

# **Does the content of the game or its design matter? Perception of the success in developing crowdfunding health education game**

Hong Huang, Han Yu, Wanwan Li

Submitted to: JMIR Serious Games  
on: May 15, 2022

**Disclaimer:** © The authors. All rights reserved. This is a privileged document currently under peer-review/community review. Authors have provided JMIR Publications with an exclusive license to publish this preprint on its website for review purposes only. While the final peer-reviewed paper may be licensed under a CC BY license on publication, at this stage authors and publisher expressly prohibit redistribution of this draft paper other than for review purposes.

Table of Contents

Original Manuscript..... 4

Supplementary Files..... 28

    Related publication(s) - for reviewers eyes onlies ..... 29

    Related publication(s) - for reviewers eyes only 1 ..... 30

# Does the content of the game or its design matter? Perception of the success in developing crowdfunding health education game

Hong Huang<sup>1</sup> PhD; Han Yu<sup>2</sup> PhD; Wanwan Li<sup>3</sup> PhD

<sup>1</sup>University of South Florida School of Information Tampa US

<sup>2</sup>University of Northern Colorado Greeley US

<sup>3</sup>University of South Florida Tampa US

## Corresponding Author:

Hong Huang PhD

University of South Florida

School of Information

school of Information

Tampa

US

## Abstract

This study conducted a user survey to evaluate the successfulness of health learning game crowdfunding project from Kickstarter. Total of seventy-five participants used the eight game evaluation dimensions including Game Rules; Learning Objectives; Narrative Context; Content Organization and User Friendliness; Engagement; Interactivity; Skill building; and Assessment & Feedback. Exploratory data analysis shows that, among all the eight dimensions, Skill building and Content Organization, and interactivity are the top ranking dimensions that matter much to associate with an entrepreneurial success for the game development. The eight dimensions can be grouped into three categories from exploratory factor analysis: content related, instruction related, and game design. Further statistical analysis confirmed the correlation between these dimensions with the success of crowdfunding health learning games. This empirical analysis identifies critical factors for game proposal design that can obtain a higher chance to secure crowdfunding support.

(JMIR Preprints 15/05/2022:39587)

DOI: <https://doi.org/10.2196/preprints.39587>

## Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

Please make my preprint PDF available to anyone at any time (recommended).

Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.

Only make the preprint title and abstract visible.

✓ **No, I do not wish to publish my submitted manuscript as a preprint.**

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**

Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain visible to all users.

Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in [http://](#)

## Original Manuscript

Does the content of the game or its design matter? Perception of the success in developing crowdfunding health education game

Hong Huang<sup>1\*</sup>, Han Yu<sup>2</sup>, Wanwan Li<sup>3</sup>

<sup>\*1</sup>School of Information, University of South Florida, Tampa, FL, 33620, USA

<sup>2</sup>Department of Applied Statistics and Research Methods, University of Northern Colorado, Greeley, CO, 80639, USA

<sup>3</sup>Tandy School of Computer Science, University of Tulsa, Tulsa, OK, 74104, USA

## Abstract

### Background:

Health education games make health-related tasks enjoyable and interactive, thereby encouraging user participation. Entrepreneurs and health educators can leverage online crowdfunding platforms, like Kickstarter, to transform their innovative ideas into funded projects.

### Objective:

This research focuses on health education game initiatives on Kickstarter. Through an online user survey, it aims to understand user perceptions and evaluate the significance of eight distinct components that may influence the success of such crowdfunding initiatives.

### Methods:

Seventy-five participants evaluated games using eight dimensions: Game Rules, Learning Objectives, Narrative, Content Organization and User Friendliness, Engagement, Interactivity, Skill Building, and Assessment & Feedback. The survey data was analyzed using descriptive statistical analysis, exploratory factor analysis, the Wilcoxon-Mann-Whitney Test, and multivariate analysis.

### Results:

Exploratory data analysis shows that, among the eight dimensions, Skill Building, Content Organization, and Interactivity are the top-ranking dimensions most closely associated with entrepreneurial game development. The eight dimensions can be grouped into three categories from exploratory factor analysis: content-related, instruction-related, and game design. Further statistical analysis confirmed the correlation between these dimensions with the success of crowdfunding health education games.

### Conclusions:

This empirical analysis identifies critical factors for game proposal design that can increase the likelihood of securing crowdfunding support.

**Key word:** Game-based learning, Rubrics, Kickstarter, education game campaign, collaboration, user perception

## Background

Digital strategies, particularly gamification, have introduced a refreshing dynamic to health education [1, 2]. Platforms, like Kickstarter, champion these tech-infused health games, providing a unique avenue for their development. By leveraging the power of crowdfunding, Kickstarter and similar platforms facilitate the evolution of health education games. This allows entrepreneurs, educators, game developers, and supporters to access essential resources and connect with audiences eager for meaningful health support and intervention.

### *Gamification in Health*

Gamification in health integrates game-design elements into non-game health scenarios, aiming to boost user engagement and immersion in health solutions. This transforms routine health tasks into enjoyable, competitive activities. This approach leads to positive behavioral changes, improving overall health, fitness, and adherence to medical treatments and programs [1,2,3,4]. Gamification has been applied in a wide range of medical fields, including health education, medical therapy, obesity, and mental health [1, 2, 3, 4].

Health education games are interactive digital tools specifically designed to impart knowledge or skills related to health and wellness [1, 2]. These games transform traditional health-

related lessons into enjoyable and engaging tasks, aiming to enhance retention and application of health information in daily life [1, 2, 3]. Serious health games, created primarily for specific health objectives rather than solely for entertainment, use gaming components to create an educational environment [1, 2]. They utilize gaming components to facilitate a teaching environment, enabling users to learn specific health skills or gain valuable health-related information [1,2]. Especially beneficial for long-term health and chronic-related applications, these games foster positive emotional or empathy connections among users, leading to improved medical treatment plans and behavior changes [1, 2, 3].

### *The Role of Crowdfunding in Promoting Health Education Games*

Given the modest initial investment required and the scale of crowdfunding, it is advocated that crowdfunding serve as a primary method to promote and support the development of health education games. With the recent success of platforms like Kickstarter, researchers and healthcare advocates are turning to these tools to fund their projects [5, 6]. Through crowdfunding, health educators, entrepreneurs, and other stakeholders can conduct their work to meet community needs while also achieving financial and community outreach goals. This method attracts a varied group of participants who contribute financially, participate in development, and offer social support [7, 8, 9, 10, 11].

Health education games, like other game-based learning tools, motivate users by making health-related tasks more enjoyable [1, 12]. Online crowdfunding can assist entrepreneurs and health educators with limited resources in translating their innovative ideas into solid and appealing content and formats [13, 14]. Crowdfunding platforms help individuals transform ideas into fundable and actionable projects [15, 16]. Health serious games, particularly for long-term health and chronic-related applications, foster positive emotional or empathy connections among users and communities, leading to improved medical treatment plans [3].

Crowdfunding for health education games benefits users' self-efficacy, well-being, chronic disease management, and physical activity [8, 9, 10]. Rewards, feedback, and socialization elements are frequently used to gamify e-Health in crowdfunding-based health education games. Furthermore, health education games can positively change their health behaviors, benefiting their overall health and wellness [2]. Successful health education crowdfunding projects elicit both intrinsic (altruistic) and extrinsic (rewards and feedback) motivation in order to attract a diverse range of crowdfunding donors, and they work smoothly online digital health engagement [17]. [This study aims to explore the eight critical evaluation dimensions from the user's perspective that influence the success of crowdfunding campaigns for health education games. The findings will guide practitioners and entrepreneurs in strategizing and designing impactful crowdfunding campaigns for health education games.](#)

## Related Works

To understand the intricacies of successful crowdfunding for health education games, a literature review provides insights on various dimensions related to the subject. The literature review enables us to systematically explore the dynamics of crowdfunding, the principles of game-based learning, and the factors that influence the success of health education games.

### *Dynamics and Success Factors of Crowdfunding Initiatives*

To develop and promote content for successful crowdfunding campaigns, extensive planning, outreach, and marketing are required. [Data suggests that](#) the most popular crowdfunding projects are those that are creative, participatory, or consumable, such as games, technology, film and video, and art and design [18]. In general, crowdfunding projects have small funding sizes and offer various donors' incentives, small gifts, or awards, which leads to a higher success rate of



outcome for the projects [18]. Such success not only mirrors financial objectives but also nurtures the emergence of communities with shared interests [19]. Numerous game developers have used crowdfunding to fund the initial investment in educational applications [20]. This will encourage more entrepreneurs to participate in collaborative crowdfunding platforms and launch their projects.

Unlike a traditional purchase, crowdfunding involves a high level of social capital influence, particularly the status and reach on social network sites [16]. Social capital creates an online environment that combines collective knowledge, appeal, and emotional responses, enabling investors to make well-informed decisions [16]. This investment process shapes perception and investment behavior. The interaction mechanism has a broader and more pervasive contextual impact, and the crowdfunding campaign design and features also influence decisions [20].

Crowdfunding initiatives require both content richness and ownership diversity [24]. Several studies have explored strategies to optimize the success of such crowdfunding efforts [24, 25]. Notably, during crowdfunding, potential investors often evaluate founders based on their personal communication skills and presentation, both of which influence investment decisions [26]. In addition, the use of specific language, the length of campaign text, the frequency of updates, and the inclusion of video in campaign texts have all been correlated with success of crowdfunding campaigns [38, 39]. Reducing the cognitive effort needed to understand campaign content has been shown to result in increased funding [14].

Researchers have also linked crowdfunding success to the trustworthiness and reputation of developers, as well as their experiences on social crowdfunding networks [32, 33]. However, the quality of the presented information also plays an important role in determining crowdfunding success [34, 35, 36]. Factors that contribute to successful crowdfunding factors include the content of the campaign, audience participation, and the timing of fundraising development [37].

### *Health Education Game Development and User Experience*

Gamification has been proven to enhance medication and treatment adherence among chronic disease patients [3, 29]. Health serious games, on the other hand, have been praised for their ability to help people with chronic illnesses improve their behavior [2, 30]. These games mirror real-life challenges, allowing players to develop coping strategies [16]. They educate players about their condition and necessary lifestyle alterations, with compelling storylines ensuring better engagement [14, 16]. Game interactivity allows players to make decisions, learn from outcomes, and receive feedback on health implications [2 16].

When evaluating the feasibility of a game proposal, it is important to consider both the organization and narrative of the content, as well as the effectiveness of interactive games as a learning tool [85]. A well-organized and clearly written proposal can help the investor understand the purpose, goals, and potential value of the project [37]. Interactive health games can educate users with content and skills [85]. Users can also actively engage with the material, explore and experiment with different concepts and strategies, and receive immediate feedback on their progress [40]. This can help them understand and retain the content and skills being taught.

Game rules and interactivity stand as important components in health game design. Game rules ensure alignment with educational objectives, and the inherent challenge-reward system in these games drives players to continue, thereby continuously learning and adopting healthier behaviors [4, 12]. Defining game rules/challenges and delivering feedback can increase users' self-concept, efficacy, knowledge skills, communication, and social support, resulting in better health behaviors for self-care and adherence, lowering health costs, and establishing a stronger health system [17].

Health education game users are drawn to characters that resemble them, experiencing

validation when such characters feature in media [61]. Young role models, especially those in media genres like cartoons and video games, are particularly valued by these users [62]. For example, the motivation and design of the interactive health game series can be focused on using positive role models to inspire and motivate players [62, 67]. These role models are described as being successful in their adventures while also managing their health, which could help users including children with chronic illnesses like asthma or diabetes feel more positive about their own abilities to manage their health and self-care [62,67].

Interestingly, health game players without specific medical conditions are often less certain about in-game decisions compared to their peers with those conditions [62]. Health education games allow players to try new things, fail, learn, and eventually win. Such games also motivate users to adopt a healthier lifestyle, adhere to medical advice when unwell, navigate life crises, and foster close social connections for support [64].

Regarding assessments and feedback mechanisms, those health learners who receive personalized feedback and engage deeply with medical content tend to experience great benefit. This approach is especially effective in reaching younger individuals who might not typically consult other media or seek expert health advice [65]. Interactive health games not only foster communication and social support but also empower users to discuss their health with friends, family, and healthcare professionals. They also motivate users to actively seek out advice and support [62]. For instance, in a series of interactive health games, players accessed factual details about the causes, treatments, social contexts, and self-care options related to specific health topics [62].

### *Game-Based Learning Principles*

One of the game-based learning principles that allows users to benefit from the game is the development of problem-solving skills [41]. Educational games can assist users in developing skills such as problem-solving [41, 42]. The modalities of game content representation should be adjusted to boost motivation and performance [43]. If learners cannot understand the app's content, no matter how rich and useful it is, or how beautiful the design is, the app's entire instructional value is lost [44]. Learners can learn problem-solving, strategic and analytical thinking, decision-making, and other 21<sup>st</sup>-century skills in narrative-centered learning environments [45].

Based on the constructivist learning theory, individuals gain deeper insights about the world through direct experiences and interactions [46, 47]. Games offer a dynamic and interactive environment that aligns with this theory, enabling learners to actively explore, experiment, and tackle challenges [46,47]. The appeal of a game's narrative indicates its potential to captivate users [71]. The game creators should focus more on the content, storyline, and interaction components of the game to attract individual users, determining whether it will be successful or not [71].

The quality of a learning game is significantly influenced by the effectiveness of user feedback [49, 50]. Numerous studies have shown that feedback enhances learning outcomes [48]. It provides learners with clarity on their strengths and areas needing improvement, and serves as a motivational tool, encouraging continuous learning even within the gaming context [48].

Educational games can customize learning experiences by gauging a student's readiness, providing constructive feedback, and modifying the level of challenge [52]. It's essential for an educational game to have well-defined learning objectives that detail the desired skills and knowledge [53]. Game rules facilitate learning by allowing players to interact with their environment [51]. Achieving these objectives depends on adhering to specific rules, which may involve certain challenges or conditions the learner must satisfy [43].

A learner's level of motivation can greatly influence their enthusiasm or indifference

towards a task [54, 55]. Moreover, there's substantial evidence suggesting that motivation enhances cognitive functions, particularly influencing what learners focus on and how they assimilate information [56,57,58].

Literature suggests that multiple factors influence the success of crowdfunding campaigns, especially those related to health education games [48, 51]. These range from the trustworthiness of developers, the quality of information presented, to the design and content of the game itself. While previous studies have shed light on general principles of game-based learning and the dynamics of crowdfunding, there remains a gap in understanding how these principles specifically apply to health education games on platforms like Kickstarter. Moreover, the user's perspective, which is crucial in determining the success of such campaigns, has not been thoroughly explored. We aim to bridge this knowledge gap by focusing on the user's perception and evaluating the critical components that resonate most with potential users, thereby influencing the success of health education game initiatives on crowdfunding platforms.

## Objectives

This study aims to provide a comprehensive overview of eighteen health education game projects launched on the crowdfunding platform, Kickstarter, and to understand user perceptions concerning the important factors determining the success of such health education game crowdfunding initiatives. To achieve this, we conducted a user survey using a health education assessment rubric specifically designed to evaluate the key components contributing to the success of these projects on Kickstarter.

## Methodology

### *Data Collection for Health Education Games*

A comprehensive keyword search using “Health, Education, Learning, Game” was conducted in August 2019 from Kickstarter and identified eighteen online health education game projects (See in Table 1). On the Kickstarter site, the system marked it as “Successful” if the project achieves or exceeds its goal money amount within the time set by the creators. Conversely, projects that fail to meet their financial target within the designated period are labeled as “Unsuccessful” (Table 1).

Insert Table 1. Health education game descriptive data from the crowdfunding site: Kickstarter

#### *Online Survey Design*

We use the Qualtrics online survey platform (Qualtrics, Provo, UT) to create an online survey based on health education game assessment rubrics derived from the literature. This survey allowed participants to evaluate and rank crowdfunding health education games on the Kickstarter website. The survey incorporated eight criteria, each essential for the evaluation of health education games. These criteria, along with their definitions and cited literature, are presented in Table 2. Before commencing this study, the researchers obtained approval from the Institutional Review Board (IRB) of the University of South Florida.

Insert Table 2. Crowdfunding health education game assessing criteria and definitions

Before the main survey was launched, a pilot test of the survey instrument was conducted with seven undergraduate students majoring in health science. This pilot test aimed to assess the validity and understandability of the survey questions. The participants were asked to read through the survey and provide feedback on its clarity and relevance. Based on their comments, necessary revisions were made to the questions to enhance the overall quality of the survey.

In the final survey version, participants rated the rubrics on a three-point Likert scale. The

scoring system for these criteria ranged from 0 to 2, with the following interpretations. 0 = “Does not meet expectations” or is rated as "Poor" (0), 1 = “Meets expectations” or is rated as "Fair" (1), and 2 = “Exceeds expectations” or is rated as "Good" (2). Participants could also select “Unable to decide” or “Not applicable” if they felt unable to make a judgment on a particular criterion. Additionally, an open-ended question was incorporated: “Do you have any comments or concerns (accuracy of terms, comprehensiveness, clarity of questions, etc.) for this question sets?” This allowed participants to provide further feedback on the survey questions.

In November 2019, undergraduate students majoring in health science were invited to participate in an online survey. Those who agreed to participate were provided with a standardized set of questions, accompanied by comprehensive instructions and definitions for the eight evaluation criteria, as detailed in Table 2. Each student was then randomly assigned one specific crowdfunding health education game from a pool of eighteen games, referenced in Table 1. Their task was to evaluate their assigned game based on these eight criteria. Ultimately, seventy-five undergraduate students were recruited as participants.

### *Data Analysis*

We used STATA 15 software, based in College Station, TX, for statistical analyses. We utilized several data analysis approaches to understand the results.

#### 1. Descriptive Statistical Analysis

This method provides a summary of the main aspects of the data, offering a simple overview of the data. By calculating the percentage of ranking types and the mean value of the criteria, we can gain insights into the general behavior and preferences of the survey participants.

#### 2. Exploratory Factor Analysis

Exploratory Factor Analysis is used in reducing the data's dimensionality and identifying the underlying relationships between measured variables. It was used to group the eight criteria into meaningful categories, helping to decipher any latent structures within the dataset. This ensures that we can identify which sets of criteria tend to co-occur or are rated similarly by participants.

### 3. Wilcoxon-Mann-Whitney Test

The Wilcoxon-Mann-Whitney test is a non-parametric statistical hypothesis test used to compare two unrelated samples. This test was used to determine if there were any significant differences in the rankings given by participants to different game criteria.

### 4. Multivariate Analysis

The aim of this study extends beyond merely understanding the criteria. It also seeks to predict the success of crowdfunding health education games based on these criteria. We use logistic regression with the binary variable: success of the crowdfunding project, for prediction. This model determines the odds of a game being successful based on its criteria rankings, offering insights into which criteria are the most influential predictors of success.

By employing these methods, the study ensures a comprehensive analysis of the data - from understanding the basic patterns to deciphering underlying component structures, to finally being able to predict the success of health education games based on their criteria.

## Result

A list of health education games launched on Kickstarter is presented in Table 1. This table enumerates eighteen distinct health education games originating from various countries, namely the United States, Canada, Norway, and the United Kingdom. Some projects have exceeded their goals by a large margin, while others have fallen significantly short. The diversity of the sample provides a comprehensive foundation for our study. This diversity enables an exploration into users' perceptions



regarding educational game assessment rubrics. Such an investigation can discern potential factors that could influence the success trajectory of health education games on crowdfunding platforms like Kickstarter.

Table 2 focuses on various criteria relevant to design and evaluation of games. These criteria are based on established literature, highlighting their credibility and validity. When assessing potential predictors of crowdfunding game success based on feedback from seventy-five survey participants, certain criteria stood out as important (Table 3).

Skill Building is ranked first, followed by Content Organization and then Narrative. Skill Building holds the top rank due to its emphasis on continuous learning and engagement, ensuring that players progressively acquire and refine their skills throughout the game (Table 3). The importance of Content Organization is highlighted by its role in enhancing user experience; a well-organized game offers clear navigation, allowing players to immerse themselves fully (Table 3). Narrative further enhances the gaming experience by introducing an engaging storyline that lends context and purpose, enriching the gameplay. Interactivity is important for keeping players engaged. It gives them a sense of belonging and influence within the game world. Yet, intriguingly, Motivation ranks the lowest among these dimensions, even though its presence ensures that games are compelling enough to retain players' interest and drive continuous participation (Table 3). While Skill Building and Content Organization seem to be the areas where games excel, Motivation appears to be a challenging area for many developers.

Insert Table 3. Ranking of eight assessing dimensions of crowdfunding health education games

To identify the assessment structure for campaign initiatives' quality reflected by seventy-five survey respondents' rankings, the study conducted exploratory factor analysis using principal-

components analysis as the extraction method and varimax with Kaiser normalization as the rotation method (see Table 4). The cutoff size for criterion loadings was set to 0.45 [58]. Both the Bartlett ( $\chi^2 = 68.26$ ,  $p < 0.001$ ) and measure of sampling adequacy (MSA = 0.57) tests for the sample pointed to a significant level of correlation among the dimensions.

Exploratory Factor Analysis indicated that these eight criteria can be grouped into three components: content related (Content Organization, Motivation, Assessment & Feedback), instruction related (Learning Objectives, Narrative, and Skill Building), and game designed related (Game Rules and Interactivity) (Table 4). The content-related group suggests that a well-organized game with clear feedback mechanisms can effectively motivate players. The instruction-related components reflect the instructional journey of the player, from understanding the objectives, engaging with narrative, to building skills. Game-related components are fundamental to the gameplay experience, ensuring players are not just passive observers but active participants.

Insert Table 4. Factor components for eight criteria in crowdfunding health education games

To review the perception gaps among these dimensions for successful or unsuccessful crowdfunding campaigns, group-based comparison was conducted between these dimensional means. Table 5 showed the gaps between successful and unsuccessful games in criteria rating. Among them, Motivation, Interactivity, Game rules, Learning Objectives demonstrated larger difference gaps in decreasing order, and these are followed by Assessment & Feedback, Skill building, Narrative and Content Organization.

The Wilcoxon-Mann-Whitney test comparing distributions of successful and unsuccessful games showed that Motivation ( $p=0.004$ ), Game Rules ( $p=0.03$ ), Learning Objectives ( $p=0.04$ ), and Interactivity ( $p=0.04$ ) show statistically significant difference among these two groups (Table 5). These criteria show clear distinctions between successful and unsuccessful games, suggesting these factors might be crucial for the success of such games. On the other hand, criteria like Content

Organization and Skill Building, while important, don't show a significant difference between the two categories of games. This could mean that both successful and unsuccessful games have these criteria well-implemented, but they might not be the distinguishing factors for success. Multivariate analysis showed Learning Objectives and Motivation are two significant factors associated with successful health education game crowdfunding campaigns (Table 6). This suggests that these two criteria might be especially important for the success of health-related games.

Insert Table 5. Wilcoxon-Mann-Whitney test of eight ranking assessments based on successful or fail crowdfunding health education games

Insert Table 6. Multivariate Logistic Regression predicting the success of the health educational game crowdfunding.

Figure 1 presents an empirical framework outlining the key components underpinning the success of health education game crowdfunding. The model highlights the balance between foundational structural components, such as game rules and content organization, and experiential elements that enhance the player's immersion and engagement, such as motivation and narrative. A successful educational game should seamlessly integrate all these facets. This ensures not only the delivery of educational content but also fosters an environment where players are intrinsically driven to remain engaged and continue their learning journey within the game.

Insert Figure 1. Health education game crowdfunding successful model

## Discussion

The crowdfunding landscape for health education games is diverse, with success determined by a myriad of factors beyond just a funding goal. Factors such as the clarity of the project's purpose,

its presentation, and its marketing likely play a significant role in attracting users [40, 41]. It is also important to have a reasonable and attainable goal, as this might increase the likelihood of a project's success.

Crowdfunding backers, especially on platforms like Kickstarter, often support projects that offer value beyond just entertainment. Skill Building in games implies that players will acquire new abilities or knowledge, making them both fun and beneficial. This dual-purpose might appeal to game players who see an opportunity for a return on investment, not just in potential product rewards but also in personal or societal skill development.

The ranking of these criteria sheds light on the preferences and priorities of both backers and players. It's possible that backers perceive tangible attributes like Skill Building and Content Organization as immediate indicators of game quality and potential success. These elements can be readily demonstrated in promotional materials, making them more attractive to potential backers. On the other hand, Motivation, being more abstract and subjective, might be harder to convey and measure, leading to its lower ranking. It's essential for game developers to recognize these perceptions and strike a balance in their design, ensuring a comprehensive and engaging game experience that appeals to a broad audience.

For skill building, it is essential for players to acquire and build on skills as they progress in the game. This ensures continuous learning and engagement. A well-structured game content helps players navigate and understand the game better, enhancing their experience. An engaging storyline provides context and purpose, making gameplay more meaningful. Player interactivity is vital for player engagement. Players should feel they are part of the game world and can influence it. Immediate feedback helps players understand their progression and areas of improvement. Clear rules ensure that players can easily understand how to play the games, leading to smoother game experiences. For health education games, it is important to have clear learning outcomes that guide the game design. The game must be engaging enough to keep players interested and motivated to

continue.

Multivariate analysis identifies Learning Objectives and Motivation as the two significant predictors of a health education game's crowdfunding success, as detailed in Table 6. This indicated the emphasis users place on clear educational outcomes and the motivation to engage with the game. Users prioritize games that offer clear educational outcomes and that effectively motivate players to engage. The significance of Learning Objectives suggests backers might prioritize games that have a clear educational goal, ensuring players gain tangible knowledge or skills. Motivation, on the other hand, ensures that players remain engaged and committed to the game's objectives. When combined, these criteria can lead to a game that not only educates but does so in a compelling manner, maximizing player retention and learning outcomes.

### Limitations and Future Work

The study has some limitations due to the examination of user perception, which is based on a small number of user responses in a small number of crowdfunding campaigns. The study examined subjective opinions across eight evaluation criteria, but the reasons for crowdfunding's effectiveness in health education games require further investigation. In addition, we survey participants as potential backers. A more comprehensive approach would involve surveying actual backers, who make real investments, to discern any differences in perceptions. This could provide a richer understanding of the dynamics at play. The impact of quality on the campaign content and media aspects, as well as user indicators of motivation and interactivity, was investigated in this study. Through crowdfunding, health education games improve engagements, learning components, and cultural adaptability for user engagement [7,8,9].

### Conclusion

Crowdfunding for health education games presents a unique opportunity to bridge the gap between game developers and potential users. There has been little research that has provided empirical evidence for evaluating user perspectives on crowdfunding health education games. Further empirical evaluations are clearly beneficial to provide a rigorous validity of gamification's effectiveness in e-Health. This research conducts exploratory study and identifies three major components that matter for health crowdfunding game success. [These components are related to game design, instruction, and game content.](#) Interestingly, motivation and assessment & feedback are grouped into game content categories, not [into](#) game design categories. This indicated that the crowdfunding health game proposals are tight-in the proposal content that is importantly engaging, interesting and attractive, with solid assessment & feedback components. Among them, given the nature of health subjects, entrepreneurs and educators shall pay more attention for game development factors such as motivation, interactivity, as well as game rules, so that the health or scientific subjects can be easily infused in the gaming process. Making health games look playful and attractive enable users to grasp basic health knowledge easily during the gaming process [60]. Interestingly, there is little difference in content organization between successful and unsuccessful games, this indicates that if the game content is easy to follow, it is still not enough. Backers and potential funders or users mostly [agree with](#) the health content itself, but rather care more about the game development components, and assess the crowdfunding game proposal and see if these game designs are in proper ways and make logical sense.

[Our findings recognize the importance of aligning game design with user preferences. The success of health education games on crowdfunding platforms relies on a combination of clear educational objectives, effective player engagement mechanism, and a well-structured game content. The study highlights the significance of Learning Objectives and Motivation as key determinants of crowdfunding success for health education games. Game developers aiming for success in this domain should prioritize these criteria, ensuring that their games offer a clear educational outcome.](#)

## Acknowledgements

We would like to extend our sincere gratitude to the three anonymous reviewers for their invaluable and insightful feedback on our manuscript. Their consistent comments significantly improved our manuscript.

## Reference

1. Bartolomé, N. A., Zorrilla, A. M., & Zapirain, B. G. (2011, July). Can game-based therapies be trusted? Is game-based education effective? A systematic review of the Serious Games for health and education. In *2011 16th International Conference on Computer Games (CGAMES)* (pp. 275-282). IEEE.
2. Baranowski, T., Buday, R., Thompson, D., Lyons, E. J., Lu, A. S., & Baranowski, J. (2013). Developing games for health behavior change: Getting started. *GAMES FOR HEALTH: Research, Development, and Clinical Applications*, 2(4), 183-190.
3. Davis, A. J., Parker, H. M., & Gallagher, R. (2021). Gamified applications for secondary prevention in patients with high cardiovascular disease risk: a systematic review of effectiveness and acceptability. *Journal of Clinical Nursing*, 30(19-20), 3001-3010.
4. Amresh, A., Salla, R., Sinha, M., & Birr, R. (2016, May). Design, implementation and evaluation of a game-based intervention targeting latino children for improving obesity outcomes. In *2016 IEEE International Conference on Serious Games and Applications for health (SeGAH)* (pp. 1-8). IEEE.
5. Bassani, G., Marinelli, N., & Vismara, S. (2019). Crowdfunding in healthcare. *The Journal of Technology Transfer*, 44(4), 1290-1310.
6. Besancenot, D., & Vranceanu, R. (2020). A Global Game Model of Medical Project Crowdfunding. *International Game Theory Review*, 22(03), 19500167.
7. Gonzales, A. L., Kwon, E. Y., Lynch, T., & Fritz, N. (2018). "Better everyone should know our business than we lose our house": Costs and benefits of medical crowdfunding for support, privacy, and identity. *New Media & Society*, 20(2), 641-658.
8. Choy, K., & Schlagwein, D. (2016). Crowdsourcing for a better world: On the relation between IT affordances and donor motivations in charitable crowdfunding. *Information Technology & People*.
9. Kim, J. G., Hong, H., & Karahalios, K. (2018, April). Understanding identity presentation in medical crowdfunding. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (pp. 1-12).
10. Kenworthy, N. J. (2019). Crowdfunding and global health disparities: an exploratory conceptual and empirical analysis. *Globalization and health*, 15(1), 1-13.
11. Kenworthy, N. (2021). Like a Grinding Stone: How Crowdfunding Platforms Create, Perpetuate, and Value Health Inequities. *Medical Anthropology Quarterly*.
12. Eukel, H. N., Frenzel, J. E., & Cernusca, D. (2017). Educational gaming for pharmacy students—design and evaluation of a diabetes-themed escape room. *American journal of pharmaceutical education*, 81(7).
13. Ortiz, R. A., Witte, S., Gouw, A., Sanfilippo, A., Tsai, R., Fumagalli, D., ... & Lin, J. C. H. (2018). Engaging a community for rare genetic disease: best practices and education from individual crowdfunding campaigns. *Interactive journal of medical research*, 7(1), e7176.
14. Rose, S., Wentzel, D., Hopp, C., & Kaminski, J. (2020). Launching for success: The effects of psychological distance and mental simulation on funding decisions and crowdfunding



- performance. *Journal of Business Venturing*, 106021.
15. Lukk, M., Schneiderhan, E., & Soares, J. (2018). Worthy? Crowdfunding the Canadian health care and education sectors. *Canadian Review of Sociology/Revue canadienne de sociologie*, 55(3), 404-424.
  16. Olszewski, A. E., & Wolbrink, T. A. (2017). Serious gaming in medical education: a proposed structured framework for game development. *Simulation in Healthcare*, 12(4), 240-253.
  17. Ryu, S., Park, J., Kim, K., & Kim, Y. G. (2020). Reward versus altruistic motivations in reward-based crowdfunding. *International Journal of Electronic Commerce*, 24(2), 159-183.
  18. Mollick, E. (2014). The dynamics of crowdfunding: An exploratory study. *Journal of business venturing*, 29(1), 1-16.
  19. Da Cruz, J. V. (2018). Beyond financing: crowdfunding as an informational mechanism. *Journal of Business Venturing*, 33(3), 371-393.
  20. Antonenko, P. D., Lee, B. R., & Kleinheksel, A. J. (2014). Trends in the crowdfunding of educational technology startups. *TechTrends*, 58(6), 36-41.
  21. Kharrazi, H., Lu, A. S., Gharghabi, F., & Coleman, W. (2012). A scoping review of health game research: Past, present, and future. *GAMES FOR HEALTH: Research, Development, and Clinical Applications*, 1(2), 153-164.
  22. Rustina, Y., Krianto, T., & Ayubi, D. (2018). Developing a health education game for preschoolers: What should we consider?. *Enfermería Clínica*, 28, 1-4.
  23. Muangsrinoon, S., & Boonbrahm, P. (2019). Game elements from literature review of gamification in healthcare context. *Journal of Technology and Science Education*, 9(1), 20-31. <https://doi.org/10.3926/jotse.556>
  24. Cha, J. (2017). Crowdfunding for video games: factors that influence the success of and capital pledged for campaigns. *International Journal on Media Management*, 19(3), 240-259.
  25. Tyni, H. (2020). Double duty: Crowdfunding and the evolving game production network. *Games and Culture*, 15(2), 114-137.
  26. Smith, A. N. (2015). The backer-developer connection: Exploring crowdfunding's influence on video game production. *new media & society*, 17(2), 198-214.
  27. Sardi, L., Idri, A., & Fernández-Alemán, J. L. (2017). A systematic review of gamification in e-Health. *Journal of biomedical informatics*, 71, 31-48.
  28. Bochennek, K., Wittekindt, B., Zimmermann, S. Y., & Klingebiel, T. (2007). More than mere games: a review of card and board games for medical education. *Medical teacher*, 29(9-10), 941-948.
  29. Henkemans, O. A. B., Bierman, B. P., Janssen, J., Looije, R., Neerincx, M. A., van Dooren, M. M., ... & Huisman, S. D. (2017). Design and evaluation of a personal robot playing a self-management education game with children with diabetes type, *International Journal of Human-Computer Studies*, 106, 63-76.
  30. Jacobson, D., Jacobson, J., Leong, T., Lourenco, S., Mancl, L., & Chi, D. L. (2019). Evaluating child toothbrushing behavior changes associated with a mobile game app: A single arm pre/post pilot study. *Pediatric dentistry*, 41(4), 299-303.
  31. Burtch, G., & Chan, J. (2019). Investigating the Relationship Between Medical Crowdfunding and Personal Bankruptcy in the United States: Evidence of a Digital Divide. *Management Information Systems Quarterly*, 43(1), 237-262.
  32. Macht, 2014 Macht, S. A., & Weatherston, J. (2014). The benefits of online crowdfunding for fund-seeking business ventures. *Strategic Change*, 23(1-2), 1-14.
  33. Gerber & Hui, 2013 Gerber, E. M., & Hui, J. (2013). Crowdfunding: Motivations and deterrents for participation. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 20(6), 1-32.
  34. Zhou et al., 2018 Zhou, M. J., Lu, B., Fan, W. P., & Wang, G. A. (2018). Project description and crowdfunding success: an exploratory study. *Information Systems Frontiers*, 20(2), 259-



274.

35. Wang, N., Li, Q., Liang, H., Ye, T., & Ge, S. (2018). Understanding the importance of interaction between creators and backers in crowdfunding success. *Electronic Commerce Research and Applications*, 27, 106-117.
36. Choy, K., & Schlagwein, D. (2016). Crowdsourcing for a better world: On the relation between IT affordances and donor motivations in charitable crowdfunding. *Information Technology & People*.
37. Woods, C., Yu, H., & Huang, H. (2020). Predicting the success of entrepreneurial campaigns in crowdfunding: a spatio-temporal approach. *Journal of Innovation and Entrepreneurship*, 9(1), 1-23.
38. Yuan, X., Wang, L., Yin, X., & Wang, H. (2021). How text sentiment moderates the impact of motivational cues on crowdfunding campaigns. *Financial Innovation*, 7(1), 1-26.
39. Hoegen, A., Steininger, D. M., & Veit, D. (2018). How do investors decide? An interdisciplinary review of decision-making in crowdfunding. *Electronic Markets*, 28(3), 339-365.
40. Annetta, L. A., Lamb, R., & Stone, M. (2011). Assessing serious educational games: The development of a scoring rubric. In *Serious educational game assessment* (pp. 75-93). Brill Sense.
41. Thompson, D., Baranowski, T., Buday, R., Baranowski, J., Thompson, V., Jago, R., & Griffith, M. J. (2010). Serious video games for health: How behavioral science guided the development of a serious video game. *Simulation & gaming*, 41(4), 587-606.
42. Amory, A., & Seagram, R. (2003). Educational game models: conceptualization and evaluation: the practice of higher education. *South African Journal of Higher Education*, 17(2), 206-217.
43. Garris, R., Ahlers, R., & Driskell, J. E. (2017). Games, motivation, and learning: A research and practice model. In *Simulation in Aviation Training* (pp. 475-501). Routledge.
44. Reeves, T. C., & Harmon, S. W. (1993, April). Systematic evaluation procedures for instructional hypermedia/multimedia. In *Annual Meeting of the American Educational Research Association, Atlanta, April* (Vol. 14).
45. Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in entertainment (CIE)*, 1(1), 20-20.
46. Duffy, T. M., & Jonassen, D. H. (2013). *Constructivism and the technology of instruction: A conversation*. Routledge.
47. Huba, M. E., & Freed, J. E. (2000). *Learner-centered assessment on college campuses: Shifting the focus from teaching to learning*. Allyn & Bacon, 160 Gould St., Needham Heights, MA 02494.
48. Marzano, R. J., Pickering, D., & Pollock, J. E. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement*. ASCD.
49. Scheeler, M. C., Ruhl, K. L., & McAfee, J. K. (2004). Providing performance feedback to teachers: A review. *Teacher education and special education*, 27(4), 396-407.
50. Coddington, R. S., Feinberg, A. B., Dunn, E. K., & Pace, G. M. (2005). Effects of immediate performance feedback on implementation of behavior support plans. *Journal of applied behavior analysis*, 38(2), 205-219.
51. Siang, A. C., & Rao, R. K. (2003, December). Theories of learning: a computer game perspective. In *Fifth International Symposium on Multimedia Software Engineering, 2003. Proceedings.* (pp. 239-245). IEEE.
52. Cagiltay, N. E., Ozcelik, E., & Ozcelik, N. S. (2015). The effect of competition on learning in games. *Computers & Education*, 87, 35-41.
53. Sanchez, E. (2011). Key criteria for Game Design. A Framework. MEET Project.
54. Csikszentmihalyi, M., & Nakamura, J. (2014). The dynamics of intrinsic motivation: A study

- of adolescents. In *Flow and the foundations of positive psychology* (pp. 175-197). Springer, Dordrecht.
55. Pintrich, P. R., Smith, D. A., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and psychological measurement*, 53(3), 801-813.
  56. Eccles, J., & Wigfield, A. (1985). Teacher expectations and student motivation. *Teacher expectancies*, 185-226.
  57. Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: Theory, research, and applications*. Prentice Hall.
  58. Pugh, K. J., & Bergin, D. A. (2006). Motivational influences on transfer. *Educational psychologist*, 41(3), 147-160.
  59. Hair, J., Black, B., Babin, B., Anderson, R., & Tatham, R. (2005). *Multivariate data analysis*. Upper Saddle River, NJ: Prentice-Hall.
  60. Grimes, A., Kantroo, V., & Grinter, R. E. (2010, September). Let's play! Mobile health games for adults. In *Proceedings of the 12th ACM international conference on Ubiquitous computing* (pp. 241-250).
  61. Orji, R., Vassileva, J., & Mandryk, R. L. (2014). Modeling the efficacy of persuasive strategies for different gamer types in serious games for health. *User Modeling and User-Adapted Interaction*, 24(5), 453-498.
  62. Lieberman, D. A. (2001). Management of chronic pediatric diseases with interactive health games: Theory and research findings. *The Journal of ambulatory care management*, 24(1), 26-38.
  63. Lieberman, D.A. (1997). Interactive video games for health promotion: Effects on knowledge, self-efficacy, social support, and health. In R.L. Street, W.R. Gold, & T. Manning (Eds.), *Health promotion and interactive technology: Theoretical applications and future directions* (pp. 103–120). Mahwah, NJ: Lawrence Erlbaum Associates.
  64. Dos Santos, H., Bredehoft, M. D., Gonzalez, F. M., & Montgomery, S. (2016). Exercise video games and exercise self-efficacy in children. *Global pediatric health*, 3, 2333794X16644139.
  65. Sung, H. Y., Hwang, G. J., & Yen, Y. F. (2015). Development of a contextual decision-making game for improving students' learning performance in a health education course. *Computers & Education*, 82, 179-190.
  66. Madrazo-Lemarroy, P., Barajas-Portas, K., & Tovar, M. E. L. (2019). Analyzing campaign's outcome in reward-based crowdfunding: Social capital as a determinant factor. *Internet research*.
  67. Rewolinski, J. A., Kelemen, A., & Liang, Y. (2021). Type I diabetes self-management with game-based interventions for pediatric and adolescent patients. *CIN: Computers, Informatics, Nursing*, 39(2), 78-88.
  68. Lieberman, D. A., Fisk, M. C., & Biely, E. (2009). Digital games for young children ages three to six: From research to design. *Computers in the Schools*, 26(4), 299-313.
  69. Amory, A., & Seagram, R. (2003). Educational game models: conceptualization and evaluation: the practice of higher education. *South African Journal of Higher Education*, 17(2), 206-217.
  70. Ortiz, P., & Khin Khin, E. (2018). Traditional and new media's influence on suicidal behavior and contagion. *Behavioral sciences & the law*, 36(2), 245-256.
  71. Armstrong, M. B., & Landers, R. N. (2017). An evaluation of gamified training: Using narrative to improve reactions and learning. *Simulation & Gaming*, 48(4), 513-538.
  72. Hermans, R. C., Van Den Broek, N., Nederkoorn, C., Otten, R., Ruiter, E. L., & Johnson-Glenberg, M. C. (2018). Feed the Alien! the effects of a nutrition instruction game on children's nutritional knowledge and food intake. *Games for health journal*, 7(3), 164-174.
  73. Staiano, A. E. (2014). Learning by Playing: Video Gaming in Education—A Cheat Sheet for

- Games for Health Designers. *GAMES FOR HEALTH: Research, Development, and Clinical Applications*, 3(5), 319-321.
74. Lieberman, D. A. (2015). Using digital games to promote health behavior change. *The handbook of the psychology of communication technology*, 507-527.
75. Chaudy, Y., & Connolly, T. (2019). Specification and evaluation of an assessment engine for educational games: Integrating learning analytics and providing an assessment authoring tool. *Entertainment Computing*, 30, 100294.
76. Radhakrishnan, K., Toprac, P., O'Hair, M., Bias, R., Kim, M. T., Bradley, P., & Mackert, M. (2016). Interactive digital e-health game for heart failure self-management: a feasibility study. *Games for health journal*, 5(6), 366-374.
77. Sajjad, S., Hanan Abdullah, A., Sharif, M., & Mohsin, S. (2014). Psychotherapy through video game to target illness related problematic behaviors of children with brain tumor. *Current Medical Imaging*, 10(1), 62-72.
78. Cagiltay, N. E., Ozcelik, E., & Ozcelik, N. S. (2015). The effect of competition on learning in games. *Computers & Education*, 87, 35-41.
79. Mueller, S., Soriano, D., Boscor, A., Saville, N., Arjyal, A., Baral, S., ... & Kostkova, P. (2020). MANTRA: development and localization of a mobile educational health game targeting low literacy players in low and middle income countries. *BMC Public Health*, 20(1), 1-14.
80. Akl, E. A., Sackett, K. M., Pretorius, R., Bhoopathi, P. S. S., Mustafa, R., Schünemann, H., & Erdley, W. S. (2008). Educational games for health professionals. *Cochrane Database of Systematic Reviews*, (1).
81. Abraham, O., LeMay, S., Bittner, S., Thakur, T., Stafford, H., & Brown, R. (2020). Investigating serious games that incorporate medication use for patients: systematic literature review. *JMIR Serious Games*, 8(2), e16096.
82. Parisod, H., Pakarinen, A., Axelin, A., Löyttyniemi, E., Smed, J., & Salanterä, S. (2018). Feasibility of mobile health game "Fume" in supporting tobacco-related health literacy among early adolescents: A three-armed cluster randomized design. *International journal of medical informatics*, 113, 26-37.
83. Wols, A., Poppelaars, M., Lichtwarck-Aschoff, A., & Granic, I. (2020). The role of motivation to change and mindsets in a game promoted for mental health. *Entertainment Computing*, 35, 100371.
84. Poppelaars, M., Lichtwarck-Aschoff, A., Kleinjan, M., & Granic, I. (2018). The impact of explicit mental health messages in video games on players' motivation and affect. *Computers in Human Behavior*, 83, 16-23.
85. Begg, M. (2008). Leveraging game-informed healthcare education. *Medical teacher*, 30(2), 155-158.

## Supplementary Files

## **Related publication(s) - for reviewers eyes onlies**

Figure(s) for the manuscript.



Figure 1. Health education game crowdfunding successful model