



# Bibliometric Analysis: Research Trends of Simulation Game Utilization in Self-Regulated Learning (2013 - 2023)

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**Abstract.** Self-Regulated Learning (SRL) is a person's ability to understand and control the learning environment which includes goal-setting, self-monitoring, self-instruction and self-reinforcement. The development of these abilities enables students to learn more effectively as they can set clear goals for themselves and monitor their progress, allowing them to be more proactive in their learning. The components of self-regulated learning can be found in video games, where players regulate their cognitive, affective, and behavioral processes in processing information and mastering how to play to achieve the game's end goal. One genre of video games is simulation games, where players can mimic real-life activities for the purpose of training, analysis, prediction, or entertainment. With the similarity between self-regulated learning and the process of playing a video game, there is a possibility to develop a simulation game genre that can illustrate self-regulated learning to players. This study aims to determine trends and identify publications related to video games (especially simulation games) and self-regulated learning. The method used in this research is bibliometric analysis using a database of journal articles from Scopus related to the keywords "game" and "self-regulated learning" between 2013-2023. There are five stages carried out in this research, namely keyword determination, data search, article selection, data validation, and data analysis. The results obtained four clusters that discuss the topic of game utilization for self-regulated learning. Especially for simulation games, the topic only appeared in 2020 and has only appeared three times so far. Thus, the development of simulation games for self-regulated learning can be a topic for further research.

**Keywords:** Self-Regulated Learning, Simulation Game, Bibliometric Analysis.

## 1 Introduction

Self-regulated learning (SRL) is a person's ability to understand and control their learning environment, including goal setting, self-monitoring, self-instruction, and self-reinforcement [1]. Self-regulated learning is a broad construct that involves interactions between different control systems (cognition, self-attention, metacognition, self-emotion, motivation, and self-reinforcement) [2]. This skill becomes very important for students if they want their learning process to be effective. To become a

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smart learner, it is necessary to have a basic understanding of the learning process, how to identify and interpret mistakes or errors, and avoid thinking that one's learning process cannot be changed, encouraging his thinking to think freely, broadly, and appreciate human beings. extraordinary abilities. In line with the Merdeka Belajar Curriculum, self-regulated learning skills are a topic of conversation, as the name suggests. So it becomes important to be able to introduce and guide students to be able to develop these abilities. Boekaerts (in Panadero) said that there are six components that affect a person's SRL: 1) content or learning domain, 2) cognitive strategies, 3) cognitive regulation strategies, 4) metacognitive knowledge and motivational beliefs, 5) motivational strategies, and 6) motivational regulation strategies. Each of these components represents the type of prior knowledge required in the SRL structure: cognitive and affective regulation/self-motivation [3]. So it is very important for students to be able to develop this ability and for teachers to facilitate or guide students in developing it. One way is by utilizing technology media in learning.

Technology-based learning provides various advantages, such as (1) being a driver in education, including teachers who are required to be more appreciative and proactive in maximizing the potential of education; and (2) providing extensive opportunities for students to utilize every potential that can be obtained from unlimited sources [4]. Similarly, the use of cell phones in everyday life where it produces positive and negative impacts. In Surachman's research, it is said that the positive impact of using cell phones can provide access to information and communication more efficiently and facilitate various jobs in various fields. While the negative impact of using cell phones can cause addiction to social media, games, etc. and waste time [5].

One of the utilizations of technology in research is educational games. Educational games are not new. There have been many games specifically designed for education. In a study conducted by Backlund and Hendrix, the utilization of games in learning has a positive impact. Games, whether designed for learning or just as entertainment, can increase motivation and promote problem-solving skills better, although there was no significant difference in academic achievement between the group of students who used games in learning and the group of students who used classical learning. Thus, the utilization of games, especially those designed as entertainment, without reducing academic achievement [6]. However, there are barriers to the utilization of games in teaching. In a study conducted by Sandford, Ulicsak & Facer, teachers and parents were not happy with the idea of playing games during class time due to incompatibility with the curriculum [7]. Not only that, in Egenfeldt-Nielsen's study, several other barriers were found, such as the difficulty of teachers to identify how a game can be relevant in the curriculum and to convince other school stakeholders about the benefits of using games as an educational tool, the lack of time for teachers to learn about game utilization, the sorting of content and functions that are related or not in teaching and learning activities, and technological barriers in IT equipment in many schools [8].

One type of game is a simulation game or simulation game. As the name suggests, simulation games aim to provide an imitation of real-life events or activities. This genre can provide opportunities for players to virtually simulate activities that cannot be done by them, such as driving a bus or plane [9]. In education, simulation games

can provide students with simulations of real-life situations to solve by utilizing their own knowledge and skills. From this, when a teacher or designer wants to develop a simulation game for learning, consideration should be given to what simulation process and learning objectives will be presented in the game, the time needed to deliver factual knowledge, attitudes, and strategies as well as the outcomes of the game compared to conventional methods, learner characteristics (age, social status, participation intensity, personal inclination, and achievement level) that may affect the effectiveness of the game, and future influences on the use of the game [10]. From here, in theory, a teacher can provide simulated activities that can improve SRL. Therefore, a game is needed that can develop students' motivation to continue learning, maintain their emotion regulation and self-attention, and their cognitive improvement. Thus, the purpose of this study is to see whether the development of simulation games related to self-regulated learning, as well as to see how the development of research and game development related to self-regulated learning.

## 2 Method

The method used in this research is a literature review with a bibliometric approach. A literature review is a systematic, explicit, and reproducible method for identifying, evaluating, and synthesizing research works and ideas that have been produced by researchers and practitioners. The literature review aims to analyze and synthesize existing knowledge related to the topic to be researched to find gaps in the research to be carried out. More detailed objectives are explained by Okoli & Schabram, namely (1) providing the background/theoretical basis for the research to be conducted, (2) studying the depth or breadth of existing research related to the topic to be studied and (3) answering practical questions with an understanding of what has been produced by previous research [11]. Meanwhile, the bibliometric approach is an analytical approach to examine the development or evolution of a research domain, including topics and authors, based on the social, intellectual, and conceptual structure of the discipline [12]. This analysis is commonly used in quantitative research sourced from journal papers, books, or other types of written communication [13]. In this analysis, the database used was journal articles from the Scopus database that included the keywords "game" and "self-regulated learning" during the period 2013 to 2023. From this, 61 articles were analyzed.

## 3 Result

### 3.1 Development of Game Media Publications related to Self-Regulated Learning

Table 1 show an analysis of the number of publications on game media related to Self-Regulated Learning from year to year between 2013 and 2023. 2020 saw a drastic increase and peak in this period. Interestingly, this was the year COVID-19 occurred with WHO declaring this a Public Health Emergency of International Concern

(PHEIC) on January 31, 2020, and eventually a pandemic on March 11, 2020. Research in this topic decreased in the following years, with only 8 to 10 publications, but more than in previous years where there were only 0 to 5 publications per year.

**Table 1.** Publication Development by Year.

Year	Number of Publication
2013	4
2014	3
2015	0
2016	3
2017	2
2018	3
2019	5
2020	15
2021	8
2022	10
2023	8

### 3.2 Development of Game Media Publications related to Self-Regulated Learning

Bibliometric analysis examines authors, research titles, number of citations, affiliations and countries. From the search results, there are not many authors or researchers on this topic. Of the 61 articles that have been collected, there are 166 authors. The author with the most contributions is Roger Azevedo from the University of Central Florida with six research articles, followed by James C. Lester from NC State University and Michelle Taub from the University of Central Florida with five studies each as shown in Table 2. The other authors have only 1-2 research papers.

**Table 2.** Number of Publications by Top Thirteen Authors.

Author	Number of Publication
Azevedo, R.	6
Lester, J.	5
Taub, M.	5
Chen, X.	2
Fitriyana, N.	2
Ikhsan, J.	2
Nietfeld, J.L.	2
Sawyer, R.	2
Shores, L.R.	2

Tsai, C.-W.	2
Wiyarsi, A.	2
Xie, H.	2
Zou, D.	2

It can also be said that the three authors are experts in this research topic, as evidenced by the article *The Agency Effect: The Impact of Student Agency on Learning, Emotions, and Problem-Solving Behaviors in a Game-Based Learning Environment* published in the journal *Computers & Education* (2020) which has been cited 74 times as presented in Table 3.

**Table 3.** Number of Publications by Top Five Cited Articles.

Author	Title	Year	Citations
Taub, M., Sawyer, R., Smith, A., ...Azevedo, R., Lester, J.	The agency effect: The impact of student agency on learning, emotions, and problem-solving behaviors in a game-based learning environment	2020	74
Chen, Y.-L., Hsu, C.-C.	Self-regulated mobile game-based English learning in a virtual reality environment	2020	73
Taub, M., Azevedo, R., Bradbury, A.E., Millar, G.C., Lester, J.	Using sequence mining to reveal the efficiency in scientific reasoning during STEM learning with a game-based learning environment	2018	62
Nietfeld, J.L., Shores, L.R., Hoffmann, K.F.	Self-regulation and gender within a game-based learning environment	2014	60
Sabourin, J.L., Shores, L.R., Mott, B.W., Lester, J.C.	Understanding and predicting student self-regulated learning strategies in game-based learning environments	2013	45

Regarding country and institutional affiliations, it was found that 23 countries contributed to this research topic. The United States contributed the most (17), followed by Taiwan (7), Indonesia (6), Hong Kong (5), Spain and Australia (4) as presented in Table 4. While other countries only have 1-3 research works.

**Table 4.** Number of Publications by Top Six Countries.

Nation	Number of Publication
United States	17
Taiwan	7
Indonesia	6
Hong Kong	5
Spain	4
Australia	4

In terms of institutions, there were 91 institutions that contributed to this topic with MC State University (9) being the largest contributor, followed by the University of Central Florida (5), Yogyakarta State University (4), and The Education University of Hong Kong (3) as presented in Table 5. While other institutions only have 1-2 research works.

**Table 5.** Number of Publications by Top Nine Institutions.

Affiliation	Number of Publication
NC State University	9
University of Central Florida	5
Universitas Negeri Yogyakarta	4
The Education University of Hong Kong	3
Arizona State University	2
Universidad de Burgos	2
National Chengchi University	2
Ming Chuan University	2
Erasmus MC	2

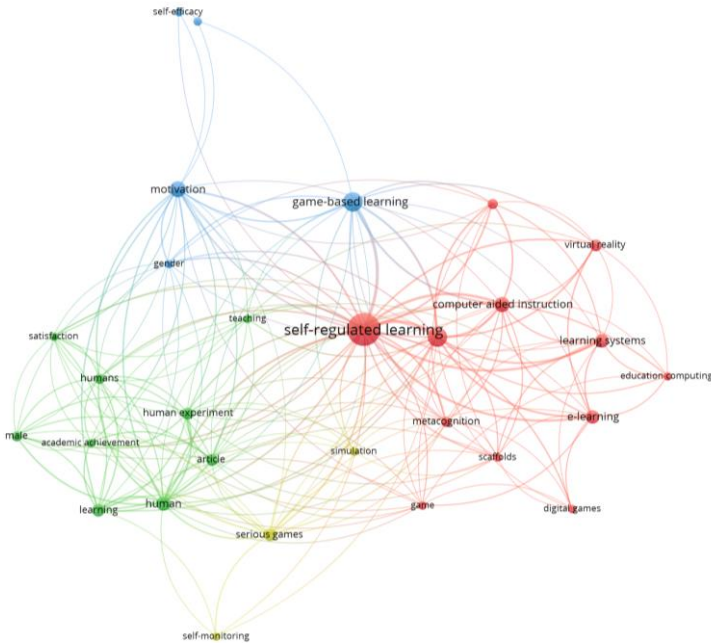
In terms of publication domains, there were 14 domains that received contributions with Social Sciences being the largest domain (40), followed by Computer Science (22), Psychology (17), Arts and Humanities (6), and Engineering Science (4) as presented in Table 6. While other domains only got 1-2 research works. Interestingly, education is not part of the contributed domain. This can mean that there hasn't been any contribution to the domain specifically related to game media related to Self-Regulated Learning.

**Table 6.** Number of Publications by Top Five by Domains.

Domain	Number of Publication
Social Sciences	40
Computer Science	22
Psychology	17
Arts and Humanities	6
Engineering	4

### 3.3 Keyword Trends related to Media Game and Self-Regulated Learning

Keyword identification using bibliometric analysis is used to identify knowledge structures and discourse within a domain. Keywords describe the authors' opinions of three to five important words in their articles, as well as finding trending topics, both in the present, and in the past [14]. From this bibliometric analysis, 29 keywords were found that appeared at least three times among the 61 journal articles collected. For more details, please see Fig. 1.



**Fig. 1.** Author Keyword Cluster Map (VOSviewer).

This study identified 29 keywords divided into four clusters in the topic of gaming media related to self-regulated learning. The first cluster (red) is the cluster that shows the positive influence of media on self-regulated learning, whether the media is a self-regulated vocabulary game [15], virtual reality [16], transmedia [17], or web-based [18]. There are also many studies in the cluster that use game-based learning methods. From these studies, it was found that game-based learning has positive effects such as high engagement in learning [18] [19], efficiency in teaching [18], better learning performance [18] [20] [21], and good emotions [20] [22] [23].

The second cluster (green) is the one that discusses factors to be considered in media development. Factors such as transparency, clarity, persuasive strategies, individual differences [24], learning methods used [18] [19] [25], linkage between game mechanics and personal organizational strategies [26] feedback provided [27], linkage between games and learning content, personal organizational features for individual and collaborative activities, integration of learning analytics that have been approved by various parties, data protection and information security, and consideration of various levels of functional diversity [28].

The third cluster (blue) discusses the relationship between game-based learning methods and other factors. There are several factors that can make game-based learning successful, such as self-regulation [16], gender [29] [30], students' self-efficacy ability [31], emotions [23] and students' self-agency [32]. On the other hand, game-based learning has a positive impact on the development of aspects of students, such

as learning performance [18] [33] [34] and motivation [35] [16]. It is also found that game-based learning environments have a positive impact and the majority of learning occurs in lessons where students can self-organize their learning environment.

The fourth cluster (yellow) is a cluster that discusses serious games. Regarding serious games, most of the research examining the outcomes of serious games focuses almost exclusively on learning outcomes [37], however, various positive aspects can be enhanced through serious games as well, such as cognitive skills [20], encouraging good performance levels and student satisfaction [38]. In relation to simulation, it was found that as one of the educational resources, it can theoretically provide facilities to develop self-regulation by covering three key aspects: learning motivation, planning and management, and self-monitoring [39]. However, as far as this analysis is concerned, there is no simulation game or serious game that is actually used to simulate the development of self-regulated learning, so this could be a topic for further research and development.

## 4 Conclusion

Self-regulated learning (SRL) has become a skill that should be taught to students, and one way to teach it is through simulation games. From the analysis of publications in this domain, it is found that there are not many studies that specialize in the development of simulation games for SRL as its keyword only appears three times in the database, although there have been many games related to SRL and its various positive impacts. As a consideration for development, a simulation game should take many factors into account, both from the students (such as self-agency and emotions) and from the learning itself (content and methods). In development, especially if it is to be associated with SRL, a game or simulation should be able to provide features for students to be able to organize their learning environment, while setting their own learning motivation, planning and management, and self-monitoring.

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