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A Systematic Literature Review on the Evaluation of Business Simulation Games Using PRISMA

Nadia Faisal
Federation University Australia, nadiafaisal@students.federation.edu.au

Mehmood Chadhar
Federation University Australia, m.chadhar@federation.edu.au

Anitra Goriss-Hunter
Federation University Australia, a.goriss-hunter@federation.edu.au

Andrew Stranieri
Federation University Australia, a.stranieri@federation.edu.au

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Full research paper

Nadia Faisal
School of Engineering, Information Technology and Physical Sciences
Federation University
Mount Helen, Australia
Email: nadiafaisal@students.federation.edu.au

Mehmood Chadhar
School of Engineering, Information Technology and Physical Sciences
Federation University
Mount Helen, Australia
Email: m.chadhar@federation.edu.au

Anitra Goriss-Hunter
School of Education
Federation University
Mount Helen, Australia
Email: a.goriss-hunter@federation.edu.au

Andrew Stranieri
Institution of Innovation, Science and Sustainability
Federation University
Mount Helen, Australia
Email: a,stranieri@federation.edu.au

Abstract

In recent years, organisational software process education has seen a considerable uptick in interest in adopting business simulation games (BSGs) as a novel learning resource. However, the lack of reliable and valid instruments to evaluate simulation learning outcomes inhibits the adoption and progress of simulation in Information System education. To fill this need, we performed a systematic review of 33 empirical studies using the PRISMA declaration approach to identify the different evaluation methods used to analyse BSG learning outcomes. We created a concept matrix using a didactic framework that categorised these assessment methodologies into three game stages (pre-game, in-game and post-game). We established a comprehensive evaluation strategy using this concept matrix, which teachers and researchers may use to choose the best appropriate evaluation method to analyse a wide range of learning outcomes of business simulation games.

Keywords Evaluation, business simulation games, PRISMA, Systematic literature review

1 Introduction

Simulations come under (Digital game-based learning) DGBL and build their premises on experiential learning, where students are provided with a risk-free environment to solve real-world problems (Löffler, Jacoby, et al., 2019). This replicating of the real world allows students to apply their acquired subject knowledge to real-world situations. Being an essential part of DGL, simulation games are linked to constructivist pedagogy, which offers a practical experience in business content areas such as management, finance, marketing and many more (Lee, Long, & Visinescu, 2016). Graduates of Information Systems programs should be experts in seeing how organisations can benefit from technology capabilities. Achieving a high level of performance related to this capability requires in-depth knowledge of technology and the domain, skills in analysing problems and designing solution alternatives, ability to analyse the strengths and weaknesses of various options, understanding issues related to the feasibility of possible solutions, as well as demonstrable skills in sourcing, designing, and implementing technology solutions (Gatti, Ulrich, & Seele, 2019).

The researchers set out to examine the effects of ERP simulation games (Faisal, Chadhar, Goriss-Hunter, & Stranieri, 2019), a business simulation game, on students' learning outcomes and immediately encounter the first challenge, the lack of a univocal evaluation framework to assess these outcomes. To address this hurdle, researchers decided to conduct a systematic literature review to explore different evaluation methods/frameworks used in the empirical research on other business simulation games. The primary motivation of this study lies in the fact that business games are already, to a certain degree, incorporated into higher education and gaining popularity due to their reported positive impacts on the teaching and learning process (S. Kim, Song, Lockee, & Burton, 2018). The steady increase in the BSGs research during the past few years shows these games' continuing popularity as a learning tool. Figure 1 demonstrates this by delivering the number of research papers published between 2012-2022 on BSGs.

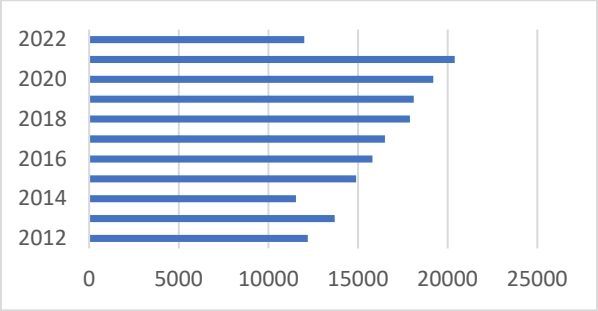

Figure 1. Number of studies on BSGs over the last 10 years

Several literature reviews have been done on simulation games addressing evaluation methods as part of the review, mostly summarising a large number of studies in different domains such as mathematics, science, health, Information technology and business. But there is not a single literature review with a focus area on business simulation games. For example, Connolly, Boyle, MacArthur, Hainey, and Boyle (2012) presented a literature review on serious games and computer games later updated by the same team of researchers (Boyle et al., 2016). Both reviews summarised empirical evidence on the effectiveness of serious games. Both reviews cited only eight studies on business simulation games and focused more on overall computer games for educational and non-educational purposes. Calderón and Ruiz (2015) Reviewed 102 papers on serious games to explore the evaluation methods adopted by educators to assess the learning outcomes of these games. The focus area of this review was software management and didn't take into account studies in the business domain. The authors classified standard methods, procedures, population size and assessment methods of games. The findings showed that educational games are primarily evaluated ad-hoc, typically through questionnaires. Petri and von Wangenheim (2016) presented a review on the evaluation of educational games, which they later updated. This review took into account all educational games, including non-digital games. On the other hand, few reviews focus on business simulation games, but most focus on a unique feature or outcome. For example, Lopes, Fialho, Cunha, and Niveiros (2013) reviewed 25 articles on the effectiveness of business simulation games on leadership qualities. Although they discussed five different business games and their role in developing leadership qualities, they didn't specifically discuss how these games were assessed.

Despite a large number of literature reviews on serious games, there is not a single review that provides a complete and detailed overview of different evaluation methods used to varying stages of BSGs. Although simulation games in other domains (agricultural, medical, etc.) run on almost the same

principles, the experiential learning, scope and procedure of running these games are different, applying a single evaluation framework for every domain is challenging. This systematic literature review (SLR) aims to identify and classify how BSGs have been assessed over the last ten years, focusing on organising evaluation techniques according to different game stages. The objectives of the study are hence formulated as follows:

RQ1. Which evaluation methods were used to assess learning outcomes at different stages of BSGs?

RQ2. Which model/frameworks were used to evaluate business simulation games systematically?

The structure of the rest of the paper is as follows: Section 2 describes the research methodology. The findings are shown in Section 3. Section 4 discusses the findings of the study. and Section 5 concludes the paper with a brief discussion of limitations and future research agendas.

2 Methodology

We followed the Preferred Reporting Items for Systematic Reviews (PRISMA) standards to produce this review. PRISMA is a standard peer-reviewed approach that employs a guideline checklist, which was closely followed in this paper (Page et al.). It contributes to the quality assurance and replicability of the revision process. We developed a review protocol detailing the article selection criteria, search strategy, data extraction, and data analysis procedures.

2.1 Data Sources, Search Strategies and Eligibility Criteria

We carefully examined five electronic databases (Web of Science, Scopus, Springerlink, Science Direct, and Wiley Online Library) between the years 2012 and 2022. Most research in IT and business-related educational interventions came from these databases. Considering our research questions, we developed our search string using Boolean operators “AND” and “OR” for the main keywords and their synonyms: Business simulation games, evaluation, serious games, assessment methods Researchers also manually searched the reference lists of the qualifying papers found via the electronic search. Three researchers worked independently to gather data and assess article quality. An evidence table was created using data gathered from each research. Three rounds of screening were carried out to select the papers for review. The first phase of analysis involves three reviewers assessing the title and abstract and utilising the criteria: Only open-access papers, published between 2012 and 2022, were included, their worldwide visibility without barriers. These open access publications have the effect of reaching non-scholarly, industry and academic audiences in less developed areas of the world.

2.2 Execution of the review

The process of elimination of the studies is represented graphically in Figure 2.

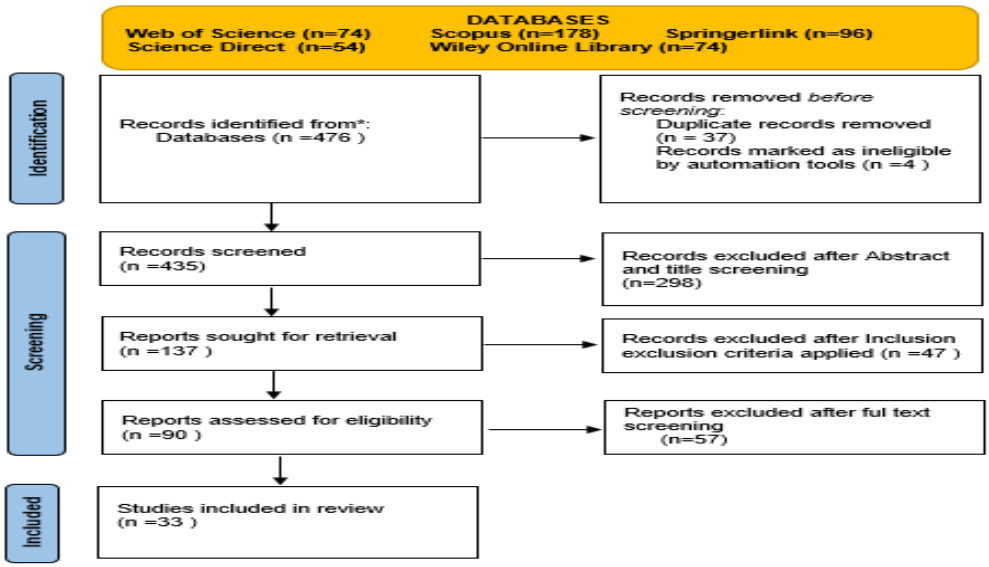

Figure 2. From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

2.3 Characteristics of included papers

We considered papers published between 2012 and 2022, with an upward trend in publishing. This demonstrates an increasing interest in developing and identifying appropriate evaluation frameworks for business simulation games. As seen in Figure 3, the year with the most papers that entered our search is 2021 (n=9). Most papers are retrieved from the SCOPUS database, followed by Springerlink (Figure 4).

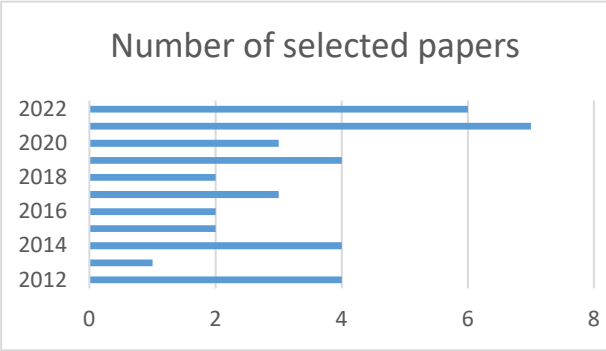

Figure 3. Number of selected papers per year

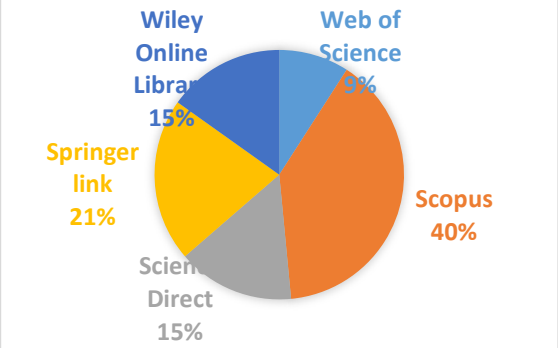

Figure 4. Number of selected papers as per database

The number of articles produced in the area reflects its readiness to adapt and experiment with novel information and teaching techniques. Europe (n=14) and North America (n=8) performed most simulation game research (Figure 5). The chosen studies employed quantitative (n=24), qualitative (n=4), and mixed approaches (n=5) based on their research goals (Figure 6)

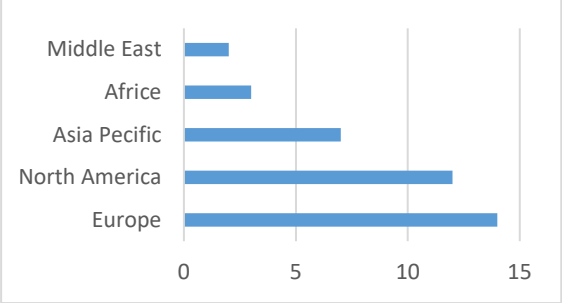

Figure 5. Number of selected papers as per region

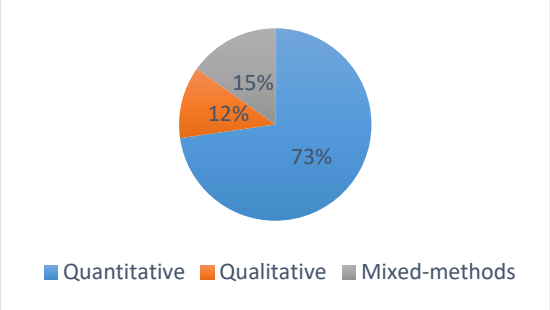

Figure 6. Number of selected papers as per research desing

3 Findings

This section presents the findings that were obtained via the previously indicated process of systematic revision. These findings are grouped in accordance with the research questions that served as the basis for our search and analysis.

3.1 Research Question 1

Which evaluation methods were used to assess learning outcomes at different stages of business simulation games?

Utesch (2016) didactic framework for describing the flow of business simulation games served as motivation for answering this research question. This framework outlines four stages of educational business simulation games. First is "preparation," when students are told the course's aim, and the teacher manages the game's resources. Next is "introduction," where students learn their responsibilities and the challenges they must overcome. Students play the game by assessing challenges, devising and executing a business plan, running the game, and presenting the outcomes. In "conclusion," participants review and discuss accomplished business goals. Based on this framework, we categorised the evaluation/assessment techniques into pre-game, in-game, and post-game. We produced a concept matrix based on Bolt's work (Table 3) that included the names of the authors, the year of publication, the business simulation game utilised in the research, the evaluation tool/method employed during any of the three stages of assessment, and the categories of respondents.

Author and year	Game	Assessment phases Pre	in	post	Sample and instrument
(Lin & Tu, 2012)	BOSS (total enterprise simulation)			X	70 students' surveys
(Tao, Cheng, & Sun, 2012)	Not mentioned			X	Students and instructors
(Tanner, Stewart, Totaro, & Hargrave, 2012)				X	106 Marketing management students
(Cronan & Douglas, 2012)	HEC Montréal ERPsim game	X		X	201 students' surveys
(Köhler, Fischlmayr, Lainema, & Saarinen, 2013)	The case simulation game VIBu		X		Students' reflective essays
(Wellington, Faria, Hutchinson, & Gowing, 2014)	Merlin: A marketing simulation game	X		X	368 students' surveys
(Ben-Zvi & Carton, 2014)	International Operations Simulation Mark/2000		X	X	1000 senior M.B.A. candidates' surreys and game results
(Ben-Zvi & Carton, 2014)	Stock Market Learning			X	183 students' surveys
(Tal, 2014)	International Operations Simulation Mark/2000			X	300 senior graduate students' surveys
(Loon, Evans, & Kerridge, 2015)	Off-the-shelf simulation game			X	168 students' surveys
(Liao, 2015)	Beer game			X	381 students surveys
(Pando-Garcia, Periañez-Cañadillas, & Charterina, 2016)	E-mprende competition			X	131 students' surveys
(Schmuck, 2016)	MMG			X	67 Students surveys
(J. Kim & Watson, 2017)	Multiple B.S.G.s			X	43 executive level students
(Mustata, 2017)	TOPSIM General Management II			X	88 participents survey
(Buil, Catalán, & Martínez, 2018)	GESTIONET			X	167 students
(Hernández-Lara & Serradell-López, 2018)	Cesim Global Challenge		X		40 teams, 4 students per team
(Gatti et al., 2019)	Napuro	X		X	54 Students
(Zulfiqar, Sarwar, Aziz, Ejaz Chandia, & Khan, 2019)	Not mentioned			X	360 students' surveys
(Buil, Catalán, & Martínez, 2019)	SimGestion			X	360 students
(Hernández-Lara, Perera-Lluna, & Serradell-López, 2019)	Cesim Global Challenge		X		362 Students' surveys

(Buil, Catalán, & Martínez, 2020)	Marketing simulation game		X	360 students surveys
(Wang, Wang, & Jian, 2020)	Business simulation game		X	141 participents surveys
(Bamufleh, 2020)	CAPsim		X	115 students
(Zulfiqar et al., 2021)	M.I.T. Salon business simulation	X	X	277 students' survey
(Kiss & Schmuck, 2021)	Multinational management game		X	329 students' surveys
(Dharmastuti, Darmoyo, Gunawan, & Duka, 2021)	Management simulation		X	83 students' surveys
(Baruah & Mao, 2021)	SimVenture Evolution		X	132 Student surveys and reflection reports
(Shafiai & Omar, 2019)	MonsoonSIM		X	50 Participants
(Zapalska, 2021)	Manufacturing simulation		X	Students interviews
(Meltzer, 2021)	Stock market game		X	120 students' reflective essays
(Scherpereel, 2022)	TFC Simulation		X	392 students exams data
(Beranič & Heričko, 2022)	ERPsim Distribution simulation	X	X	32 students' surveys
(Humpherys, Bakir, & Babb, 2022)	SDLC simulation		X	121 groups of students game results

Table 1. Concept matrix on the evaluation methods of BSGs

In most of the selected papers (Baccara et al.), authors collected data through self-developed questionnaires (Cronan & Douglas, 2012; Wellington et al., 2014), mainly distributed post-game among students to assess the learning experience and outcomes. In a few studies, researchers conducted interviews with instructors. The literature search also revealed the importance of in-game assessment as only this can provide instant feedback about the overall learning process and other behavioural changes resulting from this process (Ifenthaler, Eseryel, & Ge, 2012). Several selected papers provide examples of these positive changes that can only be assessed while students play the game. For example these assessment methods included keeping track of students' progress (Hernández-Lara & Serradell-López, 2018), classroom observation (Ben-Zvi & Carton, 2014), focus group discussion (Hernández-Lara & Serradell-López, 2018) and reflection reports (Ben-Zvi & Carton, 2014; Tal, 2014) . Most in-game assessments were done by researchers in observation, tracking of students' reports etc. Despite the apparent merits of in-game evaluation, it is the least adaptive method in business simulation games literature (5 papers) because of its complexity, time constraints and issues regarding permissions to

access participants. Pre-game assessment was used to collected data in 11 papers from the sample where questionnaires and/or interviews were conducted to evaluate students' overall experience in playing game and their achieved learning outcomes.

3.2 Research Question 2

Which model/frameworks/scales were used to evaluate business simulation games systematically?

Most selected papers (17) did not use a well-defined evaluation model or framework. Instead, it was done informally, not explicitly categorising learning outcomes. Contrarily, some studies used well-defined models. For example, T.A.M. (Technology acceptance model), which assesses the acceptance and use of new technology (Davis et at., 1989), was used by Pando-Garcia et al. (2016) to access two groups of students using two different business simulation games. Results of that study showed a positive effect of perceived ease of use on the acceptance of technology. Few other selected papers also used T.A.M. to evaluate business simulation games, for example; (Tao et al., 2012; Zulfiqar et al., 2019). In 2014, Ranchhod, Gurău, Loukis, and Trivedi (2014) developed and validated an Educational value generation model using 305 UK-based business students as a sample. The model assessed multiple dimensions of simulation games; experience generation, conceptual understanding and skill development. The model is best suited to experiential studies.

A scale that has been frequently used to evaluate business simulation games literature is EGameFlow, developed by Fu, Su, and Yu (2009). This scale measures the role of users' enjoyment in learning initiatives. Few studies that used this scale as an evaluation tool are . A scale System Usability Scale (Aasheim, Li, & Williams) (Brooke, 1996), which subjectively assesses the usability through a ten-items questionnaire, used in few studies (Löffler, Levkovskyi, Prifti, Kienegger, & Krcmar, 2019; Rajšp, Horng-Jyh, Beranič, & Heričko, 2018; Wellington et al., 2014). (Hainey & Connolly, 2010) developed a comprehensive general framework to evaluate game-based learning in terms of scaffolding, usability and social presence. Many business simulation games literature studies used one or multiple dimensions of this framework (Poonnawat & Lehmann, 2014; Poonnawat, Lehmann, & Connolly, 2015). Other approaches which were used to evaluate learning outcomes are Bloom's Taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) in Chua (2005), Computational Thinking Framework (CTF)c (Gouws, Bradshaw, & Wentworth, 2013) and Evaluation framework for effective game-based learning (All, Castellar, Van Looy, & Education, 2015). Most of the studies developed their evaluation models based on the literature review, mainly using Goal-question-matric (G.Q.M.) approach to systematically drive questions, measures and data collection instruments.

4 Discussion

Based on the analysis of 33 selected empirical papers on BSGs, we presented an evaluation framework to effectively assess the learning outcomes covering all game stages (pre-game, in-game and post-game).

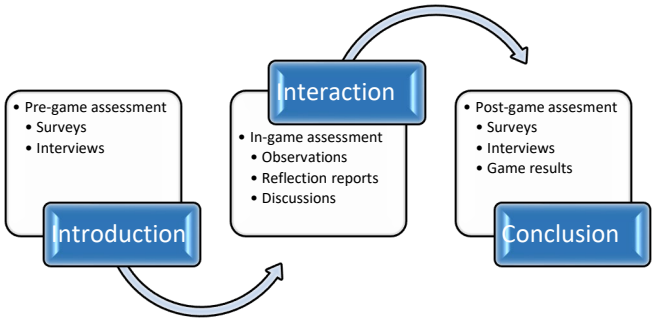

Figure 7. Multi-stages evaluation framework for simulation games

During the pre-game stage, questionnaires are the most frequently used assessment tools. Using this tool, the researcher can collect data from many respondents regarding their previous knowledge, demographic information, perception about using innovative pedagogical tools and their prior learning styles. This information help educator set goals, pace and pattern of the game. The in-game assessments include observation of players while the game, in-group discussion and reflection reports. Classroom observation is helpful to get instant feedback on game experience and cognitive analysis of students as players verbalise their thinking during discussions and decision-making process and provide insight on students' interaction with the interface and other game designs. Participatory evaluation, where the instructor or researcher is involved via asking direct questions, and recording answers, usually focuses

on the game's playability. A reflection report is also a part of in-game assessment where students qualitatively assess their learning outcomes, experience and knowledge gain. Reflection reports can be conducted once or multiple times during the game. Overall, in-game assessments measure students' subjective mood, understanding, learning and actual performance. The post-game assessment, which is most commonly used in business simulation games, can be qualitative and/or qualitative and assess students' actual knowledge gain and improvement in skills. In this assessment, games are evaluated considering their usefulness in achieving desired learning outcomes. The questionnaire is the most common tool, followed by interviews and focus groups. Compared with pre-test assessment, this evaluation can compare and analyse students' knowledge gain and achievement of desired learning outcomes. This literature review aims to find different evaluation methods/tools used to measure the learning outcomes of business simulation games. To achieve this goal, we selected 27 empirical papers on business simulation games published in the last ten years to explore different evaluation methods used in those studies to evaluate the learning outcomes of simulation games. These papers were then analysed according to three dimensions: the game stages where these methods were utilised, the evaluation models/frameworks/scales used for assessment and the learning outcomes assessed by these methods. The first dimension was addressed by presenting a concept matrix with a list of methods used at different game stages (pre-game, in-game and post-game). This concept matrix helped the researcher develop a comprehensive evaluation strategy (Figure 2) involving all stages of the business game. The matrix indicates that most studies used the post-game evaluation method through quantitative data collection, allowing researchers to evaluate many students simultaneously. Some studies used pre-post game assessments, which helped researchers compare students' learning levels before and after playing games. The second dimension of analysis which addresses the evaluation models/frameworks/scales used in selected studies, was answered by qualitatively analysing each paper. Only 6 evaluation models/frameworks were used in 12 of 23 selected studies. Most studies did not indicate the use of an existing evaluation model and typically developed instruments in an ad-hoc manner based on the analysis of the related literature review. Yet, the validity of the results of a study depends on systematically designed instruments and approaches. Thus, there exists a significant threat to the validity of the reported results using these self-developed assessment tools.

5 Conclusion, limitations and future agendas

In this paper, we systematically review 33 empirical studies on business simulation games to find out different evaluation methods used to assess the learning outcomes of these games. We used a didactic framework to develop a concepts matrix to categorise these assessment methods according to the different game stages (pre-game, in-game and post-game). With the help of this concept matrix, we developed a comprehensive evaluation strategy that can be used by instructors and researchers to choose the most suitable evaluation method to assess a wide range of learning outcomes of business simulation games. Review shows that the most popular assessment tool is questionnaires for their ease of use on larger sample sizes. However, qualitative assessments such as reflection reports, classroom observation and interviews give more profound insight into the learning experience. The review also revealed a lack of a univocal assessment framework for the practical evaluation of business simulation games as most of the studies used self-developed frameworks, which raises questions about the validity of the results. The current review has several limitations. As with all reviews, it was limited by the search terms used, the journals included, and the year of publications. However, the papers discussed in this literature review provide a snapshot of different evaluation methods used in empirical research on outcomes of business simulation games which is representative of state of the art at the time. The review excluded speculative and theoretical papers because it was important to ground our understanding of evaluation methods of business simulation games in research evidence rather than speculation. Our findings present an extensive avenue for future research, especially in evaluating business simulation games. Our review revealed a need for a more consistent and uniform evaluation method to assess business simulation games to obtain valid results systematically.

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