Colloquium

Advancements and trends in digital game-based learning research: a review of publications in selected journals from 2001 to 2010

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Background and objectives

Kinzie and Joseph (2008) indicated that "a game is an immersive, voluntary and enjoyable activity in which a challenging goal is pursued according to agreed-upon rules." In the past decade, many studies were conducted to investigate the effectiveness of educational computer games for various courses, such as mathematics (van Eck & Dempsey, 2002), software engineering (Cagiltay, 2007; Connolly, Stansfield & Hainey, 2007), civil engineering (Ebner & Holzinger, 2007), business (Kiili, 2007), computer science (Papastergiou, 2009), geography (Tüzün, Yılmaz-Soylu, Karakus, Inal & Kızılkaya, 2009), language (Liu & Chu, 2010) and decision-science (Chang, Peng & Chao, 2010).

Previous studies have reported that educational computer games can enhance the learning interest of students (Ebner & Holzinger, 2007; Malone, 1980) and further increase their learning motivation (Burguillo, 2010; Dickey, 2011; Harris & Reid, 2005). Researchers have also indicated that games are an important part of the development of children's cognition and social processes (Kim, Park & Baek, 2009; Yien, Hung, Hwang & Lin, 2011). Consequently, educational computer games have great potential for helping students to improve their learning performance as well as their learning motivation (Huang, Huang, & Tschopp, 2010; Wang & Chen, 2010).

Owing to the rapid advancement and popularity of computer and communication technologies, researchers have predicted that more technology-based learning will occur and educational computer games could play an important role in education (Prensky, 2001); moreover, analyzing the status and trend of such emerging research can provide important information for choosing appropriate research topics (Hoffler & Leutner, 2007; Hwang & Tsai, 2011; Seo & Bryant, 2009) or making critical decisions (Alper & Gulbahar, 2009; Karatas, 2008; Shih, Feng & Tsai, 2008; Zawacki-Richter, Bäcker & Vogt, 2009).

In this study, we aim to analyze the research status and trend of digital game-based learning (DGBL) from 2001 to 2010 and investigate the following three research questions:

1. What is the status of the DGBL research from 2001 to 2010? Is the number of articles concerning this topic increasing or decreasing?
2. What research sample groups related to DGBL were selected in these articles from 2001 to 2010?
3. What research learning domains related to DGBL were adopted in these articles from 2001 to 2010? Did the learning domain shift between the first 5 years (2001–2005) and the second 5 years (2006–2010)?

Methods

This study examines the DGBL articles published in seven major technology-based learning journals from 2001 to 2010 to analyze the research trends of this topic. The selected journals

include the *British Journal of Educational Technology* (*BJET*), *Computers and Education* (*C&E*), Educational Technology & Society (*ETS*), *Educational Technology Research & Development* (*ETR&D*), *Journal of Computer Assisted Learning* (*JCAL*), *Interactive Learning Environments* (*ILE*) and *Innovations in Education and Teaching International* (*IETI*).

Two researchers who have had years of experience conducting studies in technology-enhanced learning were asked to filter the DGBL studies from the 4548 papers published by these seven journals from 2001 to 2010. Only "articles" were considered in this study; that is, publications such as "book reviews," "letters," and "editorial materials" were all excluded. To more precisely select the DGBL articles from the database, the articles selected by the two researchers were compared to check for consistency. After two iterations of filtering the papers and discussing the inconsistent decisions, a total of 137 articles were selected.

Based on the subcategories defined by Hwang and Tsai (2011), the research samples of the selected articles were categorized into "Elementary school," "Junior and Senior high school," "Higher education," "Teachers," "Working Adults," and "Non-specified," and the learning domains were categorized into "Science," "Mathematics," "Language & Art," "Social Science," "Engineering," "Others," and "Non-specified."

Results

Number of articles published

Figure 1 shows the number of DGBL articles published from 2001 to 2010. It is found that the DGBL research increased at a fast pace from 2006. By dividing the past 10 years into two periods (ie, 2001–2005 and 2006–2010), it is found that the number of papers published during the second 5 years (ie, 111) is over four times that of the first 5 years (ie, 26), implying that the studies in this field has become more and more important in the past decade.

Research sample groups selected

Table 1 shows the distribution of the research sample groups utilized in those DGBL studies. It is found that from 2001 to 2010, research samples in "*Higher Education*" were selected most (44),
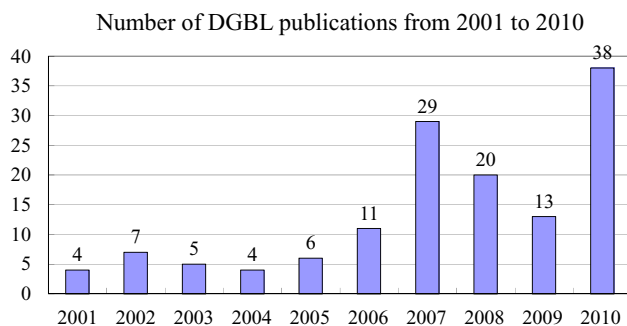

Number of DGBL publications from 2001 to 2010

Figure 1: Number of DGBL articles published from 2001 to 2010

Table 1: Sample groups selected for DGBL studies from 2001 to 2010

Sample group	Elementary school students	High school students	Higher education	Teachers	Working adults	Other	Nonspecified
2001–2005	7	7	4	1	0	3	4
2006–2010	23	16	40	2	3	7	20
Total number of articles	30	23	44	3	3	10	24

followed by "*Elementary school students*" (30) and "*High school students*" (23). Only a few studies selected "*Teachers*" (3) and "*Working adults*" (3) as the research sample. The same sequence can be found in the first and the second 5 years, <mark>implying that students from higher education and elementary schools are the major samples of DGBL research.</mark> <mark>It also implied that most researchers have considered children and young people are the major users of computer games.</mark>

Research learning domains selected
Table 2 shows the learning domains selected for the DGBL studies. It is found that most studies did not involve specific learning domains; instead, <mark>they mainly focused on the investigation of students' motivations, perceptions and attitudes toward digital games in the decade</mark> (56), followed by "Engineering (including computers)" (20), "Language and Art" (15) and "Science" (14).

Furthermore, it is found that in comparison with the studies conducted in the first 5 years, studies focused on the learning domains of "Social science" (from 0 to 9), "Mathematics" (from 1 to 8), "Science" (from 2 to 12) and "Engineering (including computers)" (from 5 to 15) have significantly increased in the second 5 years.

Major contributing countries
Figures 2 and 3 present the major contributing countries of DGBL articles in the first and the second 5 years of 2001 to 2010. In the first 5 years, British authors contributed the most publications (8), followed by American authors (3), Taiwanese authors (3) and Australian authors (3). In the second 5 years, American authors contributed the most (27), followed by

Table 2: Research learning domains selected from 2001 to 2010

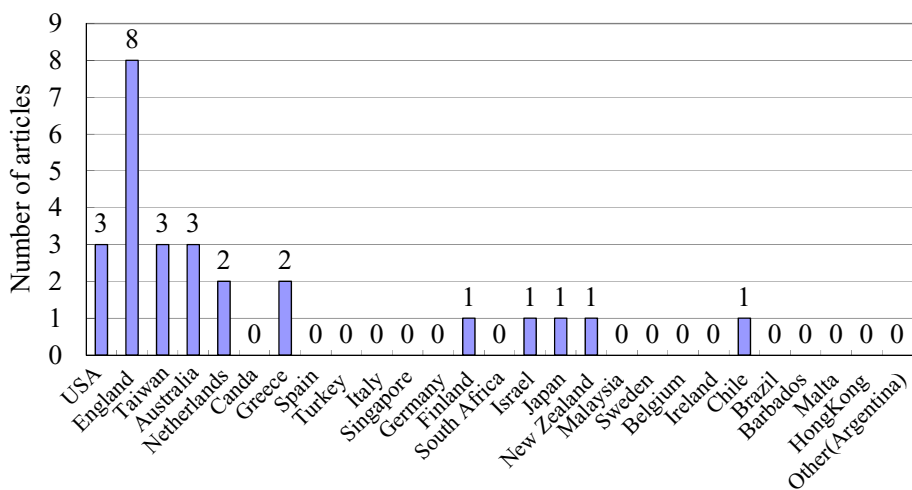| Learning domain	Science	Mathematics	Language & Art	Social science	Engineering (including computers)	Others	Nonspecified
2001–2005	2	1	7	0	5	2	9
2006–2010	12	8	8	9	15	12	47
Total number of articles	14	9	15	9	20	14	56

Figure 2: Major contributing countries of DGBL articles from 2001 to 2005
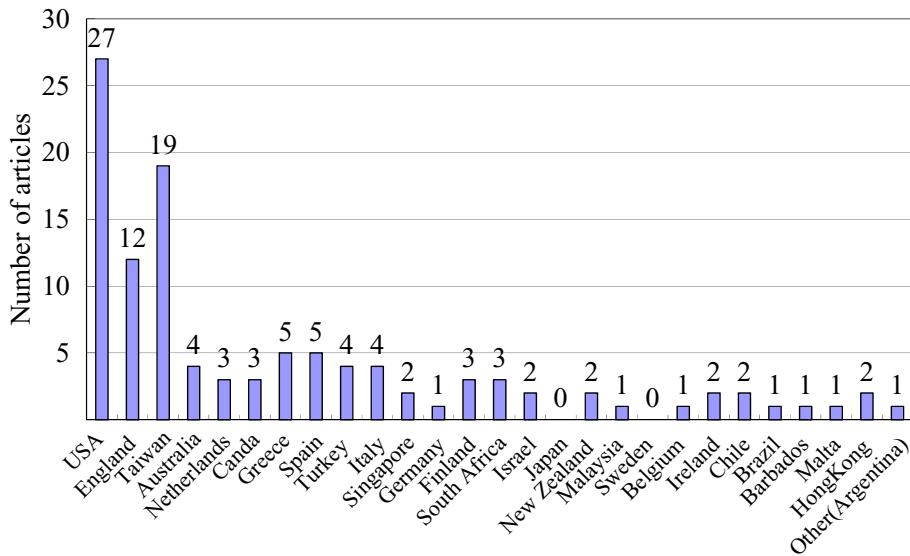
Nationality of authors from 2006-2010

Figure 3: Major contributing countries of DGBL articles from 2006 to 2010

Taiwanese authors (19) and British authors (12). Moreover, it is found that, in comparison with the first 5 years, the number of countries contributing to the DGBL studies has increased in the second 5 years (from 11 to 24), implying that DGBL is becoming a worldwide research topic.

Conclusions

This paper reviews the advancement of DGBL research from 2001 to 2010 based on the articles published in seven major SSCI journals. It is found that the number of articles has significantly increased during the past 10 years; moreover, researchers from more countries have contributed to this field in recent years. These findings could be good references for those who plan to contribute to the DGBL studies. On the other hand, the analysis results could be helpful to policymakers in governments or professional organizations make plans for supporting the development of educational game industries.

Acknowledgements

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