v. 5, n. 4, 2025

Journal of
Engineering
Research

Acceptance date: 25/03/2025

SERIOUS GAMES AS A TRAINING TOOL FOR PRIMARY CARE

Katia Gustmann
Instituto Federal de Educação, Ciência e Tecnologia Catarinense, (nurse), Rio do Sul, (SC), Brasil

Marcelo Mendes de Figueirêdo
Secretaria Municipal de Saúde de Barro, (Systems Analyst and Developer), Barro, Ceará (CE), Brasil

Marcos Daniel Cano
Instituto Federal de Educação, Ciência e Tecnologia do Amazonas, (EBTT Professor), Manaus, (AM), Brasil

Josélio Emar de Araújo Queiroz
Ministério da Saúde, (Technical Advisor), Brasília (DF), Brasil

Abstract: Introduction: Serious games are understood as immersive abstract worlds that provide learning. When people perform a concrete action in order to play, they make simulations, where it is possible to construct, investigate and question hypothetical situations, allowing them to obtain learning and thinking experiences. Objective: To investigate the use of Serious Games in the training of Primary Health Care professionals. Method: From an integrative review, using the descriptors ("Serious Games" OR "Serious Games") AND ("Health" OR "Saúde") in PubMed and Scopus, 131 articles were found; 34 fit the theme. Results: Serious Games offer Primary Health Care professionals an option for qualification and engagement in the collection and recording of health information. Conclusion: In line with the Digital Health Strategy for Brazil - 2020/2028, this tool can be used to train and qualify human resources
Keywords: Primary Health Care, Continuing Education, Serious Games.

INTRODUCTION

In recent decades, the concept of gamification has emerged with the application of the mechanics, aesthetics and dynamics of games in contexts that are not exclusively entertainment. Serious games are understood as immersive abstract worlds that provide learning situations. During the game, the person performs concrete actions and carries out simulations, which allows hypothetical situations to be constructed, investigated and questioned, thus making it possible to obtain situated learning experiences and reflect, within the context of a cycle of probing, hypothesizing, (re)probing and reconsideration. (CHINAGLIA, 2023)[1].

At the intersection between games and gamification are Serious Games (SG) as learning objects. These games are characterized by their concern with transmitting knowledge through digital media. In this sense, they are tools that have the potential for a paradigm shift in education and stand out in many ways when compared to traditional teaching-learning methods (DOS SANTOS, 2017).

In 2019, in order to improve the financing of Primary Health Care (PHC) in Brazil, the Tripartite Interagency Commission (CIT) agreed on a funding model for PHC, which culminated in the publication of Ordinance GM/MS No. 2,979, which established the Previne Brasil Program (BRASIL, 2021)[3]. The aim of this program is to allocate federal funds on a monthly basis to make up the tripartite financing of PHC on a regular and automatic basis, providing for the transfer between the National Health Fund (FNS) and the Municipal Health Funds for the costing and investment of actions and services.

In the context of public health management, performance evaluation has become an essential tool for monitoring and improving the quality of services provided to the population. These tools, which have the function of measuring and describing a population's health situation, are called Health Indicators. Thus, monitoring the Previne Brasil Program's performance indicators is fundamental to evaluating and improving the effectiveness of preventive health actions in the country.

In all, there are seven indicators covering a variety of significant aspects of health care. These indicators not only reflect the quality of care for pregnant women and vaccination coverage, but also address the monitoring of the health of patients with chronic conditions such as hypertension and diabetes. The indicators currently assessed for payment of the incentive are: I. proportion of pregnant women with at least six prenatal consultations carried out, the first of which by the 20th week of pregnancy; II. proportion of pregnant women tested for syphilis and HIV; III. proportion of pregnant women with dental care carried out; IV. Coverage of cytopathological

exams; V. Inactivated polio and pentavalent polio vaccination coverage; VI. Percentage of hypertensive people having their blood pressure measured in each semester; VII. Percentage of diabetics having their glycated hemoglobin tested (BRASIL, 2021) [3].

Hypertension is a disease categorized in the International Code of Diseases (ICD-10) as I10, called Primary Essential Hypertension and means increased blood pressure, with no known cause, when the values are above 139 x 89 mmHg and can be classified as benign, malignant, primary and systemic (ICD-10). This condition represents a significant risk factor for cardiovascular mortality and disability on a global scale (FALCÃO et al, 2023) [4]. In general, the biggest problems identified in achieving indicator VI - percentage of hypertensive people with blood pressure measured in each semester - refer to registration/capture of hypertensive people, duplicate registration, the number of people registered, the lack of training for professionals in feeding the system, the lack of clarity when using the system and also the difficulty in operationalizing the records due to the lack of internet coverage, low adherence by the target public and also the lack of professionals in the teams. In this sense, the training and engagement of professionals to collect and record information are essential elements for achieving the stipulated goals.

The use of Serious Games (SG) is an opportunity to train and engage Primary Health Care professionals in collecting and recording data and information. This action can support health professionals and managers in monitoring and promoting continuity of care for this group of patients, as well as receiving, in full, the financial benefit made available by the federal government.

The use of a teaching-learning technology strategy based on JS is based on the possibility for students to develop their autonomy, which is based on the individual's relationship with others and with their own knowledge, and is based on experience. Providing experiences that add learning to the game, in which the student is an actor in the construction of their knowledge, allows them to develop ideas, accumulate skills and develop new abilities, which are fundamental to learning.

The association of educational content in a technological platform designed to engage the student characterizes the JS, allowing constructive learning, situated in time, in addition to being a unique experience, since each student experiences, in a unique and peculiar way, the active experimentation and immersion in the game. (PEREIRA, 2019) [5].

Thus, the game must have valid and appropriate content, in addition to arousing the student's interest and meeting an institutional/organizational need, and it is essential to realistically represent the objective to which it is subject. To this end, it is essential that health professionals participate in the proposal to develop Serious Games, in order to be validated from a clinical point of view (PEREIRA, 2019) [5].

The aim of this study is to see how the use of Serious Games can support the engagement of health professionals in recording and monitoring information related to the indicator of the percentage of hypertensive people with blood pressure measured under the Previne Brasil program.

METHOD

STUDY DESIGN AND CONTEXT

This study is an integrative review that gathered and synthesized the results of primary studies on the use of Serious Games in healthcare

ELIGIBILITY CRITERIA

The search was conducted using the descriptors "Primary Health Care," "Continuing Education," "Serious Games" and their variations in English. The terms "Serious Games" AND Health OR Saúde were used to identify previous research in the PUBMED and SCOPUS repositories, covering last 6 years (2018-2023) and considering English and Portuguese language publications. The studies included in the review focused on the application of serious games in health services, including companies, employee training, workers and health workers.

DATA ANALYSIS

For the statistical analysis, we used open data from the e-SUS AB Strategy systems, compiled on the portal of the Health Information System for Primary Care (SISAB). The period analyzed was from January 2022 to the second quarter of 2023. The data was examined by federation unit (FU), considering Indicator 6, which is the proportion of people with hypertension who had a consultation and blood pressure measured in the semester. The analysis took into account the teams (eSF and eAP) with approval decrees from the Ministry of Health (MS).

The work was developed exclusively with data and information from secondary databases in the public domain and unrestricted access, exempt from ethical assessment by the CEP-CONEP System, as provided for in Article 1, sole paragraph, item III of CNS/MS Resolution No. 510/2016.

RESULTS AND DISCUSSION

Below is figure 1, used for the review carried out in this study.

In relation to the analysis of data at the level of units of the federation, the proportion of patients diagnosed with hypertension who had their blood pressure measured within the respective four-month period evaluated, from the first four-month period of 2022 to the second four-month period of 2023 in Brazil, the data shows that no state has reached the minimum necessary set as a target, which is 50%. This is explained by the low performance of municipalities that end up not reaching the target set, and consequently cause this indicator to lag behind at the state level. We believe that only one state reached the minimum required set as a target, Ceará, with 48%. The analysis takes place by four-month period and although this is a simple distribution table, with no confidence interval and no p-value, the following exploratory inferences were made: the states in the North and South have the lowest proportion of people with hypertension, with a consultation and blood pressure measured in the six-month period and the states in the Northeast have the best coverage. Ceará (48%), Alagoas (44%) and Piauí (41%) have the best coverage of this indicator. The states with the lowest coverage are Acre (21%), Roraima (24%), Rondônia (25%) and Rio de Janeiro (25%). Coverage of the indicator increased in all four-month periods, in all regions of Brazil, during the period studied. The states with the lowest adherence to the indicator among municipalities are Acre (4.54%), Rio de Janeiro (5.43%) and Rondônia (3.84%). The states with the highest adherence among municipalities are Ceará (57%), Tocantins (44.6%), Minas Gerais (36.69%) Piauí (37%) and Alagoas (36%). There is often difficulty on the part of managers and health professionals in making proper use of information systems, a fact which is often respon-

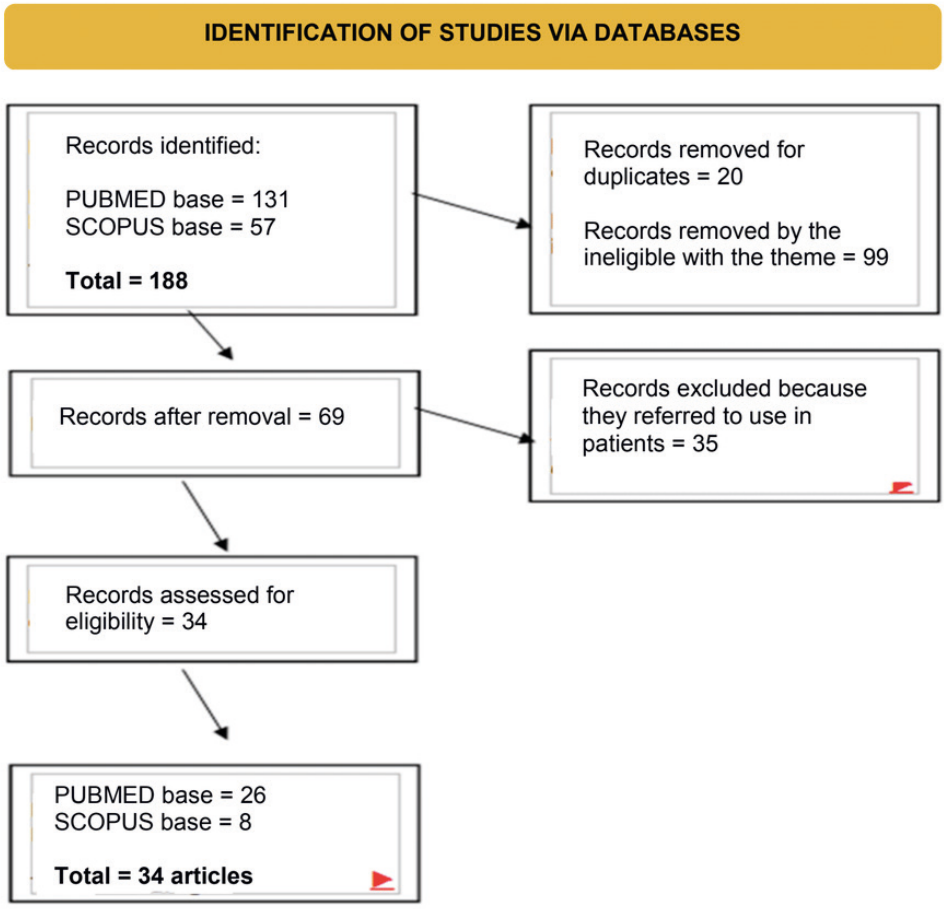

Figure 1: PRISMA diagram with methodology for selecting articles for the study

Source: Adapted and translated from PRISMA

sible for inadequate analysis and actions for the decision-making process of administration and the provision of continuity of care. Although these professionals use and share information and data, they face challenges in effectively using this technology as a basis for producing knowledge and making decisions (Saraiva et all, 2021) [6].

For this reason, it is essential to assess the need for training in the use of information systems available from the Federal Government and, in the specific context of this study, to explore the use of Serious Games as a training tool to train professionals and managers in the efficient use of Health Information Systems (HIS). Previous studies have highlighted the importance of specific training in health institutions to bring professionals closer to HIS.

JS has emerged as a trend in healthcare, and a systematic review of its application in rehabilitation diseases revealed favorable results in terms of adherence, acceptability and engagement (HUANG at al, 2023) [7]. No serious adverse effects were identified in all the studies included in this research paper. Consistently, JS have been used repeatedly in treatment and rehabilitation, demonstrating positive results.

According to (Xu et al, 2023)8, JS such as gamification play their part in promoting education by providing the possibility of combining learning activities such as feedback, tests and spaced repetition with active participation and autonomy, as well as positive experiences for students.

In the context of games, the term *game jams*, which are collaborative workshops to create and play educational games, has been developing in prominence. In this type of workshop, the students described various game dynamics, such as penalties, game characters, rewards, rules and game types, including prioritizing cultural safety (consolidation of all safety policies within the corporate environment) in order to create the games and maintain their characteristics, considering their own culture and that of others so as not to develop culturally unsafe actions (any actions that diminish, demean or weaken an individual's cultural identity and well-being) so as to be able to immerse themselves in a risk-free, interactive and engaging environment (PIMENTEL *et al*, 2022) [9].

According to Warsinsky (2021)[(10)], the conceptualizations of gamification and serious games found in the health literature are very similar, leading to conceptual ambiguity. In an analysis of empirical studies, in 5,044 articles dealing with the use of game attributes in health professions education were evaluated, it was possible to conclude that learning outcomes in health professions education through the use of gamification, especially when employing game attributes that improve learning behaviors and attitudes towards learning (VAN GAALEN, 2020) [11]. According to these authors, there is a difficulty in distinguishing in the literature between what is games and what is play, highlighting that JS incorporate elements of reality into their games. The characteristic difference between gamification and JS lies in their design intent. There is therefore a consensus among these authors that, in the literature, there is no firm concept of what JS is and they reinforce that games do not need game elements such as a scoring system and a win/lose condition to achieve success, but simulations involving the real situation can therefore be a game intention and not have game elements (VAN GAALEN, 2021) [11].

When talking about game elements and attributes, various strategies are used to improve the user experience such as: rewards, leaderboards and social elements. To structure game elements, the following 9 attributes are proposed: action language, evaluation, conflict/challenge, control, environment, game fiction, human interaction, immersion and rules/objectives (VAN GAALEN, 2021) [11].

Regarding the theories that have been applied to JS, we find Reinforcement Learning Theory (Chen et al. 2017), Social Comparison Theory (Van Nuland et al. 2015), Self-Directed Learning (Fleiszer et al. 1997) and Deliberate Practice Theory (Butt et al. 2018). (apud VAN GAALEN, p. 697, 2021) [11]. Experiential Learning Theory states that concrete experience provides information that serves as a basis for reflection. After this reflection, students think of ways to improve their ability and, after this abstract conceptualization, they will try to improve their behaviors accordingly (VAN GAALEN, 2021) [11]. This theory reports that by improving students' experiences, one also improves their view of reality. Typically, JS are related to questionnaires and *quizzes*, with correct answers offering rewards. So here we have various attributes, explained through some theories, altering learning behaviors or attitudes towards learning that can be used in JS. A study carried out in Heidelberg, Germany, reports that training based on technological methods is more effective than traditional methods (BAETZNER et al, 2020) [12].

Results have shown a promising trend in diversifying the application of health education games that go beyond a specific medical condition (CAMILO et al, 2016) [13]. However, through this work, the need for multidisciplinary team development in the design of these games was observed. In addition, future health games should expand the duration and repetition and increase the duration of follow-up evaluations to provide evidence of long-term effectiveness.

In many countries, gamification is already included in the curriculum of the pharmacy course (HOPE, 2023) [14].With the potential to improve the knowledge of skills and adherence of health professionals in the care of neonatal patients, JS have been reported in reviews as elements that can improve the performance of professionals to qualify the results in the care of citizens (Ghomam SK, 2019) [15].

Most of the articles aimed at healthcare providers are from North America (50.9%), Europe (39.7%) and Asia (8.0%). It can be seen that the papers aimed at healthcare providers have been published in greater volume since 2015. Approximately 26.1% of educational games aimed at healthcare professionals are focused on the needs of higher education and target medical students and healthcare workers. Medical education institutions, especially in North America and developed countries in Europe and Asia, are gradually incorporating Serious Games solutions into their educational curricula.

In disagreement with the findings, studies warn of addictive behavior, with the authors proposing two major classes of structural features of addictive games: features that improve immersion and realism in the game and features similar to those of games of chance, these two being associated with addiction. In contrast, JS allows for individual or collaborative self-reflection and supports resilience (SAINI; HODGINS, 2023) [16].

CONCLUSION

The study presents various initiatives for the use of Serious Games (SG) in the education of health professionals, as well as reporting the advantages of using technology-supported training over traditional methods. However, it warns against use that involves risks of addiction.

The findings of this study reinforce the use of JS in training health professionals, encouraging Primary Health Care managers to reflect on the possibility of using it to offer ongoing technical support, addressing issues such as work overload. The low coverage of the indicator evaluated in Brazil points to the need for constant evaluation regarding communication about the objectives and positive impacts of Previne Brasil.

Thus, in line with the results of this study, the JS can be used as a strategic tool to enhance the engagement and effectiveness of data collection and recording by Primary Health Care professionals.

THANKS

Thanks to the Federal Government for the initiative of the Digital Health Strategy and the availability of training in the area;

To the Institute of Health Informatics of the Federal University of Goiás for preparing and carrying out the specialization in Digital Health in Health;

REFERENCES

1 CHINAGLIA, Juliana Vegas. O percurso gamer como novo modelo de material didático para o ensino de escrita. **Trabalhos em Linguística Aplicada**, [S.L.], v. 62, n. 1, p.74-89, jan.2023. http://dx.doi.org/10.1590/010318138670204v6212023.

2 DOS SANTOS, Cristiano Alves et al. Jogos sérios em ambiente virtual para ensino-aprendizagem na saúde. **Rev Rene**, v. 18, n. 5, p. 702-709, 2017.

3 Brasil. Ministério da Saúde. Secretaria de Atenção Primária à Saúde. Departamento de Saúde da Família. Manual instrutivo financiamento do APS [recurso eletrônico] / Ministério da Saúde, Secretaria de Atenção Primária à Saúde, Departamento de Saúde da Família. – Brasília: Ministério da Saúde, 2021.

4 FALCÃO, Lariza Martins; GUEDES, Maria Vilaní Cavalcante; BORGES, José Wicto Pereira; SILVA, Grazielle Roberta Freitas da. Intervención educativa realizada por enfermeros para el control de la presión arterial: revisión sistemática con metaanálisis. **Revista Latino-Americana de Enfermagem,** [S.L.], v. 3931, n. 31, p. 1-12, dez. 2023. FapUNIFESP (SciELO). http://dx.doi.org/10.1590/1518-8345.6648.3929.

5 PEREIRA, Poliana Francibele de Oliveira. Ambiente Virtual Interativo para o ensino de anatomia humana. Um Jogo Sério para o Sistema Muscular. **Dissertação (mestrado),** Universidade Federal de Santa Catarina, Programa de Pós-Graduação em Tecnologias da Informação e Comunicação, Araranguá, 2019.

6 SARAIVA, Lucas Iago Marques; RAMOS, Francisco Alexandre Sena; SANTOS, Gilvan Ferreira dos; VETORAZO, Jabneela Vieira Pereira. Sistemas de informação em saúde, o instrumento de apoio à gestão do SUS: aplicabilidade e desafios. **Revista Eletrônica Acervo Enfermagem**, [S.L.], v. 9, p. 1-6, 4 mar. 2021. Revista Eletronica Acervo Saude. http://dx.doi.org/10.25248/reaenf.e6418.2021.

7 Huang H, Huang M, Chen Q, Hayter M, Watson R. Effects of Serious Games for Patients With Chronic Obstructive Pulmonary Disease: Systematic Literature Review. **JMIR Serious Games.** 2023 Sep 25;11:e46358. doi: 10.2196/46358. PMID: 37747768; PMCID: PMC10562969.

8 Xu L,Shi H,Shen M,Ni Y,Zhang X,Pang Y,Yu T,Lian X,Yu T,Yang X,Li F Os efeitos das intervenções de gamificação baseadas em mHealth na participação em atividades físicas: revisão sistemática **JMIR M health U health** 2022;10 (2):e 27794 doi:10.2196/27794.

9 PIMENTEL, Juan; LÓPEZ, Paola; CORREAL, Camilo; COCKCROFT, Anne; ANDERSSON, Neil. Educational games created by medical students in a cultural safety training game jam: a qualitative descriptive study. **Bmc Medical Education**, [S.L.], v. 22, n. 1, p. 2-9, 22 nov. 2022. Springer Science and Business Media LLC. http://dx.doi.org/10.1186/s12909-022-03875-w.

10 Warsinsky S, Schmidt-Kraepelin M, Rank S, Thiebes S, Sunyaev A. Conceptual Ambiguity Surrounding Gamification and Serious Games in Health Care: Literature Review and Development of Game-Based Intervention Reporting Guidelines (GAMING). **J Med Internet Res.** 2021 Sep 10;23(9):e30390. doi: 10.2196/30390. PMID: 34505840; PMCID: PMC8463952.

11 Van Gaalen AEJ, Brouwer J, Schönrock-Adema J, Bouwkamp-Timmer T, Jaarsma ADC, Georgiadis JR. Gamification of health professions education: a systematic review. **Adv Health Sci Educ Theory Pract.** 2021 May;26(2):683-711. doi: 10.1007/s10459-020-10000-3. Epub 2020 Oct 31. PMID: 33128662; PMCID: PMC8041684.

12 Baetzner AS, Wespi R, Hill Y, Gyllencreutz L, Sauter TC, Saveman BI, Mohr S, Regal G, Wrzus C, Frenkel MO. Preparing medical first responders for crises: a systematic literature review of disaster training programs and their effectiveness. **Scand J Trauma Resusc Emerg Med.** 2022 Dec 24;30(1):76. doi: 10.1186/s13049-022-01056-8. PMID: 36566227; PMCID: PMC9789518.

13 Camilo, Marcio & Cheng, Cezar & do Nascimento, José Orete & Ribeiro, Luiz &, Emmanuel & Martins, Sérgio. (2016). JOGOS SÉRIOS PARA A SAÚDE. UMA REVISÃO NARRATIVA. **J.health inform;** 8(supl.I): 211-218, 2016.

14 Denise L Hope, Gary D Grant, Gary D Rogers, Michelle A King, Gamificação na educação farmacêutica: uma revisão quantitativa sistemática da literatura, ***International Journal of Pharmacy Practice***, Volume 31, Edição 1, janeiro de 2023, páginas 15–31,https:/ /doi.org/10.1093/ijpp/riac099

15 Ghoman SK, Patel SD, Cutumisu M, von Hauff P, Jeffery T, Brown MRG, Schmölzer GM. Serious games, a game changer in teaching neonatal resuscitation? A review. **Arch Dis Child Fetal Neonatal** Ed. 2020 Jan;105(1):98-107. doi: 10.1136/archdischild-2019-317011. Epub 2019 Jun 29. PMID: 31256010; PMCID: PMC6951231.

16 SAINI, Nirav; HODGINS, David Carson. Investigating gaming structural features associated with gaming disorder and proposing a revised taxonomical model: a scoping review. **Journal Of Behavioral Addictions**, [S.L.], v. 12, n. 2, p. 352-374, 29 jun. 2023. Akademiai Kiado Zrt.. http://dx.doi.org/10.1556/2006.2023.00019.