

EXPLORING ANALOG GAME LEARNING FOR CANCER LITERACY: A BIBLIOMETRIC PERSPECTIVE

AZIZ, N. I. S. A.^{1*} – MAON, S. N.¹ – RAMLI, N.¹ – AZIZAM, N. A.¹ – DZULKIPLI, M. R.¹

¹ *Department of International Business and Management Studies, Universiti Teknologi MARA, Selangor, Malaysia.*

**Corresponding author
e-mail: shamimi4576[at]uitm.edu.my*

(Received 18th March 2026; revised 26th June 2026; accepted 28th July 2026)

Abstract. Cancer remains one of the leading causes of death worldwide, particularly in the top five cancers: lung, breast, cervix, liver, and prostate. Limited cancer literacy contributes to delays in prevention, detection, and effective self-management. To address this challenge, analog game-based learning has emerged as an innovative approach to improve engagement and understanding. This study employs a bibliometric analysis to examine research trends, productive countries, institutions, authors, and the most prominent thematic domains in this field. A total of 1,823 articles were initially retrieved from the Scopus database, with 1,741 included after screening. Metrics were gathered in the database, and VOSviewer was used to map thematic clusters. Results reveal a steady rise in publications since the early 2000s, with the United States, United Kingdom, and Canada leading scholarly output. Institutional contributions were globally dispersed, reflecting strong collaboration across regions. Thematic mapping identified four domains with one emerging as the dominant theme. Findings highlight the widespread acceptance of board and card games means the increasing interest in AGL to enhance cancer literacy, participation, and collaboration, with consistently positive feedback from learners.

Keywords: *analog game learning, game-based learning, board games, cancer literacy, bibliometric*

Introduction

Cancer remains as one of the leading causes of death globally which accumulated for nearly 10 million of death in the year of 2020. There are six (6) common types of cancer which highly associated with death namely lung (1.80 million deaths), colon and rectum (916, 000 deaths), liver (830, 000 deaths), stomach (769, 000 deaths) and breast (685 000 deaths). Every country has come up with strategized national cancer policy on how to combat the disease and reduce the likelihood of getting cancer. The possibility to reduce long-term care also can reduce the use of treatment and intervention cost (Setyawati et al., 2024). Cancer literacy refers to the capacity of a patient to obtain, digest, be able to improve basic cancer information and act to help them in making decisions. Limited cancer literacy may hinder them to think and make appropriate decisions which after that result in poor self-management (Jeitani et.al, 2025). Information should be considered from legit websites and from healthcare professionals rather than Internet influencers who promote cures for cancers and from the political purposes (Buyens et al., 2023). Treatment decisions need to be advised by the oncologist (Blanchard et al., 2026). Previous studies have been found to relate between patients' cancer illiterate with reduced access to health services. It may be due to poor communication like difficulty understanding medical jargon and complex process, interaction dominated by oncologist, receiving less information about treatment options and other related matters (Buyens et al., 2023). Some of it might be caused by unaware and misinformed about cancer, living in modifiable unhealthy lifestyles and poor eating

habits (Lawrence et al., 2025). The medium to disseminate of cancer information has been replaced according to time to time.

Strategies to improve literacy; The current approaches and analog game learning

Many alternatives have been implemented to improve cancer awareness and literacy, including pamphlets, radio, television, and multimedia advertising. However, a study among students in Bosnia Herzegovina found that leaflets alone did not significantly improve knowledge or attitudes. In contrast, posters had a stronger impact, as their long-term visibility in public spaces supported better knowledge retention (Hasanica et al., 2020). Beyond printed materials, cancer campaigns and media coverage involving public figures have also been effective, particularly in raising awareness of breast and skin cancer through collaborations that educate the public and generate funding (Cohen et al., 2020). Social media platforms also further serve as cost-effective and engaging tools for disseminating cancer literacy (Han et al., 2018). In present, gamification and game-based learning (GBL) have gained significant attention, with serious games serving as a prominent example. A pilot GBL initiative, the OutSMART Cancer Game, introduced a web-based platform presenting cancer-related scenarios covering breast, colon, and lung cancers (Abraham et al., 2024). GBL mostly covered digital games that encourage educational technological use in learning. Nevertheless, the use of analog game learning (AGL) came into educational setting way before the use gamification and GBL. AGL implemented non-traditional way of learning through the use of board games which required participant to involve as a group with the presence of physical meeting and tool to promote interpersonal and cognitive skills (Conway and Smith, 2026). For instance , a study on the prostate cancer board game LIBOG compared its effectiveness with traditional health talks. GBL used in digital games and AGL both approaches improved cancer literacy, with knowledge levels rising from 35% to 60%, demonstrating the potential of these two methods as impactful tools for health education (Obeng et al., 2025).

Despite positive progress in knowledge delivery, there remains a lack of studies that specifically examine how board games can enhance cancer literacy. To address this gap, the study provided the following objectives: (RQ1): What is the research trend in analog game learning in cancer literacy studies? (RQ2): Which are the most productive countries, institutions and authors on analog game learning in cancer literacy studies? (RQ3): Which are the most prominent theme analysis of analog game learning in cancer literacy between authors?

Materials and Methods

In this study, AGL was defined as non-digital game-based educational approaches. Bibliometric analysis is an important tool for assessing scientific outcomes such as articles, keywords, authors, journals, institutions, and countries, enabling researchers to examine the relationships and interactions among these elements (Ozturk and Kocaman, 2024). The Scopus database was used as the primary source of data as of 9th May 2026. To identify relevant articles, the search strategy with the keywords TITLE-ABS-KEY ((board AND game) OR (serious AND game) AND (cancer) OR (health) AND (education) OR (knowledge)). The search strategy used keywords “board and game” and “serious and game” to capture broader literature review in education. The TITLE-ABS-KEY option was selected because researchers systematically examine the domain

of the analog game learning and cancer literacy. This option focused on publication titles, abstracts, and keywords, ensuring the retrieval of documents with reference terms analog game learning and cancer literacy within these fields (Hussain et al., 2026). In the initial retrieval, 1823 articles were obtained. This strategy seek boarder landscape of GBL associated with cancer literacy and health education thus enable a comprehensive mapping or related publications in the field. All records were exported in CSV format, duplicates were removed, and metadata standardized. During screening stage, it was evaluated based on the relevancy to games in education associated with cancer literacy and health education. After screening and eligibility process, a total of 1741 articles were deemed suitable for inclusion, with 68 articles excluded due to no author's name and article titles. The process of article selection is illustrated in a PRISMA flow diagram in *Figure 1*. For further analysis, researchers used database information to generate citation metrics, while VOSviewer was applied to visualize the themes of analog game learning in cancer literacy. The methodology integrates descriptive statistical analysis with advanced bibliometric visualization to provide a comprehensive overview of the research landscape. Nevertheless, certain limitations must be acknowledged. First, the analysis relied solely on the Scopus database as the primary source of coverage, which may restrict the breadth of literature included. Second, some retrieved articles contained incomplete bibliographic information, such as missing author names or titles, which necessitated their exclusion from the dataset. Next, this study applied broad search strategy which included additional studies beyond GBL for cancer literacy. It may be benefit in future studies to employ more focused search strategies to refine the scope of analysis.

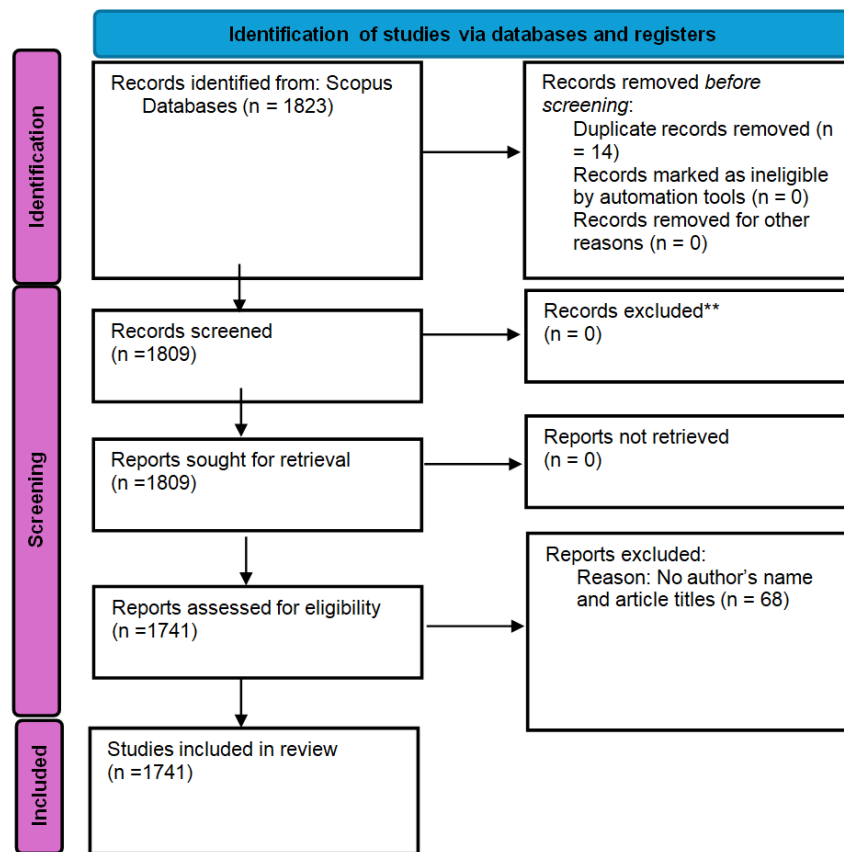


Figure 1. PRISMA flow diagram based on analog game learning search.

Results and Discussion

Early contributions of research interest in analog game learning occurred between year of 1994 to 2004. It started small, with only 27 publications recorded. A moderate increase followed during 2005–2015, yielding 392 publications. From 2016 onwards, the field experienced a steady rise, beginning with fewer than 100 publications annually and gradually expanding. The period 2019–2021 reflects consistent research activity, averaging 100–140 publications per year. Between 2022 and 2024, the trend further strengthened, with totals exceeding 120–180 publications annually. The peak was observed in 2025, with 209 publications. In 2026, a low number of 68 publications was noted due to incomplete indexing rather than a genuine reduction in research output activity. To address RQ2, this study examined the most productive countries, institutions, and authors contributing to the field. For publication by countries, United States dominates the topic with 337 publications, followed by the United Kingdom (201) and Canada (141), reflecting their central role in shaping global scholarly activity. Brazil ranks next with 133 publications, demonstrating strong engagement from Latin America. In Europe, Germany (102) and France (101) underscore the region's significant presence. The final three countries in the top ten namely Spain (87), the Netherlands (85), and Italy (84) also contribute consistently, though at lower levels compared to the leading nations. This pattern suggests that the topic is not only

geographically diverse but also increasingly recognized as a global area of scholarly interest.

Furthermore, in terms of publications from the global institution, two public research universities namely the Universidade de São Paulo and the University of Toronto lead with 23 publications each, closely followed by Ontario Tech University (22) and McGill University (20). On the other hand, European institutions also demonstrate strong engagement, including the Universidade do Porto (19), Inserm (17), and Université de Genève (17), alongside Coventry University (17) in the United Kingdom. Representation from Asia is apparent through the National University of Singapore (16), while Latin America contributes further via the Universidade Federal de Pernambuco (16). This distribution indicates that scholarly activity in analog game learning is widely dispersed across global institutions, with no single university dominating the field. Lastly on the research trend is identifying leading individual authors to the global discourse on analog game learning in cancer literacy. Kapralos, B. emerges as the most prolific author with 20 publications, followed by Abraham, O. (13), Dubrowski, A. (12), and Mitchell, G. (11), underscoring their central role in shaping the field. Authors with fewer than 10 publications include Kostkova, P. (9), Fonseca, L.M.M. (8), Guedes, T.G. (8), Thompson, D. (8), and Anderson, T. (7), reflecting a diverse set of scholars across different regions and institutions. This distribution suggests that while a small group of authors dominate in terms of volume, a broad base of authors wholly advances the research agenda, reinforcing the multidisciplinary and international nature of the field. To summarize on the RQ2, the results on countries, institutions, and authors demonstrate that research on analog game learning in cancer literacy represents a growing and positive scholarly trend, with collaboration increasingly embraced across regions in global. The findings highlight a diverse community of authors who, collectively, are shaping the development of this emerging field and reinforcing its global relevance. Result for RQ3 used VOSviewer, a mapping visualisation network to revealed eleven (11) distinct clusters output based on different colors with each representing a thematic concentration within the literature on analog and serious games.

Cluster 1 reflects the intersection of education, youth, and health promotion, emphasizing active learning, simulations, and mental health among younger populations. Cluster 2 focuses on the technical and pedagogical dimensions of game design, including accessibility, mechanics, and user centered instructional development, with applications in health professions education. Cluster 3 highlights innovation in medical and educational contexts, linking usability, engagement, and patient safety to knowledge transfer and simulation. Cluster 4 centers on learner attitudes, self efficacy, and interactive educational design, extending to older adults. Cluster 5 is specifically oriented toward health education and cancer prevention, connecting games to health literacy, communication, and patient education. Cluster 6 emphasizes youth wellbeing, integrating physical activity, emotional regulation, and parental involvement. Cluster 7 underscores cognitive and experiential learning, illustrating how analog game methods foster motivation, critical thinking, and professional training. Cluster 8 situates serious games within public health, highlighting awareness, self management, and healthcare applications. Cluster 9 isolates gamification and patient engagement as a distinct but emerging theme. Cluster 10 introduces personalization in health interventions, reflecting individualized approaches to wellbeing. Finally, Cluster 11 represents healthcare education directly, underscoring the role of serious games in professional training.

Figure 2 illustrates the initial 11 clusters encompassing diverse subjects have been combined into four main themes for clearer analysis. Among them, Theme 2 (Healthcare/Public Health) emerges as the dominant domain. The clusters grouped under this theme (cancer prevention, patient education, health literacy, medical education, healthcare, and serious games for health) demonstrate that most author contributions focus on the use of analog and serious games as tools for improving cancer literacy, prevention strategies, and communication in both clinical and community contexts.

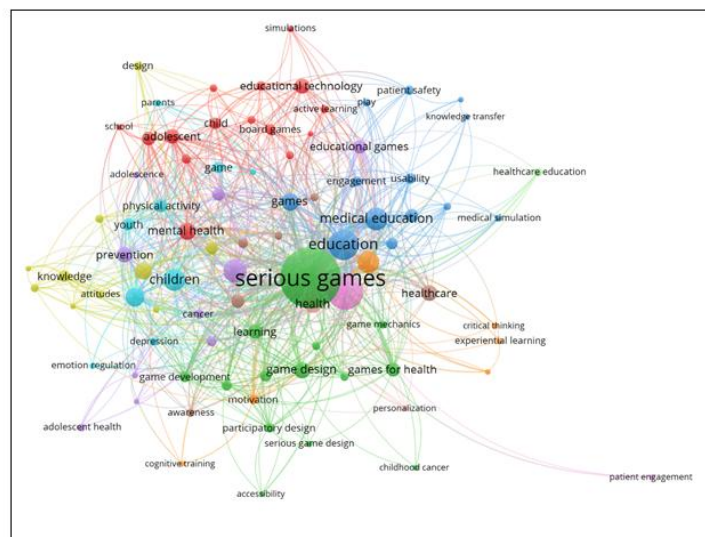


Figure 2. Network Visualization of clusters in analog game learning for cancer literacy.

Furthermore, Theme 1 (Education & Pedagogy) captures how games are integrated into learning environments, while Theme 3 (Wellbeing) situates games in psychosocial support for adolescents and youth. Theme 4 (Game Design & Gamification) addresses mechanics, usability, and instructional methods through analog game design. Notably, VOSviewer mapping reveals that the keyword “serious games” appears most frequently, however, its co-occurrence patterns confirm that the dominant thematic domain is Theme 2 (Healthcare/Public Health), particularly in relation to cancer literacy, patient education, and prevention. In Indonesia, game-based learning is regarded as a method for enhancing mental wellbeing, primarily due to its reliance on face-to-face interaction, which fosters engagement and emotional involvement among players (Respati et al., 2024). In the current technological era, learners are exposed to various methods of understanding complex cancer information, and interactive approaches have been found to increase motivation, engagement, and knowledge acquisition. A recent study conducted in Ghana compare the effectiveness of traditional health talks with a board game intervention known as S-S-LIBOG in prostate cancer education. The findings demonstrated more than 80% of participants reported satisfaction with the learning experience compared to health talks (Obeng et al., 2025). Similarly, another recent

study developed a board game for children with cancer, Skuba! An Adventure Under the Sea. They provided positive feedback and expressed enjoyment while engaging in the analog game-based learning activity (Amador and Mandetta, 2022).

Second objective was investigating countries that dominated in the field of analog game design. Countries such as the United States, the United Kingdom, and Canada have long-integrated game-based learning approaches into educational and healthcare settings and with that, it allow researchers to explore alternative teaching methods including board games, card games, and other analog learning tools whichever is appropriate in delivering health related topics. A previous literature review has mentioned that majority of the boardgame created on health topics were to improve different types of outcomes such as behavior, knowledge, self-efficacy, attitudes and belief and social functioning. Some of the boardgame listed on the list were Goodbye-to-Dengue, Polio Eradication Game, Kaledo (healthy lifestyle), Anatomy Adventure the Lifestyle Board Game and Make a Positive Start Today! (facts on HIV, STIs, antiretroviral treatment, etc) (Gauthier et al., 2019). Other than examining the countries dominating the field, the second objective also explored the limited number of studies originating from ASEAN countries. As illustrated in Figure 4, Singapore was the only ASEAN country identified in the publications related to analog game-based learning. The existing gap suggests that although board games have increasingly been recognized as interactive educational tools capable of improving knowledge, engagement, and communication, the volume of related scholarly publications remains relatively low. Furthermore, the functions, applications, and educational effects of board games are still insufficiently explored (Noda et al., 2019), with most existing studies originating from developed countries.

The final aspect examined under the second objective was the number of prolific authors actively contributing to the research field of analog game-based learning related to cancer literacy. The findings demonstrated a growing scholarly interest in this area beginning in the early 2000s, with the number of publications increasing progressively each year. Most of the authors involved in this field originated from healthcare, nursing, pharmacy, medical, and public health backgrounds. Their contributions through scholarly publications indicate that analog game-based learning remains relevant and valuable for larger groups of populations, including learners, patients, and communities. The final objective of this study is to highlight the most prominent thematic domain identified through bibliometric mapping. Analysis of the articles and keyword co-occurrence using VOSviewer revealed that Theme 2 Healthcare/Public Health emerged as the most dominant domain. Nevertheless, the three other themes collectively underscore the interdisciplinary connections between education, wellbeing, and game design. These elements were integrated to ensure that knowledge acquisition is not only effective but also enjoyable, thereby fostering greater engagement among learners and players. Supporting this finding, a recent scoping review reported that health-related contexts are among the most frequent applications of board and card games, particularly in promoting participation, literacy, and collaboration, with consistently positive feedback from participants (Conway and Smith, 2026).

Conclusion

This study explored analog game learning in enhancing cancer literacy through bibliometric analysis. Findings show steady growth of publications over three decades,

led by western and European countries. Board and card games are increasingly explored as opportunity in educational approaches which may support engagement and knowledge acquisition. Thematic analysis revealed four domains, with Healthcare/Public Health as the most dominant ones. Overall, analog game learning is still relevant especially in the health education field which offers a fun, interactive, and impactful strategy to strengthen cancer literacy among populations.

Acknowledgement

The authors wish to express sincere gratitude to the Universiti Teknologi MARA, especially Faculty of Business and Management for approving the internal research grant funding of RM5,000. Appreciation is also extended to the co-authors for their valuable contributions of knowledge and time which made this bibliometric analysis article possible.

Conflict of interest

The authors confirm that there is no conflict of interest involved with any parties in this research study.

REFERENCES

- [1] Abraham, O., McCarthy, T.J. (2024): An introduction to the OutSMART Cancer serious game: Current and future directions. – *JMIR Cancer* 10: 5p.
- [2] Amador, D.D., Mandetta, M.A. (2022): Development and validation of a board game for children with cancer. – *Acta Paulista de Enfermagem* 35: 8p.
- [3] Blanchard, C.L., McInerney, P., Joffe, M., Patel, M., Prigerson, H.G., Norris, S. (2026): A mixed methods systematic review of cancer treatment decision-making in vulnerable populations. – *Patient Education and Counseling* 145: 15p.
- [4] Buyens, G., van Balken, M., Oliver, K., Price, R., Venegoni, E., Lawler, M., Battisti, N.M.L., Van Poppel, H. (2023): Cancer literacy-Informing patients and implementing shared decision making. – *Journal of Cancer Policy* 35: 5p.
- [5] Cohen, S.A., Cohen, L.E., Tijerina, J.D. (2020): The impact of monthly campaigns and other high-profile media coverage on public interest in 13 malignancies: A Google Trends analysis. – *ecancermedicalsecience* 14: 13p.
- [6] Conway, E., Smith, R. (2026): Analogue play in the age of AI: A scoping review of non-digital games as active learning strategies in higher education. – *Behavioral Sciences* 16(1): 17p.
- [7] Gauthier, A., Kato, P.M., Bul, K.C.M., Dunwell, I., Walker-Clarke, A., Lamerias, P. (2019): Board games for health: A systematic literature review and meta-analysis. – *Games for Health Journal* 8(2): 85-100.
- [8] Han, C.J., Lee, Y.J., Demiris, G. (2018): Interventions using social media for cancer prevention and management: A systematic review. – *Cancer Nursing* 41(6): E19-E31.
- [9] Hasanica, N., Ramic-Catak, A., Mujezinovic, A., Begagic, S., Galijasevic, K., Oruc, M. (2020): The effectiveness of leaflets and posters as a health education method. – *Materia Socio-Medica* 32(2): 135-139.
- [10] Hussain, N.H.C., Muhmad, S.N., Sallem, N.R.M., Zainal@Zakaria, Z.N. (2026): Mapping the landscape of internal audit and data analytics: A bibliometric approach. – *Akademika* 96(1): 254-272.

- [11] Jeitani, C., Van den Broucke, S., Leemans, C. (2025): Interventions addressing health literacy in cancer care: A systematic review of reviews. – *International Journal of Environmental Research and Public Health* 22(2): 24p.
- [12] Lawrence, S., Fitzgerald, S., Hegarty, J., Saab, M.M. (2025): Cancer awareness among adolescents in second-level education: A mixed methods systematic review. – *Health Education Research* 40(3): 16p.
- [13] Noda, S., Shiotsuki, K., Nakao, M. (2019): The effectiveness of intervention with board games: A systematic review. – *BioPsychoSocial Medicine* 13: 22p.
- [14] Obeng, F., Fadil, M., Adamu, A.F., Dadee-Seshie, D.S., Okai, E.N., Agbeteti, G., Boakye, S.A., Kpanyaano, B., Zikpi, E.K., Boadu, A.W., Okai, J.N.A., Owiafe, S., Boateng, M.O. (2025): Evaluating a behavioural theory-based board game (S-S-LIBOG) against traditional health talk (HT) in prostate cancer education: Findings from a quasi-experimental study, plus introducing 17 other S-S-LIBOGs. – *Healthcare* 13(23): 20p.
- [15] Öztürk, O., Kocaman, R., Kanbach, D.K. (2024): How to design bibliometric research: An overview and a framework proposal. – *Review of Managerial Science* 18(11): 3333-3361.
- [16] Respati, T., Feriandi, Y., Frederico, R., Nugroho, E., Pardosi, J.F., Withall, A. (2024): Efficacy of a mental health game-board intervention for adolescents in remote areas: Reducing stigma and encouraging peer engagement. – *The Open Public Health Journal* 17: 9p.
- [17] Setyawati, R., Astuti, A., Utami, T.P., Adiwijaya, S., Hasyim, D.M. (2024): The importance of early detection in disease management. – *Journal of World Future Medicine, Health and Nursing* 2(1): 51-63.