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A Bibliometric Analysis of Health-Based Gamification

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Abstract. Gamification, the application of game design elements in non-game contexts, has emerged as a promising strategy to promote positive behavior change. Although gamification has shown potential in various domains, including healthcare, a comprehensive analysis of the existing literature is needed to map research trends, influential works, and future directions in the field of health-based gamification. This study used a bibliometric analysis approach, using PoP software for data extraction, VOSviewer for visualization, and Mendeley for reference management. Relevant publications on health-based gamification were identified through a comprehensive search across multiple databases. The extracted data was analyzed to examine temporal trends, thematic clusters, influential authors, and citation patterns. The analysis revealed a steady growth in articles related to health-based gamification, with contributions from researchers in different disciplines. The key thematic groups included gamification applications in mHealth, physical activity interventions, serious games, and adherence. Influential authors and highly cited studies were identified, highlighting foundational work and seminal contributions. This bibliometric study offers a comprehensive overview of the health-based gamification literature, underscoring its interdisciplinary nature and diverse research topics. The findings highlight the potential of gamification in promoting positive health behaviors and facilitating patient engagement. Identified research gaps and emerging trends provide valuable information for future studies, fostering innovation and collaboration in integrating gamification principles into healthcare interventions.

Keywords: *bibliometric analysis, health, gamification*

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1. Introduction

Gamification was defined in 2011 as the use of game design principles in non-game environments. Since then, it has quickly evolved as one of the most popular persuasive methods, extensively utilized to promote a positive change in the user's behavior by incorporating game-like aspects in non-game contexts [1],[1], [2]. The most common goal of gamification is to increase user engagement and internal drive to create certain tasks that are generally deemed boring or uninteresting. Originally used in the fields of business and marketing [3]. The application of gamification in learning is considered to have a huge appeal among students in stimulating motivation and influencing society.

This research aims to present a summary in the field of gamification which is currently developing in the domain. Game-based gamification is a very popular technology that uses game elements to encourage desired behavior and drive corporate learning outcomes. This method is built for constructivist learning, experiences through social interaction with the environment and peers [3], [4]. In the corporate environment, organizational learning is related to serious strategic objectives, regardless of the level of technology [5]. Gamification features, often known as "mechanics," are integrated into the overall context of the program to improve usability and appeal to those aspects of video games that gamers usually love and compel continuing play. Understanding these mechanics and their accompanying design and development considerations, contextualized by examples of mHealth applications, should help guide the creation of gamified mHealth applications that could better motivate patient self-management[5].

In winter 2014, an examination of health and fitness apps related to physical activity and diet was conducted among the apps on the Apple App Store. This study examined 132 apps for the 10 most effective aspects of the game, the six fundamental components of health gamification, and the thirteen core constructs of health

behavior. The association between health behavior variables, gamification components, and effective game aspects was measured using a regression analysis [6]. The literature on gamification is rapidly expanding and spreading in various directions, but this is the traditional method of any development with huge potential and a horde of enthusiastic devotees. To regulate and capitalize on this development, coordinated efforts are required to put the literature and existing knowledge to productive use, as well as to provide the field with a research agenda. Gamification is still in its infancy and is rapidly evolving, but what is truly known about the phenomenon is based on fragmented fragments of information and a diversity of opinions [7].

Gamifying education and learning has a long history and an intuitively understandable basis because game design and learning theories draw extensively from the same psychological theoretical bases. The trend of gamification in education and learning is only growing, thanks to technological improvements that allow more digitized learning environments, as well as the use of, for example, technical possibilities established in relation to video games to create immersive and engaging learning experiences [8]. Because our purpose is to methodically analyze persuasive technology in the health sector, we used quantitative content analysis, a technique that allows data comparison, contrast, and categorization based on various themes and concepts. This includes careful data collection, with special attention paid to the objectivity of the results [9]. Any health program must be able to categorically explain how many deaths it will prevent and what proportion of the global burden of diseases it will address. To fill data shortages, model-based approaches to creating global, regional, and national estimates of mortality, morbidity, and disease burden have proliferated [10].

Despite proven benefits, participation in physical activity remains low in patients with coronary heart disease (CHD). Scientific evidence suggests that mobile health (mHealth)-based gamification interventions could increase physical activity levels [11]. However, several systematic reviews demonstrated that most of the gamification intervention designs do not take advantage of theories of health behavior models and empirical evidence on the efficacy of such interventions among patients with CHD [12]. Low anterior resection syndrome (LARS) involves bowel dysfunction after sphincter-preserving surgery for rectal resection that significantly affects the quality of life of patients (QoL). The improvement of LARS largely depends on the patient's self-management behavior; however, insufficient information about supportive care and weak awareness of self-management lead to poor self-management behavior.

Motivational interviews (MI) explore and change the ambivalence of patients during conversation, thus changing and maintaining healthy behaviors to improve effective participation. In recent years, mobile health has been widely used in clinical practice, providing continuous information support and remote interaction [13]. However, current online information on LARS is suboptimal, websites are highly variable, important content is often lacking, and the material is too complex for patients. Therefore, this study will evaluate the impacts of a remote LARS interaction management intervention based on a WeChat app ('e-bowel safety') and MI in patients with LARS. High molecular weight (HMW) molecules of animal, plant, and microbial origin have long been recognized as potent respiratory sensitizers. Most of these sensitizers are naturally occurring water-soluble proteins in the molecular weight range of 10-60 kDa that in a hydrophilic environment, such as respiratory mucosa, are easily released from, for example, skin scales, plant fibers, pollen grains and other tissue matrices.

Table 1. State of the art Gamification

Author(s) & Year	Number of Documents Analyzed	Sources	Findings
M. Trinidad, M. Ruiz, and A. Calderon(2021)	60	*Google Scholar*	Gamification as a scientific field that will be useful to junior and senior researchers, practitioners, funding agencies, and policy makers. DOI:10.1109/ACCESS.2021.3063986
Z Zainuddin SKW Chu M Shujahat(2020)	557	*Google Scholar*	Gamification that is considered a game changer and a key driver of user motivation, engagement, and experience, but also seeks to outline the main challenges and obstacles to gamification. DOI:10.1016/j.edurev.2020.100326
AS Miller; JA. Cafazzo E. Seto(2016)	419	*Google Scholar*	That gamification could be used to develop applications with the potential to better facilitate self-management in people with chronic diseases. DOI:10.1177/1460458214537511
C. Lister, J. H. West, B. Cannon, T. Sax, and D. Brodegard(2014)	610	*Google Scholar*	Gamification in relation to the construction of health behaviors or insight into the actual development of gamification in health applications. DOI: 10.2196/games.3413
J. Koivisto and J. Hamari(2019)	1339	*Google Scholer*	Gamification refers to designing information systems to afford similar experiences and motivations as games and, consequently, to attempt to affect user behavior. DOI:10.1016/j.ijinfomgt.2018.10.013. J.

The purpose of this paper is to answer the following questions:
a. How to the classification this paper regards health-based gamification?
b. Nowadays how to analyze research regards health-based Gamification?
c. Which is the most current publication on health-based gamification?
d. What topic analysis research considering health-based gamification in the future for advanced research?

In Section 1, is to understanding Gamification has quickly evolved as one of the most popular persuasive strategies, extensively utilized to promote a positive change in the user's behavior by including game-like features in non-game circumstances. In Section 2 methods use to motivate about Gamification in learning and instruction is perceived to have broad appeal among learners in terms of increasing motivation, learner engagement, and social influence. This study aims to provide a summary of the empirical findings of the current literature in the emerging field of gamification within the educational domain of learning and instruction. In Section 3, Gamification in mHealth (mobile health) applications has the potential to improve patient self-management.

This review article fills a knowledge gap about the efficient implementation of gamification design principles, or mechanics, in the development of mHealth applications. In Section 4. The goal of this research was to determine the extent to which gamification is employed in health applications and to examine gamification of health and fitness apps as a potential component of influence on a consumer's health behavior. In section 5, As the review's last contribution, we present a complete discussion of 15 possible research pathways on the future agenda for the growing vein of literature on gamification and gameful systems within the field of information system science.

2. Methods

Bibliometric analysis is a study of bibliographic analysis of scientific activity, presuming that a researcher conducts or conducts research and must communicate the results to peers [14], [15]. Some computer programs, such as VOS viewer, Pajek, and Gephi, can be used to visualize the results of the bibliometric analysis. VOS viewer is a free computer program for visualizing and exploring bibliometric knowledge maps [16], [17] [18][19]. MDS (Multi Dimentional Scaling) is the algorithm used in this program. Clusters generated by VOS viewer are automatically colored on the map. Figure 1 depicts the study framework based on the description above.

2.1 Search of specific Terms Health Based Gamification

The use of bibliometric analysis is becoming popular as a means of discovering scientific patterns in the knowledge collected in the literature, revealing emerging trends [20], [21]. in the research field and analyze the structure underlying the research, its evolution, and its dynamic aspects. This method is statistical for measuring the output of individual/research teams, institutions, and countries, identifying national and international networks, and mapping the development of new fields of science and technology.

There are two types of bibliometric analysis: (1) performance analysis and (2) science mapping. The main difference between the two is that performance analysis uses bibliographic data to measure the research activities of individuals, groups, organizations, or countries and their impact, while scientific mapping focuses on visualizing the structure. Research method using digital database searches IEE Xplore, Science Direct, Scopus, WoS, Springer Link, and Wiley Online Libray.

2.2 Information Health Based Gamification

The goal of a bibliometric analysis of health-based gamification is to provide in-depth insight into developments, trends, and research priorities in the context of health-based gamification. Researchers can use bibliometrical analysis to investigate a wide range of scientific articles published in this field, analyze the distribution of publications based on time, place, author or specific topic, and identify correlation patterns between different scientific works. Table 2 shows the metric information for the terms.

Table 2. Metrics information of Terms

Metrics Data	Gamification
Publication's years	1989-2023
Citation years	34 (1989-2023)
Citations	980
Cites/years	193949
Cites/paper	5704,38
Author/paper	197,91
h-index	2,80
g-index	202
hI,norm	128

hI,annual	3.76
hA,index	74

2.3 Reference Management

The information was obtained from the websites of two different journals. The next step is to clean up references with the Mendeley tool. References are required to ensure that the article's metadata, which may include author information, keywords, abstracts, and other information, exists.

2.4 Bibliometric Analysis

After verifying all the information of the article. Following completion of all tasks, a bibliometric examination will be performed. VosViewer was one of the applications used in the bibliometric analysis process for this work [22], [23].

3. Results and Discussion

To answer the first purpose of this paper about how are social entrepreneurship articles classified, in JSE and SEJ using VosViewer software, through creating a map based on text data using the title and abstract fields, with the binary counting method there are 4684 terms found. With a minimum number of occurrences of a term of 10 times, 156 thresholds were found. However, for each of the 156 terms, a relevance score will be calculated. Based on this score, the most relevant terms will be selected automatically by default as much as Template: Anonymized document 60%, so we get the 94 most appropriate words. However, the verification process still has to be done manually by eliminating unrelated words, such as editorial, sample, abstract, and others. Thus, the total words that can be included in making a map are 94 words.

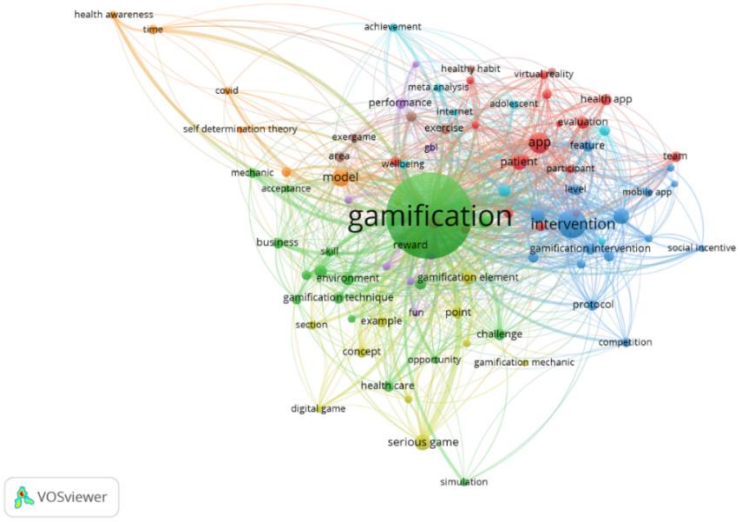

Figure 1. Network visualization map of keywords

Figure 1 shows a variety of clusters labeled with different colors, including blue, purple, yellow, red, and green. On the basis of the total number of articles, many of the cluster's keywords are the most frequently used. This cluster shows that there are nine different types of article as of this writing. More information is available in Table 3.

Table 3. Clusters and keyword therein

Cluster	Total Items	Most Frequent Keywords (Occurrences)	Keywords
1	18	app(94), patient(53), evaluation(31)	app, evaluation, feasibility, gamification concept, gamification design, gamification feature, gamification principle, gamified, group, health app, home, older, adult, participant, patient, team, technique, user, engagement, virtual reality
2	17	gamification(1530), environment(33), literature review(33)	acceptance, behavior, business, challenge, environment, gamification, gamification research, gamification technique, health care, literature review, marketing, mechanic, opportunity, problem, simulation, skill, solution
3	16	Intervention(171), physical activity(56), effectiveness(43)	adult, competition, effectiveness, feature, gamification intervention, health behavior, individual, intervention, level, mobile app, physical activity, protocol, randomized controlled trial, school, social incentive, trial

4	14	serious game(55), gamification element(38),type(31)	concept, definition, digital game, example, gamification element, gamification mechanic, gamification system, gamified application, location, point, reward, section, serious game, type
5	9	Performance(26), quality(17),life(15)	case study, fun, gamification method, gbl, higher education, life, performance, physical education, quality
6	8	Adherence(30), efficacy(24), achievement(17)	achievement, adherence, adolescent, efficacy, healthy, lifestyle, internet, meta-analysis, wellbeing
7	6	Model(67),time(20), gamification framework(20)	covid, gamification framework, health awareness, model, self-determination, theory, time
8	6	Area(26),exercise(25),fitness(24)	area, exercise, exergame, fitness, healthy habit, influence

Then, to find answers to questions about social trends in health-based gamification, we could turn to the cluster itself. Figure 2 graphically depicts the number of articles published. The terms that occur the most frequently in Cluster 1 are app, patient, and evaluation.

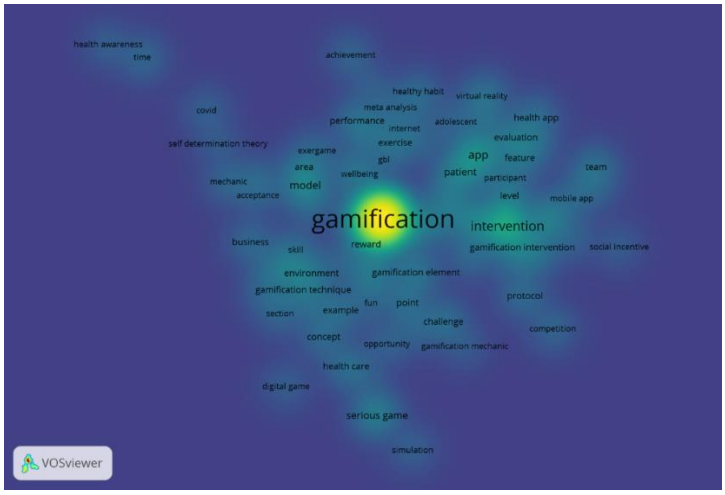

Figure 2. Density visualization map of keywords

The results of this mapping indicate that in clusters 8. Discussions in this group include the area, exercise, physical activity, fitness, healthy habits, and influence. Additionally, some terms appear only infrequently among the keywords for each cluster. Acceptance, feasibility, randomized controlled trial, and gamification mechanic are examples of these terms. That is to say, there are still research gaps that will almost certainly emerge as a trend in the future, which will be tailored to the conditions of both the world in which we live now and the world that will follow us.

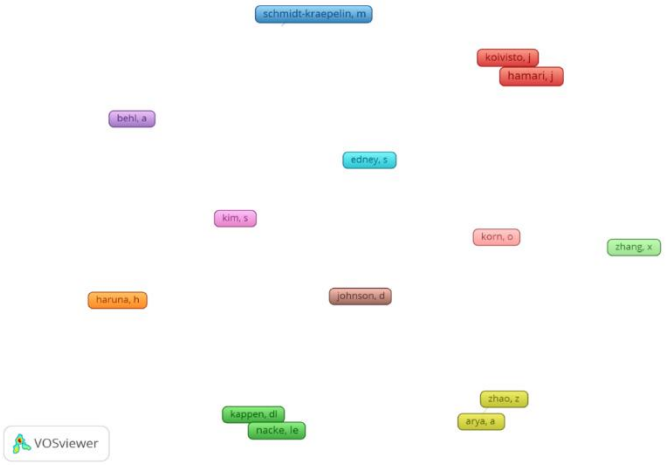

Figure 3. Network visualization map of authors

Figure 3 shows that there are 15 distinct names for each cluster that have a large number of points in each cluster. Only authors that are related to the magnitude of themselves are being reported. Expand on the situation in which authorship becomes a problem.

Table 4. The Top Ten Cited Documents in Health-Based Gamification

Citations	Author and year	Title
2973	K Seaborn, DI Fels (2015)	Gamification in theory and action: A survey
1393	Jonna Koivistoa and Juho Hamari (2019)	The Rise of Motivational Information Systems: A review of gamification research
1146	Daniel Johnson, Sebastian Deterding, Kerri-Ann Kuhn, Aleksandra Staneva, Stoyan Stoyanov, Leanne Hides (2016)	Gamification for health and well-being: A systematic review of the literature
854	Lamyae Sardi, Ali Idri, and José Luis Fernández-Alemán(2017)	A systematic review of gamification in e-Health
832	D Baker, N Kazantzis, D Rickwood, N Rickard (2016)	Mental health smartphone apps: Review and Evidence-Based Recommendations for Future Developments
736	Sujit Subhash, Elizabeth A. Cudney (2018)	Gamified learning in higher education: A systematic review of the literature
618	Cameron Lister, Joshua H West, Ben Cannon, Tyler Sax, David Brodegard (2014)	Just a fad? Gamification in Health and Fitness Apps
590	Lennart E. Nacke, Sebastian Deterding (2017)	The maturation of gamification research
582	F Xu, D Buhalis, J Waber (2017)	Serious games and the gamification of tourism
576	B Cugel Man (2013)	Gamification: What it is and why it matters to digital health Behavior Change Developers

From 2011 to 2023, direct quotations were used in most health-based gamification documentation. The most recent materials will contain numerous citations only if the author has conducted extensive background research. Then, look at Table 5 to see which fields of study have produced the most scholarly articles.

Table 5. The Most and Fewer Occurences Terms in Health-Based Gamification

Most Occurrences		Fewer Occurrences	
Occurrences	**Term**	**Occurrences**	**Term**
1530	Gamification	10	acceptance
171	Intervention	10	randomized controlled trial
94	App	10	gamification mechanic
67	Model	10	self-determination theory
56	Physical Activity	11	feasibility
55	Serious game	11	fun
53	Patient	11	social incentive
43	Effectiveness	11	physical education
38	Gamification Element	12	gamification feature
33	Environment	12	digital game
33	Literature review	12	gbl
31	Evaluation	12	healthy lifestyle
31	Type	12	internet
30	Adherence	13	definition
26	Performance	13	gamification system
26	Area	13	influence
25	Exercise	13	gamification method
24	Efficacy	13	heath awareness
24	Fitness	14	healthy habit
20	Time	14	gamification concept
20	Gamification framework	14	simulation
17	Quality	14	location
17	Achievement	14	case study
15	Life	14	covid

Table 5 not only explains the topics most frequently discussed in published works, but also highlights the overarching goal of this piece of writing, which is to determine which future potential health-based gamification issues warrant further investigation. A great deal of new information has been collected about the prevention, application, and safety of health-based gamification. The same can be said about issues concerning gamification adulteration, such as their supply networks and methods, both of which are mentioned extensively in the preceding paragraphs. Problems that have the potential to lead to future research on more detailed aspects of health, exercise, and a healthy lifestyle. Almost no research has been done on a variety of topics, including finding health-based gamification.

4. Conclusions

In conclusion, the bibliometric analysis of health-based gamification presented in this article offers valuable information on the evolving landscape of this interdisciplinary field. Leveraging powerful tools such as PoP software, VOSviewer, and Mendeley has allowed for a comprehensive examination of the existing literature,

revealing key trends, influential authors, and prominent research clusters. The application of PoP software facilitated the systematic extraction and organization of pertinent data, allowing a structured examination of the temporal evolution and growth patterns within the field. VOSviewer, with its visualization capabilities, contributed to the identification of thematic clusters, illustrating the interconnectedness of various research themes and the emergence of new trends over time.

Mendeley, as a reference management tool, provided a robust platform to track citation patterns and gauge the impact of individual studies. Through these methodologies, this article not only has quantified the growth of health-based gamification research, but also has shed light on collaborative networks among researchers. It has identified influential scholars, key journals, and pivotal studies that have contributed significantly to the advancement of knowledge in this domain. The findings of this bibliometric analysis have implications for researchers, practitioners, and policymakers alike. As health-based gamification continues to gain traction, the identified trends and influential works can guide future research efforts, fostering collaboration and innovation.

This paper serves as a valuable resource for scholars seeking to navigate the extensive literature on health-based gamification and contributes to the ongoing discourse surrounding the integration of gamification principles into health and wellness interventions. In essence, the application of PoP software, VOSviewer, and Mendeley in this bibliometric analysis has not only facilitated a comprehensive examination of the existing literature, but has also provided a foundation for future research and development in the dynamic and evolving field of health-based gamification.

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