Web-based Platform as a Digital Confluence: Narrative Review of Games and Social Media in Medical Education

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Submitted to: JMIR Medical Education
on: August 20, 2024

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Abstract

Background: The evolution of the internet in the early 21st century was marked by a seismic shift in the user's role. It comes as no surprise that medical educators and students would come to embrace the more active role afforded by this sea change. Social media has empowered the user with virtually limitless ways to create and engage with information, and serious games have been shown to enhance learner engagement and satisfaction. This appears to set the stage for a web-based learning platform that combines elements of both games and social media.

Objective: This review details recent online trends in medical education against a broader narrative of increasing user participation on web applications. Specifically, this review is concerned with whether threads of games and social media could be woven into the fabric of a more comprehensive learning platform, and the potential of this platform for training healthcare professionals.

Methods: A literature review was conducted between July and August of 2024 using PubMed and Google Scholar for all English-language papers going back 10 years. Articles that described use of social media among students and trainees, as well as those that studied the effectiveness of games and other electronic media, were included. Articles were excluded if full text was not available, or if their primary concern was patient self-management or other patient outcomes, as the primary focus of this review is use of these approaches in medical education.

Results: The literature search revealed 219 references. After comprehensive review, 15 studies of various designs were highlighted. Themes in social media that emerged were asynchronous learning preferences and reliability concerns. Themes in game-based learning were game balance and immersivity.

Conclusions: Research on games and social media in medical education is flourishing. As such, exciting opportunities exist to identify new teaching methods. The most effective elements to achieve a balanced curriculum are being identified. Dedicated medical learning platforms, integrated with existing programs of study and administered at the university level, may strike the perfect chord.

(JMIR Preprints 20/08/2024:65601)
DOI: https://doi.org/10.2196/preprints.65601

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Review

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Results: The literature search revealed 219 references. After comprehensive review, 15 studies of various designs were highlighted. Themes in social media that emerged were *asynchronous learning* and *reliability*. Game subheadings that emerged were *game balance* and *immersivity*.
Conclusions: Research on games and social media in medical education is flourishing. As such, exciting opportunities exist to identify new teaching methods. The most effective elements to achieve a balanced curriculum are being identified. Dedicated medical learning platforms, integrated with existing programs of study and administered at the university level, may strike the perfect chord.

Keywords: medicine; education; social media; social network; game; serious game; internet; web; application

Introduction

In the beginning, there was data: rough-hewn, monolithic, immutable. Information was passed down through song, and when the Roman Empire collapsed, knowledge was maintained by the libraries in the East. Later, in the dawn of a new age, data is fleshed out in forms as infinite as the human imagination. The advent of the World Wide Web(web) in the late 20th century has indelibly changed not just education, but all aspects of modern life. By 2010, the shift from Web 1.0 to Web 2.0 was well underway. The role of the user was radically changed from passive consumer of web pages, to active creator of content in the form of posts, comments, and channels[1]. Concurrently, medical

education has seen a transition away from solely didactic teaching, with web-based resources exceeding traditional methods in some cases[2].

This era has seen exciting changes in the realm of web design. If HTML and CSS are the number of cars and style of the train, respectively, JavaScript is the engineer smoothly facilitating a tour of the countryside. For example, web applications used by gastroenterologists to assist in decision-making regarding blood-thinners, endoscopy, and thromboembolic risk are built with JavaScript[3]. Social media is synonymous with Web 2.0, and perhaps synonymous with what the average person calls "the Internet." The concept is the same: a dynamic process of viewing and creating information. Social media is a pathologist sharing an anonymized image, nephrology fellows discussing the loop of Henle in a forum, or a professor building a quiz for a web-based lecture series. It is used in healthcare across a wide range of use cases, from networking to medical education[4].

Getting a picky toddler to eat can have even the sternest parent resort to game design. The potential for a game to make an arduous task more enjoyable has long been recognized, and in the modern age games have extended into many "serious" domains of life. Gamification, simply, refers to "the use of game design elements in non-game contexts[5]." The formidable obstacle of advancing through medical education lends itself to gamification(games). Studies combining the elements of points, digital rewards, and leaderboards resulted in increased use of learning materials, and no negative outcomes[6]. Games are social by their very nature, and the prospect of synergism between social media and games to improve learning outcomes is intriguing.

Objectives

Web-based resource use is increasing to meet the changes in how students assimilate information. The goal of this review is to look at the recent literature on social media and games in medical education. The resources required to design a web application are dwarfed by the potential benefit. As such it is worthwhile to identify any opportunities where a novel educational platform could be introduced at the intersection of social media and games. Ideally, this review will be the initial foray into a new research opportunity.

Methods

Search Strategy and Information Sources

In the summer of 2024, a series of PubMed search were conducted through the University of Tennessee Health Science Center library for all English-language medical studies that were published since 2014. The first search was for social media studies and the following keywords were used to search titles and abstracts: "social media" AND "medical" AND "education." The second search was for game studies and the following keywords were used: "game" AND "medical" AND "web."

Screening Process

Results were sorted by best match, and the first 100 titles and abstracts from each search were assessed for eligibility. Articles without full text were searched in Google Scholar, and excluded if full text was not available. Studies that were not related to healthcare or health professions education were excluded, as were studies of patient self-management or education of the public. Studies of games that were not web-based were excluded. Selected publications were added to an EndNote library, and full texts were attached and reviewed. Several relevant references were found in the initial search. Full texts were located when possible and added to EndNote. Sources were grouped

into "Game" and "Social" categories.

Categorization

The articles were then comprehensively reviewed and categorized according to the findings. Social media subheadings that emerged from this review were *asynchronous learning* preferences and *reliability* concerns. Themes in game-based learning were *game balance* and *immersivity*.

Results

The initial search yielded 219 titles. After exclusion of ineligible studies, review articles, perspectives, and commentaries, the sample consisted of 15 studies(Table 1 and Table 2). These were of the following types: descriptive(2), cross-sectional(5), cohort studies(5), randomized controlled trials(3). Articles were from the following countries: Australia, Canada, Lebanon, Malaysia, Netherlands, Saudi Arabia, Thailand, Turkey, United States. The following medical specialties were highlighted: Radiology, Pediatrics, Orthopedic Surgery, Internal Medicine, Emergency Medicine, Family Medicine, Hepatology, Infectious Disease, Nephrology, Pathology, General Surgery. Social media sites included Instagram, X(fka Twitter), Facebook, YouTube, WhatsApp. Game types included escape rooms, simulators, and multiple-choice quizzes in a variety of game configurations. The majority of the articles reviewed are from the past 5 years, with an end to being as contemporary as possible in a rapidly-changing landscape.

Textbox 1. The caption/title is placed here in a sentence format (capitalization of every word is unnecessary).

Summary of Game Articles

Table 1. Summary of Game Articles

Author	Population	Design	Element	Result
Bond et al. (2017)	Doctors, nurses, and pharmacists (n=163)	Prospective cohort	Narrative, quiz, web, video	Pharmacists scored highest; enhanced vancomycin knowledge
Bouthillier et al. (2023)	Medical students studying radiology (n=47)	Cross-sectional	Quiz, leaderboard, web, score, feedback, teams	Increased interest and understanding; national turnout
Buijs-Spanjers et al. (2018)	Preclinical medical students (n=156)	RCT	Web, video, simulation, choices, narrative, feedback	Delirium Experience group better able to advise care
Burgon et al. (2021)	Primary care physicians (n=120)	RCT	Quiz, leaderboard, web, score,	37% decrease in care variation; improved score;

			feedback	increased MIPS compliance
Courtier et al. (2016)	Medical students in pediatric radiology (n=48)	Prospective cohort	Tic-tac-toe, quiz, teams, feedback	Non-game group higher exam score and perceived learning/retention
Krishnan et al. (2022)	Pharmacy students (n=418)	Prospective cohort, pilot study	Puzzles, web, 3D video game, team	Improvement in post-intervention scores
McCarthy et al. (2020)	Emergency medicine residents (n=109)	RCT	Mobile app, narrative, quiz, feedback	Results pending
Yuenyongviwat et al. (2021)	Medical students in Orthopedics (n=85)	Retrospective cohort	Quiz, leaderboard, web, score, feedback	No difference in exam score and satisfaction

Textbox 2. The caption/title is placed here in a sentence format (capitalization of every word is unnecessary).

Summary of Social Media Articles

Table 2. Summary of Social Media Articles

Author	Population	Design	Element	Result
Atallah et al. (2023)	Medical, pharmacy, and nursing students (n=125)	Prospective cohort	Facebook posts, images, Instagram polls	Improvement in knowledge scores for 13/18 infection types
Carson et al. (2020)	Medical students and residents (n=44)	Cross-sectional	Files, comments, Box content management	Helped understand expectations; self-directed learning

Lilley et al. (2021)	PathElective users (n=177)	Cross-sectional	Web app, PathTwitter, video, free account, quiz, slide images	Users pathologists or trainees; 56% traffic from Twitter
Nisar et al. (2022)	Medical students and educators (n=128)	Cross-sectional	Video, text, files, chat, Blackboard discussions	Vastly adopted; YouTube, Blackboard, WhatsApp most common
Ortadeveci et al. (2023)	Medical and dental anatomy students (n=762)	Cross-sectional	Text, image, like, comment, chat	Students want instant answers; reliability concerns
Sparks et al. (2018)	Nephrology twitter users	Descriptive	Hashtags, Twitter, brackets, leaderboard, blog	Yearly increase #NephMadness tweets from inception to 2017
Tian et al. (2024)	Pathology hashtags (n=591892)	Descriptive	Text, image, like, comment, chat, hashtag	Annual increase in use of Twitter by pathology community since 2012.

Discussion

Medical education is striving to keep up with a generation of learners born into the internet age. There is an overall trend away from solely didactic teaching, and towards incorporation of self-directed, student-centric learning. Educators are scrambling to find ways to drive engagement with course content, leading to the integration of games and social media into traditional methods. Out of 15 studies, key concepts emerge and inform the narrative.

Game Balance

There is no doubt that video games enhance recall: anyone who has played Oregon Trail has not forgotten dying of dysentery. Interest in these effects has led to the study of a preponderance of games - from various configurations of multiple-choice quizzes to escape rooms. The quiz is a teaching method that can be fashioned into a game or infused into a slide presentation to enhance interactivity. The quiz most commonly takes the form of a clinical vignette presented in a question stem, with the student tasked with selecting the most appropriate response or next step in management. A 2021 review of this interactive method showed almost universally increased post-

test scores[7]. Burgon et al. conducted a trial evaluating the quiz in increasing physician adherence to standard-of-care(i.e. reducing practice variation). They implemented a gamified quiz featuring digital feedback and peer benchmarking(leaderboard) and found a 37% decrease in care variation in diabetes diagnosis and treatment, improved scores between paired cases, and an increase in diabetic eye exam referrals along Medicare MIPS guidelines[8].

Cohort and cross-sectional studies have shown mixed results. In a study from Thailand, students taking a multiple-choice, web-based quiz on Kahoot! were compared with students taking a paper quiz. In the Kahoot! group a leaderboard was shown on a screen in the classroom. Final examination score 2 weeks later, and student satisfaction were not significantly different between the groups[9]. In a study of medical students taking a quiz in a competitive, Tic-Tac-Toe layout the non-game group had higher exam scores and perceived learning/retention[10]. The 2022 RADGames had a turnout of 97 students from 15 Canadian medical schools[11]. Students and radiology residents used a combination of platforms(Zoom, AhaSlides, Facebook Messenger, PowerPoint) to administer an image-based, gamified quiz to overwhelmingly positive feedback. Cohort studies are planned to further evaluate the effectiveness of the game, due to the potential for driving interest in an underrepresented medical specialty. The widespread use of the gamified quiz is consistent with other reviews that found assessment(scoring, digital trophies) and conflict/challenge(teams, leaderboard) to be the most common game attributes[6]. The prominence of the gamified quiz complementing traditional methods reflects the granularity with which the educator can balance question difficulty and student knowledge.

Immersivity

From the boom in the 1980's to the sprawling open-world games of today, video games offer a multimedia experience and go beyond the quiz in their potential to mimic reality. A team in the Netherlands has approximated the "holy grail" of an intervention that is educational, entertaining, and maintains stewardship of educator time and other resources. Delirium is known to add to the complexity of patient care and can affect prognosis. A web-based video game was designed to simulate the experience of caring for a delirious patient over a 4-day period, with choices made by the player affecting improvement or deterioration in the patient's mental status. Students in the Delirium Experience arm were better able to provide guideline-aligned care recommendations than the control groups[12]. A follow-up study in 2020 found that roughly half of students will make "dark play" choices that exacerbate delirium, in order to understand the patient experience[13]. Learning objectives of the exercise can be met regardless of play style. Another experiment is currently underway in Chicago to evaluate the effect of a mobile game on communicating diagnostic uncertainty in emergency departments[14].

Level of immersion in a video game depends on sound quality, narrative("lore"), graphics, and dimensionality(2D versus 3D), among other variables. Immersion is associated with capturing a player's attention[15]. A team in Australia developed a gamified quiz to enhance knowledge of safe and effective use of vancomycin[16]. Leaning heavily into storytelling, the quiz was interspersed in a humorous live-action video and was viewed by staff of three hospitals. A 2D web-based game has been developed that can be customized for most communication scenarios, featuring characters that can express a range of emotions based on player input[17]. More immersive still is a 3D virtual escape room developed by Krishnan et al. and built with the Unity game engine. Players solve puzzles that assess knowledge of hepatitis B virus immunization, diagnosis, and treatment. Improvement was seen in post-intervention scores in a cohort study[18]. Experiences in this space will doubtless be pushed to even greater heights as augmented reality and virtual reality are introduced in clinical simulation-based learning.

Asynchronous Learning

To keep up with "digital natives," the keen educator is on the lookout for delivery vehicles for on-demand, asynchronous educational content. The vast majority of students and educators use social media, 89.1% and 88.8%, respectively[19]. Instagram, YouTube, X, and WhatsApp can be used to network, discuss, and share educational content and research. Facebook posts have been used to promote antibiotic stewardship and combat antimicrobial resistance[20]. In addition, some research teams have built their own web platforms with an end towards official elective credit. Pathology and other subspecialty clerkships are not "baked" into the clinical curriculum, and must be sought out as electives. Lilley et al. built a web application featuring a free account to access multimedia pathology modules[21]. This avenue of free, on-demand, and asynchronous learning was found to be acceptable to users of the web app during a time when in-person electives were limited by the pandemic. Twitter was successfully used to drive traffic to the website. In a similar vein, a team at Mayo Clinic scraped almost 600,000 tweets and found annual growth on pathology twitter, during a time when global activity was decreasing[22].

In an innovative use of software to supplement teaching rounds, an inpatient medical team used Box to upload articles pertinent to the clinical rotation and files outlining student expectations[23]. Students were assigned short presentations on a clinical topic(e.g. interpreting an ABG). The Box notes feature was used to provide feedback to individual learners, or as a means for students to ask about specific details from rounds outside of work hours. Survey responses were mixed on the subject of feedback, but the system helped students understand expectations and supported self-directed learning.

Reliability

The annual distance in miles of content scrolled by users of the internet is the equivalent of ~30,000 round-trips to the moon, and both have their share of junk. Descriptive studies have revealed that students are motivated to use social media to learn, but have concerns about reliability of information[24]. Students also prefer "answers-on-demand" in the form of instant responses from page administrators(admins). It has been proposed that social media platforms at the university level, with professors as admins, would simultaneously increase student-centricity and reliability concerns.

Perhaps no specialty has embraced social media and games as wholeheartedly as nephrology. NephMadness finds increasing numbers of nephrology community members discussing which of 64 current nephrology topics has the most potential to affect patient care[25]. Winners are determined by a "Blue Ribbon Panel" of experts, providing quality control. Team Gila Monster won in 2024, on account of exanetide's use in diabetes treatment, and the resultant decrease in negative renal outcomes.

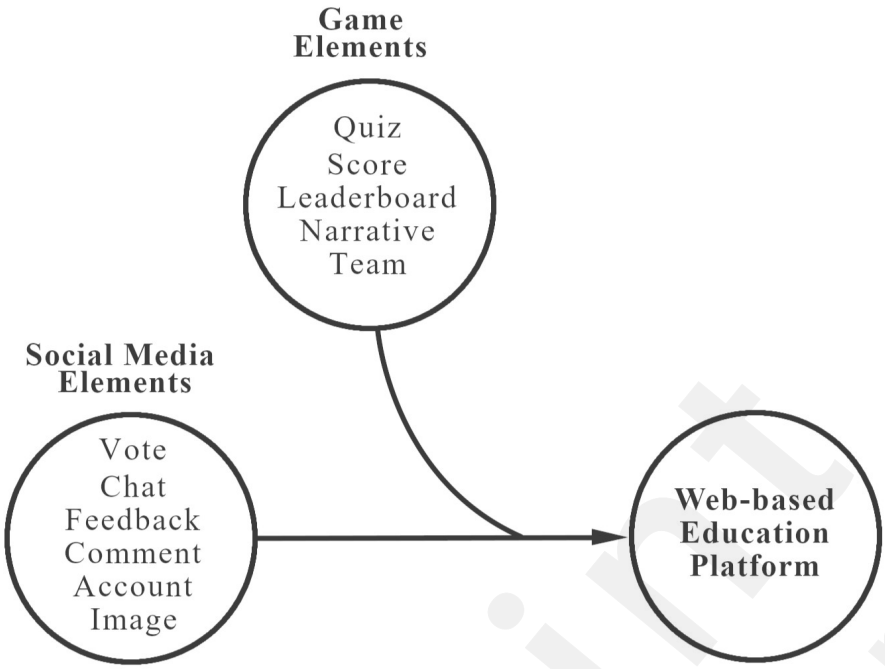


Figure 1. The convergence of elements into a single platform.

Digital Confluence

The success of NephMadness, at the nexus of games and social media, and the evidence presented in this review, ostensibly paves the way for future platforms in medical education. A dedicated education platform could be built that combines elements of both social media and games(figure 1). This platform would allow students on a monthly rotation to participate in gamified quizzes that are administered in-house by their attending or professor. A leaderboard, team score, digital trophies, and narrative would provide an immersive experience. Learning would be asynchronous as students could discuss, comment, and vote on each quiz question. It would be possible to receive on-demand answers from their professor, a measure of quality control.

Conclusion

To quote Wordsworth, being an educator during the information revolution is the “very heaven." Unlimited opportunities exist to incorporate game-based and asynchronous learning into a medical education curriculum. Although further high-quality studies are needed, the evidence is compelling. Modern students have indicated an acceptance of nontraditional teaching methods and a preference for on-demand answers and feedback. These findings appear to suggest a role for an educational platform combining elements of games and social media. This novel platform could be further evaluated in cross-sectional and cohort studies.

Conflicts of Interest

No financial disclosures were reported by the authors of this paper.

Abbreviations

ABG: Arterial Blood Gas
CSS: Cascading Style Sheet
fka: formerly known as
HTML: Hypertext Markup Language

JMIR: Journal of Medical Internet Research
MIPS: Merit-based Incentive Payment System
RCT: Randomized Controlled Trial
UTHSC: University of Tennessee Health Science Center

References

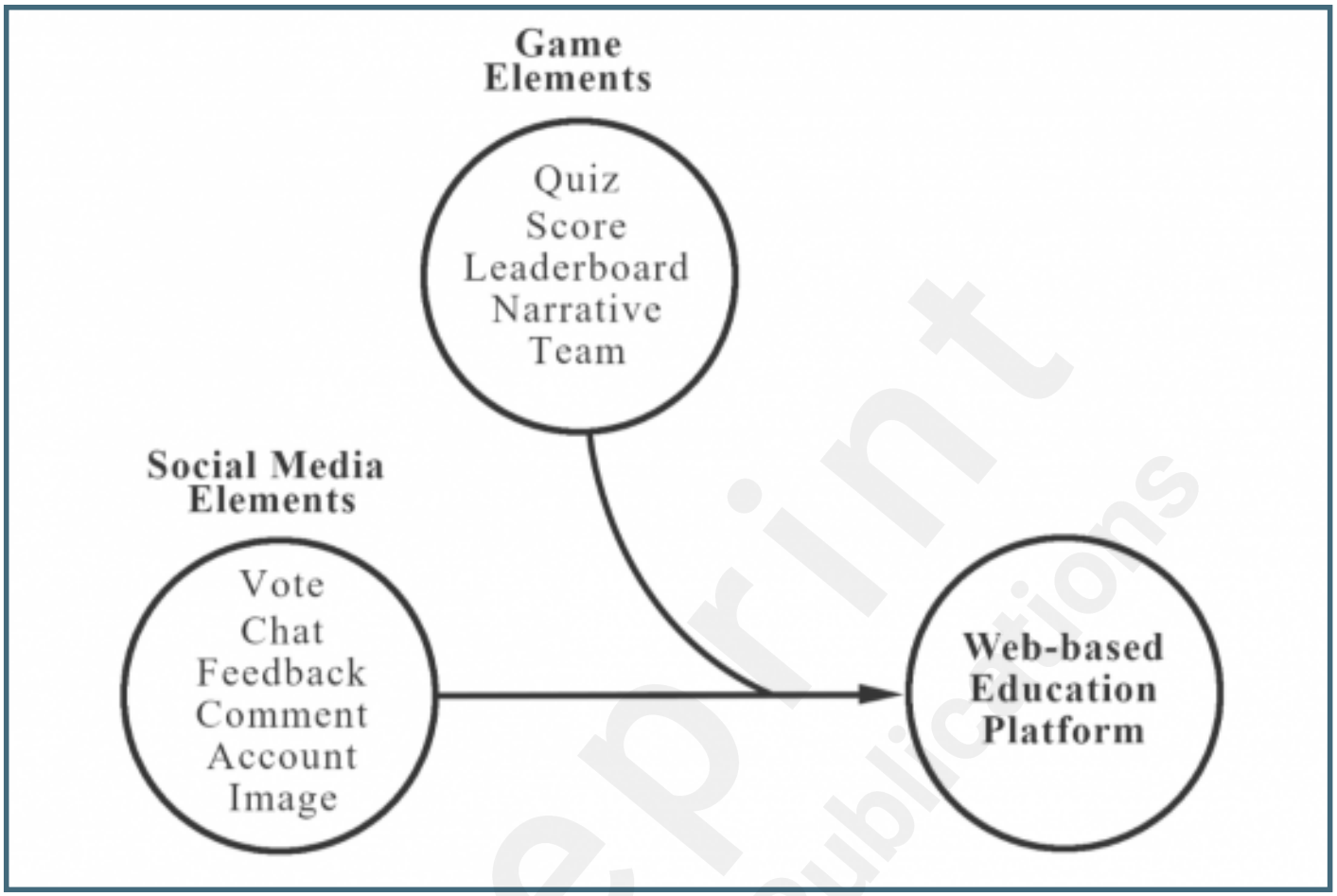
1. Lewis KO, Popov V, Fatima SS. From static web to metaverse: reinventing medical education in the post-pandemic era. Ann Med 2024; 56(1): 2305694 doi:10.1080/07853890.2024.2305694
2. El-Ali A, Kamal F, Cabral CL, Squires JH. Comparison of traditional and web-based medical student teaching by radiology residents. J Am Coll Radiol 2019; 16(4 Pt A): 492–495 doi:10.1016/j.jacr.2018.09.048
3. Nutalapati V, Tokala KT, Desai M, Kanakadandi V, Olyaee M, Parasa S, Rastogi A. Development and validation of a web-based electronic application in managing antithrombotic agents in patients undergoing GI endoscopy. Gastrointest Endosc 2019; 90(6): 906–912 doi:10.1016/j.gie.2019.06.015
4. Farsi D. Social media and health care, part i: Literature review of social media use by health care providers. J Med Internet Res 2021; 23(4): 23205 doi:10.2196/23205
5. Deterding S, Dixon D, Khaled R, Nacke L. From game design elements to gamefulness: defining" gamification." Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments 2011; pp. 9–15
6. 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; 26(2): 683–711 doi:10.1007/s10459-020-10000-3
7. Dengri C, Gill A, Chopra J, Dengri C, Koritala T, Khedr A, Korsapati AR, Adhikari R, Jain S, Zec S, Chand M, Kashyap R, Pattan V, Khan SA, Jain NK. A review of the quiz, as a new dimension in medical education. Cureus 2021; 13(10):18854 doi:10.7759/cureus.18854
8. Burgon T, Casebeer L, Aasen H, Valdenor C, Tamondong-Lachica D, Belen E, Paculdo D, Peabody J. Measuring and improving evidence-based patient care using a web-based gamified approach in primary care (qualityiq):Randomized controlled trial. J Med Internet Res 2021; 23(12): 31042 doi:10.2196/31042
9. Yuenyongviwat V, Bvonpanttarananon J. Using a web-based quiz game as a tool to summarize essential content in medical school classes: Retrospective comparative study. JMIR Med Educ 2021; 7(2): 22992 doi:10.2196/22992
10. Courtier J, Webb EM, Phelps AS, Naeger DM. Assessing the learning potential of an interactive digital game versus an interactive-style didactic lecture: the continued importance of didactic teaching in medical student education. Pediatr Radiol 2016; 46(13): 1787–1796 doi:10.1007/s00247-016-3692-x
11. Bouthillier M, Canil A, Cheng BYC, Lebel K, Dobson JL. Inaugural pan-canadian radgames: Results from a successful approach to radiology education for medical students. Acad Radiol 2023; 30(1): 113–121 doi:10.1016/j.acra.2022.07.005
12. Buijs-Spanjers KR, Hegge HH, Jansen CJ, Hoogendoorn E, Rooij SE: A web-based serious game on delirium as an educational intervention for medical students: Randomized controlled trial. JMIR Serious Games 2018; 6(4):17 doi:10.2196/games.9886
13. Buijs-Spanjers KR, Hegge HH, Cnossen F, Jaarsma DA, Rooij SE. Reasons to engage in and learning experiences from different play strategies in a web-based serious game on delirium for medical students: Mixed methods design. JMIR

Serious Games 2020; 8(3):18479 doi:10.2196/18479
14. McCarthy DM, Powell RE, Cameron KA, Salzman DH, Papanagnou D, Doty AM, Leiby BE, Piserchia K, Klein MR, Zhang XC, McGaghie WC, Rising KL. Simulation-based mastery learning compared to standard education for discussing diagnostic uncertainty with patients in the emergency department: a randomized controlled trial. BMC Med Educ 2020; 20(1): 49 doi:10.1186/s12909-020-1926-y
15. Baranowski T, Buday R, Thompson DI, Baranowski J. Playing for real: video games and stories for health-related behavior change. Am J Prev Med 2008; 34(1):74–82 doi:10.1016/j.amepre.2007.09.027
16. Bond SE, Crowther SP, Adhikari S, Chubaty AJ, Yu P, Borchard JP, Boutlis CS, Yeo WW, Miyakis S. Design and implementation of a novel web-based e-learning tool for education of health professionals on the antibiotic vancomycin. J Med Internet Res 2017; 19(3): 93 doi:10.2196/jmir.6971
17. Khan Z, Kapralos B. A low-fidelity serious game for medical-based cultural competence education. Health Informatics J 2019; 25(3): 632–648 doi:10.1177/1460458217719562
18. Krishnan S, Blebil AQ, Dujaili JA, Chuang S, Lim A. Implementation of a hepatitis-themed virtual escape room in pharmacy education: A pilot study. Educ Inf Technol 2023: 1–13 doi:10.1007/s10639-023-11745-1
19. Nisar S, Alshanberi AM, Mousa AH, El Said M, Hassan F, Rehman A, Ansari SA. Trend of social media use by undergraduate medical students; a comparison between medical students and educators. Ann Med Surg (Lond) 2022; 81: 104420 doi:10.1016/j.amsu.2022.104420
20. Atallah S, Mansour H, Dimassi H, Kabbara WK. Impact of social media education on antimicrobial stewardship awareness among pharmacy, medical and nursing students and residents. BMC Med Educ 2023; 23(1): 446 doi:10.1186/s12909-023-04423-w
21. Lilley CM, Arnold CA, Arnold M, Booth AL, Gardner JM, Jiang XS, Loghavi S, Mirza KM. The implementation and effectiveness of pathelective.com. Acad Pathol 2021; 8: 23742895211006829 doi:10.1177/23742895211006829
22. Tian R, Wang E, Sivasubramaniam P, Baskota SU, Sharma A, Cecchini MJ. Ten years of pathology on twitter (x): Landscape and evolution of pathology on twitter from 2012 to 2023. Arch Pathol Lab Med 2024 doi:10.5858/arpa.2023-0447-OA
23. Carson TY, Hatzigeorgiou C, Wyatt TR, Egan S, Beidas SO. Development and implementation of a web-based learning environment for an inpatient internal medicine team: Questionnaire study. JMIR Med Educ 2020; 6(2):18102 doi:10.2196/18102
24. Ortadeveci A, Ozden H. Social media as a learning tool in anatomy education from the perspective of medical and dental students. Clin Anat 2023; 36(5): 809–817 doi:10.1002/ca.24046
25. Sparks MA, Topf JM. Nephmadness after 5 years: A recap and game plan for the future. Am J Kidney Dis 2018; 71(3):299–301 doi:10.1053/j.ajkd.2017.12.001

Supplementary Files

Figures

The convergence of elements into a single platform.



TOC/Feature image for homepages

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