pal (W-Pal) provided students with explicit writing strategy instruction and practice (Allen et al., 2014). Commercial games ($n = 19$, 32.20%) were the second most utilized by ELL field scholars, such as WoW (World of Warcraft) in Bytheway (2014). Only a small proportion of the studies ($n = 11$, 18.64%) utilized freely available games for the acquisition of English, such as Second Life, found within Liang (2012).

In the aspect of game platforms, PCs ($n = 43$, 72.88%) are the most popular platforms for delivery of games in this scoping study, consistent with Connolly, Boyle, MacArthur, Hainey, and Boyle (2012) and Hung and colleagues (2018). This result is reasonable since PCs still dominate the general use of technology in contemporary education. Our findings also concur with earlier researchers' findings of the trends of game platforms (Hung et al., 2018; Sung, Chang, & Yang, 2015).

The included studies suggest that mobile games have become more popular in recent years in the field of language education. Although mobile games ($n = 6$) only occupied 10.17% of the total studies, 50% of the mobile games studies are from 2015-2018, compared with 32.20% of PC games from 2015-2018. In the context of DGBLL to support English learning, video consoles were least frequently used ($n = 3$, 5.08%). Collectively, these findings show a trend that mobile games

are easier to access. We recommend future researchers and developers work towards building more well-designed mobile digital games to exploit the advantages of the emergent and fast-developing technologies.

Games' pedagogical applications. In terms of the pedagogical applications of games, we found the majority of the included games sought to enhance ELLs' cognitive development in English language learning ($n = 24$, 40.68%). Unsurprisingly, many of the games were categorized as mixed in the pedagogical applications, which means they aimed to improve ELLs' cognition and communication. Language learning and development is a comprehensive process, which involves both internal (e.g., linguistic and cognitive process) and external factors (e.g., situation, input) (Ellis, 1989). This could help to explain why the included studies were classified as mixed. Only one study (1.69%) identified its purpose as communication, which indicates that future researchers should focus on communication. The studies that did not provide specific information about the employed games ($n = 11$, 18.64%) were classified as unspecified.

The association between game availability, game characteristics, and games' pedagogical applications. In our exploration of game elements in terms of their availability, we found commercial games outperform the other two categories of digital games—freely available games and research-designed games—in every element. Because of the uneven number of studies in each category of digital games, we compare the percentage covered by each category. Specific goals, sensory stimuli, ongoing feedback, interactive problem-solving, uncertainty, and control elements are most frequently found in commercial games, followed by researcher-designed games, and freely available digital games (Figure 7). Commercial games all include sensory stimuli and uncertainty. Specific goals and interactive problem-solving were found within 89.4% of the commercial games, 78.95% of commercial games have adaptive challenges, and 73.68% of

commercial games cover the elements of ongoing feedback and control. Researcher-designed games and freely available games are inferior to the commercial games. For instance, only 27.37% of freely available games and 31.82% of researcher-designed games contain ongoing feedback. Only 45.45% of freely available games and 54.55% of researcher-designed games include the element of control. Only for the adaptive challenges element were freely available (63.64%) digital games better than researcher-designed (50%); however, commercial games still did best among three types of digital games (78.95%).

[insert Figure 7 here]

Similarly, in terms of games' pedagogical applications according to game availability, commercial games outperform freely available games and researcher-designed games. All of the commercial games have their pedagogical applications: 10 were coded as cognitive, and nine were categorized as mixed in the pedagogical applications. Two freely available games and three of researcher-designed games were coded as unspecified for the pedagogical applications. This might result from that commercial games contain more key gaming elements, which may facilitate teachers integrate these games into instruction. We noticed the only one study coded as communication in terms of games' pedagogical applications is a researcher-designed game. Communication competency is critical for ELLs' language development. This indicates that researchers should collaborate more with commercial games to develop more high-quality games for ELLs.

Hung et al. (2018) suggested that educational researchers make more and better use of commercial games because commercial games tend to align the gaming goals with learning objectives when learning objectives exist. Our findings are consistent with their findings and provide further statistical support for this suggestion. Since commercial games outperform the

other two categories of digital games in terms of both game elements and games' pedagogical applications and because language educators generally are not highly trained programmers/artists for digital game design, researchers should employ commercial games more often to obtain greater outcome measures with regard to ELLs' language development.

Conclusion and Future Research

DGBLL is a rapidly growing field of interest to the educational technology community, and our scoping study addresses the need to improve the research rigor and quality of language learning game design. The purpose of this scoping study was to broadly examine DGBLL literature for ELL characteristics, methodological features, gaming characteristics, and associations among these domains. We investigated these domains to contribute to our understanding of how DGBLL has recently being applied within educational technology environments and to bring attention to the importance of designing good games.

A good-quality scoping study starts from a broad and extensive search. The current study searched eight commonly used databases and generated more than 2,000 articles, leading to a comprehensive review. In addition, the examination of the features/elements of DGBLL, which are critical foci for both research and practice to improve DGBLL, has not received enough attention in previous reviews. This scoping study adopted Shute and Ke's (2012) seven core elements of well-designed games to evaluate the quality of the digital games. By examining existing digital games for language learning using game design criteria, researchers can assess the quality of digital games for language learning and explore their features with considerations of other components such as language learning objectives, educational level, and language proficiency level.

As a result of our analyses, data revealed that researchers need to be more rigorous in terms of their methods and transparency in reporting (e.g., language proficiency levels, gaming characteristics). With regard to the analyzed domains, we discovered that vocabulary is the most dominant practiced language skill, methods were primarily quantitative with researcher-designed tests, and commercial games contain the most elements of a good game. Inconsistency exists among good gaming elements, with the only common element being a specific goal. Sensory stimuli, ongoing feedback, and interactive problem-solving were prominent in about half of the examined games; however, uncertainty, control, and adaptive challenges were sparsely included gaming elements in DGBLL.

Based on our collective findings, we provide some recommendations for future research. Since we found that commercial games currently contain the most good game elements, we recommend researchers utilize more commercial games. If researchers desire to create their own game, we advise they focus on constructing games with more good gaming elements. We also recommend the implementation of more standardized tests that align with the commercial games, because this may improve the reliability and validity of research results. Finally, with growing interest and adoption of mobile learning, we recommend research of commercial games that investigates availability and learning outcomes.

Though this scoping review shed light on the effect of digital games in ELL field, it also has some limitations. For instance, a broader array of game types were not examined. One meaningful divide would be between casual and non-casual (e.g., triple-A) games which differ in game genre (e.g., puzzle vs RPG (role-playing game)/ARPG (Action Role-Playing Games)/RTS (real time strategy) /FPS (first-person-shooting)), gamer demographics, and many other dimensions (Keogh, 2015; Kuittinen, Kultima, Niemelä, & Paavilainen, 2007). Since we are doing

a scoping review about the topic of digital games, future researchers might also include conference proceedings. Future studies might even intentionally choose to compare conference proceedings with published journal articles to investigate the value of the peer review process. Since we found that commercial games outperform the other two categories of games, future researchers could further investigate the differences between commercial games with and without explicit educational goals. This might be of critical importance since our ultimate goal is to facilitate ELLs' learning language learning through the use of digital game-based technology.

Statement on Conflicts of Interest

We declare that we have no conflicts of interest.

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