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A bibliometric analysis of gamification education in higher education research

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Abstract

Gamification in higher education has become a noteworthy subject recently, with the aim of transforming traditional educational approaches and having a positive effect. A systematic bibliometric review was conducted to identify six clusters related to this academic topic, including general overview, educational technologies, innovation of methods, external equipment and learning strategies. Self-determination theory, learning motivation, and flow theory are the main theories, and developed countries are the most researched regions.

Keywords

Bibliometric analysis, gamification education, higher education, Citespace

1.Introduction

In recent years, the concept of gamification has become increasingly popular, being applied in various fields such as education, industry, commerce, environment, government, and marketing(Xu)2012; Hanus & Fox, 2015). Gamification is seen as a way to revolutionize traditional educational methods, making learning more enjoyable and interactive. It involves the use of game elements and game design principles to motivate and influence people's behavior. Crawford believes that games can help with learning in three ways: cognitively, emotionally, and spiritually. Gamification of learning is a way to use entertainment to achieve educational goals, thereby helping teachers to improve the effectiveness of the learning and evaluation process(Subhash & Cudney, 2018).

As digital natives, teenagers are exposed to digital games more than ever before, making them a part of their lives. This raises the question of how to adapt to the educational needs of this generation, who have grown up with digitalization(Behl et al., 2022).

The use of gamified teaching in higher education has been widely adopted in various disciplines, such as language learning, science education, and engineering education, and has been found to be effective in improving students' learning motivation, participation, and outcomes. However, there are still some challenges to be addressed, such as designing effective gamified teaching plans, reducing cognitive load while increasing students' interest in learning, and finding a balance between gamified teaching and traditional teaching methods. Therefore, further research and exploration is needed to better understand the application of gamified teaching in higher education.

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2.Research design and data collection

This research uses bibliometric methods to analyze the major studies on university innovation and entrepreneurship education. Through the use of mathematical and statistical techniques, as well as computer visualization technology, the bibliometric approach provides a comprehensive look at numerous documents, allowing for a better understanding of the research hotspots and their development in the relevant areas. Commonly used methods of analysis include co-citation, co-word, and co-authorship analysis(Utkarsh & Sigala, 2021). Citespace is an example of a computer tool created with the help of appropriate research methods(Chen, 2006).

This research utilizes established metrology techniques and a keyword-based search strategy to extract data from WoS. On July 3, 2023, a search was conducted using the keywords "TI=gamif* OR game" AND "TI=higher education OR university * OR college *", with a preference for literature papers. Only English-language papers published in journals were included, resulting in 669 papers. After a thorough examination of their titles and abstracts, 322 papers were found to meet the criteria. Citespace was then used to conduct a metrology analysis of the chosen literature.

3.Data analysis

3.1Major publication of gamification education in higher education

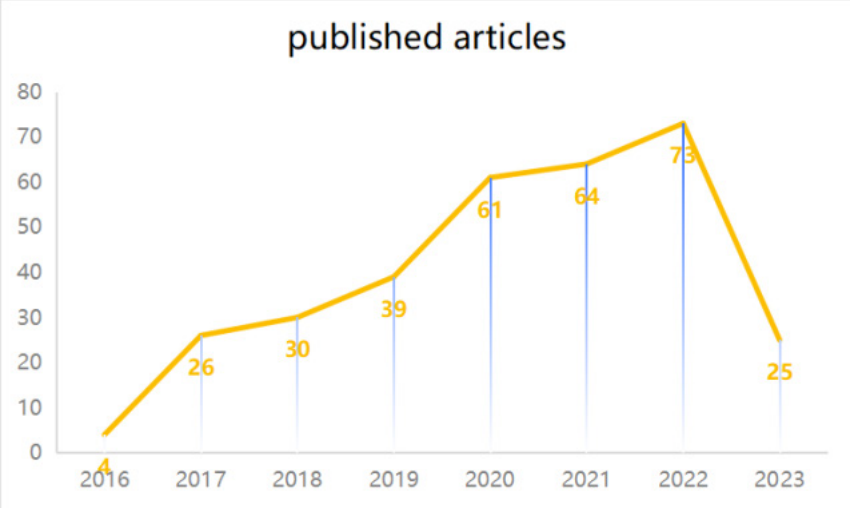


Fig1 pulished articles in gamification education

Statistical data reveals that the yearly average of publications in this field is 40.25, and the total number of publications over 8 years has exceeded this average. Since 2016, this field has experienced tremendous growth and development, with more than 20 papers published. This demonstrates the continuous interest of scholars in this area of study. Especially, the outbreak of COVID-19 has further accelerated its development due to the rise of online education.

3.2Principal authors of gamification education research in higher education

Table 1 Top 10 authors in gamification education research in higher education

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Rank	Freq	Author	Year	Source
1	18	Linn MC	2015	SCIENCE
2	13	Shanahan JO	2015	MENTOR TUTOR
3	11	Aikens ML	2016	CBE-LIFE SCI EDUC
4	9	Hurd NM	2016	AM J COMMUN PSYCHOL
5	8	Aikens ML	2017	CBE-LIFE SCI EDUC
6	8	Estrada M	2018	CBE-LIFE SCI EDUC
7	7	Hernandez PR	2017	J EXP EDUC
8	7	Morales DX	2017	RES HIGH EDUC
9	6	Joshi M	2019	BIOSCIENCE
10	6	Haeger H	2016	CBE-LIFE SCI EDUC

According to Linn(2015) , selection criteria, curriculum, and gamification are common methods of providing research experiences. Combining theoretical and practical aspects, increasing knowledge, deepening understanding of scientific inquiry, using investigative pedagogical methods, integrating within and beyond the syllabus, and encouraging communication and gamification among peers are all important elements. Generally, authors who are highly cited in this field have published mostly after 2010. Additionally, those who receive the most citations tend to focus on research in natural science and higher education.

3.3Major countries of gamification education research in higher education

Table 2 Top 20 authors in gamification education research in higher education

Rank	Freq	Country/District	Year
1	254	USA	1994
2	23	ENGLAND	1995
3	13	AUSTRALIA	2009
4	11	CANADA	2000
5	9	SPAIN	2011
6	8	SOUTH AFRICA	2006
7	7	GERMANY	2016
8	6	SCOTLAND	2014
9	5	IRELAND	2011
10	5	PAKISTAN	2011
11	5	PEOPLES R CHINA	2001
12	4	TURKEY	2019
13	4	INDIA	2010
14	3	UGANDA	2014
15	3	SAUDI ARABIA	2015
16	3	MALAYSIA	2020
17	2	DENMARK	2020
18	2	NORWAY	2018
19	2	ECUADOR	2020
20	2	QATAR	2019

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The importance of undergraduate mentorship systems is often indicative of a nation's capacity for scientific research and development (Linn et al., 2015). Table 2 shows that the top 10 countries/regions with relevant academic accomplishments are the USA, England, Australia, Canada, Spain, South Africa, Germany, Scotland, Ireland, and Pakistan. Notably, the top five countries, being the USA, UK, Austria, Canada, and Spain, are all developed countries, thus highlighting the advanced nature of higher education.

3.4Major themes of gamification education research in higher education

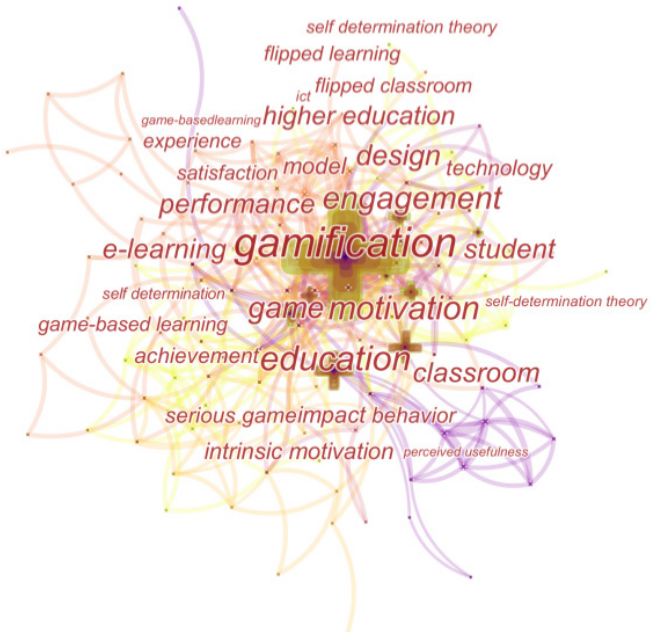


Fig2 co-word analysis of research in gamification education research

Table 3 Top 30 keywords in gamification education research in higher education

Rank	Frequency	Label	Year
1	64	students	1996
2	49	higher education	2009
3	38	education	2000
4	37	experiences	2001
5	35	perceptions	1999
6	32	faculty	2005
7	31	undergraduate research	2001
8	24	benefits	2009
9	24	women	1994
10	23	gender	2009
11	22	college students	2009
12	19	science	2000
13	17	outcome	2009
14	17	peer gamification	2013
15	16	programs	2016
16	15	race	2014

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17	15	program	2001
18	14	success	1994
19	13	support	2005
20	12	mentorship	1999
21	11	self efficacy	2011
22	11	youth	2018
23	10	adjustment	2002
24	10	impact	2011
25	10	university	2009
26	10	academic success	2011
27	10	performance	2000
28	10	research experiences	2016
29	9	transition	2014
30	9	model	2008

Table 4 Top 10 most cited papers in this academic field

Rank	Title	Authors	Source Title	Publication Date	Average per Year
1	Digital Game-Based Learning in high school Computer Science education: Impact on educational effectiveness and student motivation	Papastergiou, Marina	COMPUTERS & EDUCATION	JAN 2009	54.33
2	Successful implementation of user-centered game based learning in higher education: An example from civil engineering	Ebner, Martin; Holzinger, Andreas	COMPUTERS & EDUCATION	NOV 2007	21.94
3	Gamified learning in higher education: A systematic review of the literature	Subhash, Sujit; Cudney, Elizabeth A.	COMPUTERS IN HUMAN BEHAVIOR	OCT 2018	42.67
4	Higher education, social class and the mobilisation of capitals: recognising and playing the game	Bathmaker, Ann-Marie; Ingram, Nicola; Waller, Richard	BRITISH JOURNAL OF SOCIOLOGY OF EDUCATION	NOV 1 2013	20.55
5	The rules of the game: women and the leaderist turn in higher education	Morley, Louise	GENDER AND EDUCATION	JAN 1 2013	17.45

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6	Serious games for higher education: a framework for reducing design complexity	Westera, W.; Nadolski, R. J.; Hummel, H. G. K.; Wopereis, I. G. J. H.	JOURNAL OF COMPUTER ASSISTED LEARNING	OCT 2008	11.25
7	What influences college students to continue using business simulation games? The Taiwan experience	Tao, Yu-Hui; Cheng, Chieh-Jen; Sun, Szu-Yuan	COMPUTERS & EDUCATION	NOV 2009	9.27
8	College students' video game participation and perceptions: Gender differences and implications	Matile Ogletree, Shirley; Drake, Ryan	SEX ROLES	APR 2007	7.76
9	The effectiveness of in-game advertising - Comparing college students' explicit and implicit memory for brand names	Yang, Moonhee; Roskos-Ewoldsen, David R.; Dinu, Lucian; Arpan, Laura M.	JOURNAL OF ADVERTISING	WIN 2006	6.83
10	Why do universities compete in the ratings game? An empirical analysis of the effects of the US News and World Report college rankings	Meredith, M	RESEARCH IN HIGHER EDUCATION	AUG 2004	5.5

It is found through Citespace's cluster analysis function that there are a total of six clusters which can be identified. Cluster 1 is a general overview of gamification education, containing words such as self-determination theory, online learning, environmental education, mobile apps, language learning, physical education, computer programming, game elements, learning, achievement, participation, interaction data, physical education, computer programming, game elements, active learning, emotional engagement, and structured knowledge learning.

Cluster 2 is focused on educational technologies such as foreign language, gamified platforms, competitiveness, physical education, facial expression, innovative methodologies, assignments, and digital games. Performance outcomes and physical education are also taken into consideration, as well as facial expression and innovative approaches.

Cluster 3 is more related to innovative methodologies such as antimicrobial agents and includes terms like medical education, English learning, learning, educational innovation, methodological contrast, transformative pedagogies, mathematics, mathematics education, secondary education, mixed learning, teaching methods, secondary schools, learning processes, classroom, online learning, physical education, innovative methodologies, and engagement.

Cluster 4 is related to external equipment, which includes innovative methodologies, project-based learn-

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ing, mobile apps, environmental education, medical education, computer programming, improving classroom teaching, educational technology, and self-determination.

Cluster 5 is associated with external learning environment, and includes words such as methodology, education, computer programming, physical education, learning strategies, classroom management, computer game, achievement, cooperative learning, English vocabulary learning, augmented reality/game-based learning, collaboration, learning strategies, classroom management, elementary student, physical education, computer game, achievement, and cooperative.

Cluster 6 is related to learning strategies, featuring words such as methodology, physical education, learning strategies, classroom management, computer game, achievement, cooperative learning, English vocabulary learning, augmented reality, game-based learning, collaboration, learning strategies, classroom management, elementary student, physical education, computer game, achievement, and cooperative.

4.Conclusions

Research into the importance of teaching education is still in its early stages and primarily focuses on theoretical discussions. Currently, studies mainly concentrate on the connection between gamification and online tool use in developed countries.

In the field of research, cognitive psychology is the main theoretical basis for studying gamified learning, particularly in regards to self-determination theory, learning motivation, and flow theory. Different studies have come to varied conclusions about the effectiveness of gamified learning. To further explore this topic, experimental methods, EEG technology, and other research methods should be utilized, particularly in terms of improving teaching content, reducing student cognitive overload, and boosting internal and external motivation. Moreover, due to the rapid growth of information technology and education in recent years in countries like China, there is still a lot of potential for further research.

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