



Educational Game Design for Raising Awareness of Non-Communicable Diseases Among Late Adolescents Through Midlife Affliction

Diah Mayang Sari, Dwita Alfiani, Dewi Iriani*

Universitas Pendidikan Indonesia, Bandung, Indonesia

*Correspondence: E-mail: diahmayangsari@upi.edu

ABSTRACT

The increasing prevalence of non-communicable diseases (NCDs) among young adults highlights the urgent need for preventive health education. This study presents the design of Midlife Affliction, an educational card game developed to raise awareness among late adolescents (aged 18–25) about unhealthy lifestyle choices and their long-term health consequences. Using an iterative design method—comprising problem identification, prototyping, playtesting, and revision—the game mechanics were refined based on student feedback. The final prototype incorporates strategy-based learning through game elements such as dice, disease cards, and lifestyle actions. A total of 100 university students participated in the initial lifestyle knowledge survey, and four students joined the playtest. Results show that the game effectively engaged players and promoted understanding of NCD risk factors. This study contributes to Sustainable Development Goal 3 (health promotion) and Goal 4 (innovative education), offering a replicable model for using game-based learning to enhance youth health literacy and critical awareness.

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1. INTRODUCTION

Late adolescence, spanning the ages of 18 to 21, is a crucial transitional period from high school to higher education or early employment (Arnett, 2000; Leventhal et al., 2001; Crockett & Beal, 2012; Staff et al., 2010; Sawyer et al., 2018). This stage is marked by significant changes in lifestyle, autonomy, and health-related behaviors. University students, in particular, face increased academic responsibilities and reduced parental oversight, often leading to unhealthy habits such as poor dietary choices, lack of physical activity, and irregular sleep patterns.

The 2018 Basic Health Research (Riskesmas) reported a steady rise in non-communicable disease (NCD) risk factors among Indonesians aged 18 and above (see <https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/1/Laporan%20Riskesmas%202018%20Nasional.pdf>). Similarly, the 2015 Global School-based Student Health Survey highlighted a high prevalence of unhealthy behaviors (including fast food consumption, sugary drinks, smoking, and sedentary habits) among adolescents (Yuningrum et al., 2021). Chronic diseases such as diabetes, cardiovascular disease, and obesity, often associated with older populations, are now emerging earlier due to these patterns (Hacker, 2024).

While global health efforts have emphasized medical interventions, there remains a critical gap in preventive education targeting young people. 63% of global deaths in 2008 were caused by preventable lifestyle-related diseases (see https://iris.who.int/bitstream/handle/10665/94384/9789241506236_eng.pdf). Despite this, youth awareness of such risks remains low, with studies showing poor understanding of disease causes and consequences among students (Fitriani et al., 2024). This highlights the need for accessible, engaging educational interventions that promote proactive health behavior.

One such approach is Game-Based Learning (GBL), which blends cognitive engagement with entertainment. Educational games (particularly card and board games) have been proven effective in enhancing retention and fostering active participation (Arifudin et al., 2022). However, few educational games explicitly address the relationship between adolescent lifestyle choices and long-term health outcomes.

This study introduces Midlife Affliction, a card game designed to simulate the consequences of daily lifestyle decisions on health outcomes in adulthood. By integrating humor, strategy, and factual health content, the game provides a platform for youth to explore cause-and-effect dynamics in a low-stakes, engaging format. As an innovative educational media, this project supports Sustainable Development Goal 3 (Good Health and Well-Being) and SDG 4 (Quality Education) by embedding preventive health knowledge within an interactive learning experience.

The purpose of this study is to design, develop, and evaluate the educational game Midlife Affliction to raise awareness of non-communicable disease risks among late adolescents. Its novelty lies in its strategic card mechanics rooted in real epidemiological data, and its impact contributes to educational innovation in youth-centered health promotion.

2. METHODS

This study employed the Iterative Design Method, which allows for continuous refinement of the game through cycles of prototyping, testing, feedback collection, and revision (see **Figure 1**). While similar to the traditional Waterfall method in its initial stages (needs analysis, design, and implementation), the iterative model prioritizes flexibility and player-centered

development, making it suitable for educational game creation. The process consists of three primary stages:

- (i) Rapid Prototyping. A low-fidelity prototype was developed using accessible materials. This stage emphasized speed and adaptability, enabling multiple design revisions without excessive cost or time investment.
- (ii) Playtesting. A focused game trial was conducted with four players from the target demographic to observe gameplay mechanics, engagement levels, and identify design flaws.
- (iii) Revision. Feedback from the playtest was used to modify game elements, including the balance of healthy vs. unhealthy lifestyle cards, game pacing, and interaction dynamics. These improvements were implemented in the high-fidelity prototype.

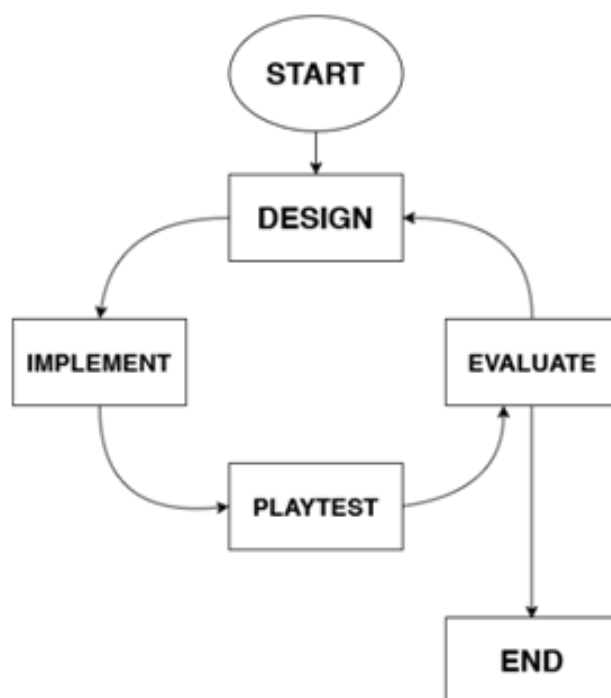


Figure 1. Procedure in this method

This iterative method ensured that the educational intent of the game (conveying NCD risk factors) was effectively embedded within an engaging and pedagogically sound game experience.

Participants were 100 university students enrolled in the Visual Communication Design Study Program, aged 18-22 years (late adolescence). This sample represents more than 10% of the total student population from the 2021–2024 cohort. The students participated in the initial survey to assess their knowledge and habits regarding lifestyle and NCDs. Four students were selected for game testing, representing the intended audience for future implementation.

The study used a structured questionnaire administered via Google Forms. It consisted of:

- (i) 3 demographic questions (age, gender, academic year),
- (ii) 7 lifestyle behavior questions (e.g., frequency of junk food, exercise, sleep),
- (iii) 11 multiple-choice knowledge questions regarding NCDs and their risk factors.

Data were analyzed using descriptive statistical techniques. Response frequencies were calculated and visualized in graphs and diagrams to identify trends in lifestyle behaviors and knowledge gaps related to non-communicable diseases. These insights guided the design of game content and mechanics.

This method prioritizes experiential learning and health education, aligning with SDG 3 (Good Health and Well-Being) by promoting preventive awareness and with SDG 4 (Quality Education) through innovative pedagogy. The game serves as both a formative assessment and a reflective learning tool, integrating health literacy into youth education using playful, strategic engagement.

3. RESULTS AND DISCUSSION

3.1. Baseline Awareness and Lifestyle Trends Among Participants

The initial data collected through the questionnaire revealed significant insights into the health behaviors and knowledge levels of late adolescents, specifically students from the Visual Communication Design Study Program. A total of 100 respondents, representing over 10% of the department's student body from 2021 to 2024, participated in the survey. This sample size is deemed adequate for identifying patterns in health-related behaviors in a university setting.

Descriptive analysis shows that 45.2% of the respondents reported not maintaining a healthy lifestyle, with only 24.7% expressing concern about acquiring chronic diseases related to such habits. This discrepancy highlights a cognitive disconnect between behavior and risk perception among students.

In terms of dietary behavior, 59.2% admitted to consuming junk food more than five times a week, while 23.7% consumed it more than three times a week. Additionally, 32.3% of the respondents stayed up late more than five times a week, and 26.9% did so every day. Moreover, 65.6% of students stated they did not exercise regularly, and 6.6% admitted to smoking.

This pattern of behavior aligns with broader national data (Risesdas, 2018), reinforcing the urgency of health interventions targeting late adolescents. Poor nutritional habits, inadequate physical activity, and insufficient sleep are recognized precursors to non-communicable diseases (NCDs), including diabetes, hypertension, and cardiovascular disorders (Fitriani et al., 2024). Detailed information is on the following web: https://iris.who.int/bitstream/handle/10665/94384/9789241506236_eng.pdf.

In terms of health literacy, the questionnaire also revealed critical gaps in students' knowledge. As shown in **Table 1**, over 80% of respondents were unable to correctly identify the causes of several chronic diseases:

- (i) 86% did not know the cause of fatty liver disease,
- (ii) 80.6% for cardiovascular disease,
- (iii) 82.7% for gastritis,
- (iv) 81.7% for Chronic Obstructive Pulmonary Disease (COPD),
- (v) And nearly half were unaware of the causes of type 2 diabetes and gout.

Table 1. Respondents' Awareness of Disease Causes Related to Lifestyle Risk Factors.

Disease	Percentage Unaware of the Cause
Fatty liver disease	86.0%
Cardiovascular disease	80.6%
Gastritis	82.7%
Chronic Obstructive Pulmonary Disease (COPD)	81.7%
Gout	46.2%
Type 2 diabetes	48.4%

Note: Data were collected from a survey of 100 university students aged 18–22, assessing their knowledge of lifestyle-related causes of chronic non-communicable diseases.

These results indicate that while unhealthy behaviors are widespread, there is a critical lack of awareness about the long-term consequences of these behaviors. This gap underlines the necessity for health education initiatives that are accessible, engaging, and contextualized, particularly for university students in transitional life stages.

The low levels of awareness, combined with the high prevalence of unhealthy behavior, support the need for an educational intervention aligned with Sustainable Development Goal 3 (Good Health and Well-Being). Moreover, by delivering health knowledge through creative and participatory formats like game-based learning, this effort simultaneously supports SDG 4 (Quality Education) by innovating pedagogical delivery.

3.2. Designing the Game Mechanics as an Educational Tool

The initial stage in the design process involved defining the formal elements of the game, following the structure of a Game Design Document (GDD). These elements (referred to as *game atoms*) include the game state, players and avatars, game bits, mechanics, dynamics, goals, and themes (Braithwaite and Schreiber, 2009). These foundational components were outlined to ensure that both the educational and entertainment aspects of the game were purposefully embedded.

The title of the game, *Midlife Affliction*, reflects the game's central theme: the onset of non-communicable diseases (NCDs) in adulthood due to unhealthy behaviors adopted in late adolescence. The core experience aimed to combine humor and strategic learning, allowing players to explore the consequences of lifestyle choices such as poor diet, physical inactivity, and sleep deprivation.

The following elements were defined in the GDD and are summarized in the text and **Table 2**:

- (i) **Game State and Game View:** The game state records virtual information such as player ages, disease progression, and card inventory. The visible portion—the game view—displays this state to all players through the board layout and card arrangements.
- (ii) **Players, Avatars, and Game Bits:** Each player is represented by a colored pawn (**Figure 3**), which moves along the Age Tracking Board from age 25 onwards (**Figure 4**). The game bits include dice (**Figure 2**), lifestyle cards (**Figures 5 and 6**), disease cards (**Figure 7**), and action cards (**Figure 8**), all of which are used to simulate health-related interactions.



Figure 2. Six-sided dice are used to determine aging



Figure 3. Player pawns as avatars

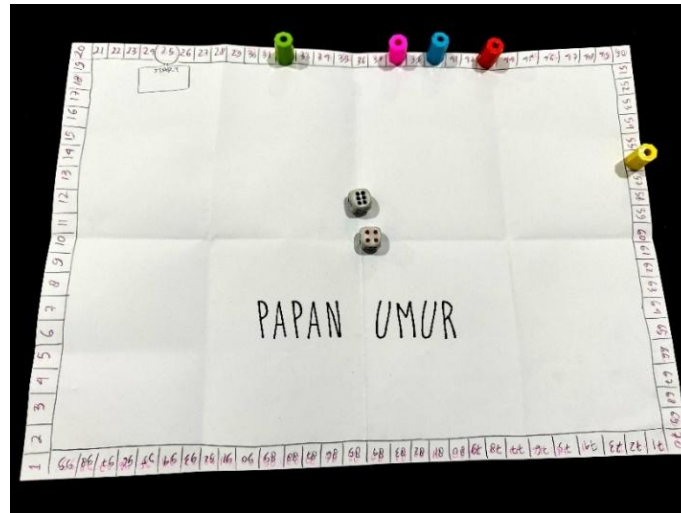


Figure 4. Age Tracking Board with 100 squares



Figure 5. Unhealthy Lifestyle Cards (13 lifestyle types, 46 total cards)



Figure 6. Healthy Lifestyle Cards (10 types, 20 total cards)



Figure 7. Disease Cards (9 diseases with lifestyle-based triggers)



Figure 8. Action Cards with dynamic gameplay effects

Each card type has a specific educational function, as detailed in **Table 2**. There are several important points:

- (i) Unhealthy lifestyle factors represent risk factors for NCDs, such as poor diet, lack of hydration, smoking, or social isolation.
- (ii) Disease cards are activated when a player accumulates a combination of relevant risk factors.
- (iii) Healthy lifestyle cards serve as protective or recovery tools, reinforcing behaviors such as exercise, proper diet, and rest.
- (iv) Action cards add unpredictability and excitement to the game, enhancing player engagement while still reinforcing core health messages.

These mechanics serve a dual purpose: they function as gameplay rules and simultaneously act as educational simulations. Players experience how accumulations of poor choices can lead to disease, and how preventive behaviors can mitigate these risks. This aligns with constructivist educational theory, where learners build knowledge through active experimentation and reflection.

From a pedagogical perspective, this game offers a powerful alternative to traditional health instruction, addressing both cognitive (knowledge) and affective (attitude) learning domains. It also supports SDG 3 by raising awareness of preventable diseases and SDG 4 by integrating health content into an engaging and meaningful learning experience.

Table 2. Types of Cards and Their Functions in the *Midlife Affliction* Game.

Card Type	Function	Examples
Disease Card	- Given to players who collect a specific set of Unhealthy Lifestyle Cards.- Placed face-up in the center for all players to access.- Triggered by disease-specific card combinations.	Depression, Diabetes, Gout, Hypertension, High Cholesterol, GERD, COPD, Kidney Stones, Stroke, Asthma
Unhealthy Lifestyle Card	- When collected in combinations, these can trigger a Disease Card.- Initially distributed to each player.- Represent negative lifestyle behaviors.	Likes sweet food, Fatty food consumption, Staying up late, Rarely exercises, Social isolation, Smoking, etc.
Healthy Lifestyle Card	- Increases player age (i.e., lifespan).- Used as a defense mechanism to delay the onset of disease.	Regular exercise, Low-fat diet, High-fiber intake, Adequate rest, Sufficient hydration, Socializing
Action Card	- Adds variety and dynamism to gameplay.- Can be used to protect, attack, or modify outcomes.	Immunity card, Steal card, Block card, Double disease effect, Age reduction card, Reverse card, Genetic card

Note: Each card type was designed to simulate real-life behaviors and their health consequences in an educational game format aligned with SDG 3 and SDG 4.

3.3. Playtesting and Iterative Improvements

The initial prototype of *Midlife Affliction* underwent a playtesting phase on 29 May 2025, involving four players within the target demographic of late adolescents. The goal of the playtest was to evaluate the balance of game mechanics, assess player engagement, and identify areas for refinement.

Before the session, players were introduced to the rules, game objectives, and evaluation questions, which included:

- (i) Is the age board format appropriate?
- (ii) Should dice be used only at the beginning or during every turn?
- (iii) Can players attack only in one direction (clockwise) or freely?
- (iv) Is the game enjoyable?
- (v) What aspects need to be improved for better balance?

During the playtest, players' feedback was collected through observation and verbal responses. The game was found to be engaging, but participants noted several mechanical and pacing issues. These observations were critical in guiding the revision process.

The feedback and corresponding improvements are summarized in **Table 3**.

Table 3. List of Playtest Feedback and Actions Taken

Feedback	Action Taken
The game duration is too long (over 45 minutes)	Reduced the age board range from 1–100 squares to 18–40, aligning with early adulthood age. Increased the impact of disease cards to accelerate victory or defeat conditions.
Too many healthy lifestyle cards with minimal perceived impact	Reduced the number and effect values of healthy lifestyle cards to increase urgency in strategic use.
Excessive number of unhealthy lifestyle choices	Halved the number of these cards. Introduced a reshuffle mechanic using the discard pile when cards run out.
Predictable gameplay due to fixed turn order	Introduced new action cards (e.g., <i>reverse card</i> , <i>alternative treatment</i> , <i>immunology card</i>) to create variability and dynamic turn sequences.

These iterative adjustments reflect the core strength of the iterative design method, which allows for rapid response to real-time user experience data (see Figures 9-13). Not only were the game mechanics refined for balance, but player feedback also led to more intuitive and contextually relevant gameplay.

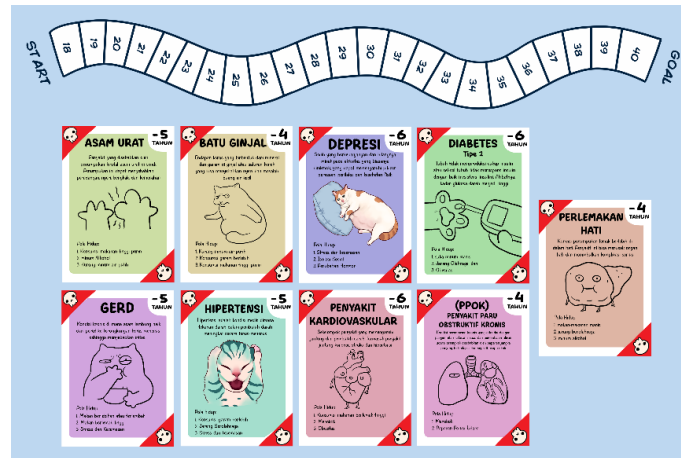


Figure 9. High-Fidelity Age Board (Post-Revision)



Figure 10. High-Fidelity Disease Cards



Figure 11. High-Fidelity Unhealthy Lifestyle Cards



Figure 12. High-Fidelity Healthy Lifestyle Cards



Figure 13. High-Fidelity Action Cards

These high-fidelity prototypes incorporated detailed graphic elements and placeholder visuals representing future visual direction. The improvements ensured that educational messages remained clear and integrated within the gameplay, while also enhancing replayability and enjoyment.

Pedagogically, this iterative process mirrors formative assessment in education, where feedback is used not just to evaluate learning, but to adapt instructional tools. From an SDG perspective, this aligns with SDG 4.7, which advocates for educational content that is transformative, learner-centered, and applicable to sustainable development. Additionally, these revisions ensure that the game can more effectively fulfill its health promotion role, in support of SDG 3.4, which targets the reduction of premature mortality from NCDs through prevention and awareness.

3.4. Educational Value and Impact on Health Literacy

The playtesting session not only informed mechanical improvements but also provided evidence of the game's educational potential. All four participants reported that the game encouraged them to reflect on their lifestyle choices and improved their understanding of the causal relationship between daily habits and long-term health outcomes. This outcome is consistent with the aims of Game-Based Learning (GBL), which integrates cognitive,

emotional, and behavioral engagement in a unified learning experience (Partovi & Razavi, 2019).

During the gameplay, students had to read, understand, and strategically deploy Unhealthy Lifestyle Cards and Disease Cards, thereby activating cognitive processing. For example, to assign a “diabetes” card to an opponent, players needed to recognize that a combination of “frequent sugar consumption” and “lack of exercise” cards could trigger the disease. This process mimics causal reasoning, reinforcing factual learning through repeated application within the game’s decision-making structure.

Furthermore, the presence of Healthy Lifestyle Cards, such as “regular exercise” or “adequate hydration,” encouraged players to think in terms of preventive health strategies. The requirement to balance offensive and defensive tactics (attacking with unhealthy cards, protecting oneself with healthy ones) introduced an element of strategic thinking, a core competency promoted in modern education frameworks.

The game mechanics not only supported factual learning but also stimulated:

- (i) Behavioral reflection: Players admitted re-evaluating their habits after the game.
- (ii) Collaborative learning: Interaction and discussion during gameplay enhanced peer-based knowledge construction.
- (iii) Motivation and engagement: The competitive nature of the game made players eager to read card descriptions and understand their consequences.

These aspects are well aligned with constructivist learning theory and the principle of intrinsic motivation in educational settings. Board and card games promote participatory and contextual learning, two critical dimensions for internalizing abstract health information (Arifudin *et al.*, 2022).

Additionally, the design's use of humor and relatable scenarios (e.g., the “loss of purpose” card or “social isolation” card) further increased engagement, while maintaining the seriousness of the topic. This balance between emotional affect and knowledge acquisition is crucial in health education, particularly for adolescents who may resist traditional didactic methods.

From a sustainable development perspective, this educational impact speaks directly to:

- (i) SDG 3 (Good Health and Well-Being): The game introduces health literacy at an early stage, promoting prevention through awareness.
- (ii) SDG 4 (Quality Education): It serves as an example of educational innovation, where critical life skills are taught using interactive and inclusive pedagogical methods.

Moreover, the game aligns with target 3.4 of SDG 3: “By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.” By creating a safe environment for discussing diseases like diabetes, cardiovascular conditions, and mental health, the game initiates crucial conversations that are often overlooked in conventional curricula.

In essence, *Midlife Affliction* serves as a dual-purpose intervention: it entertains while educating, engages while informing. Its design empowers late adolescents to critically evaluate lifestyle behaviors and fosters health-conscious decision-making—a foundational step toward both individual well-being and broader public health outcomes.

3.5. Cultural and Contextual Relevance

One of the defining strengths of *Midlife Affliction* is its deliberate emphasis on cultural and contextual relevance. Unlike many educational tools developed in Western settings with generalized or abstract content, this game draws directly from the realities faced by Indonesian university students. The card content references lifestyle habits and social

conditions commonly experienced by students in urban campuses, such as frequent fried food consumption, late-night phone use, irregular meals due to academic stress, and limited exercise.

This localization is not merely decorative; it is pedagogically strategic. Research consistently shows that learners engage more deeply with content that reflects their own lives and cultural environments (Kusuma et al., 2022). By embedding relatable scenarios, the game encourages empathy, introspection, and behavior modeling, key elements of effective learning.

For example, the Unhealthy Lifestyle Cards (Figure 5) depict behaviors like “staying up late” or “rarely drinking water”—choices that many players acknowledged during the playtest as part of their routines. When these behaviors were linked to Disease Cards (Figure 7), such as “GERD” or “hypertension,” players demonstrated surprise and curiosity, leading to in-game discussions and knowledge sharing. This form of peer-activated learning further enhances the educational impact beyond what traditional classroom instruction can offer.

Moreover, the game incorporates humor and irony, which are culturally appropriate forms of engagement in many Indonesian learning settings. For instance, the “loss of purpose in life” card elicited laughter during playtesting, yet it opened the door to discuss mental health, a topic that remains stigmatized in many communities. Thus, the game design tactfully navigates serious public health issues through culturally resonant humor, making difficult subjects more accessible and acceptable.

This culturally grounded approach directly supports SDG 4.7, which emphasizes the need for education to promote global citizenship and appreciation of cultural diversity. At the same time, the health behaviors modeled in the game reflect localized manifestations of global health concerns, fulfilling the goal of glocalization in educational media—thinking globally, but teaching locally.

Finally, the visual design of the high-fidelity prototypes (Figures 9–13) reflects an intention to align aesthetics with cultural familiarity. The board layout, icons, and illustrations draw from common visual references in youth media and health campaigns in Indonesia, reinforcing recognition and learning through visual semiotics.

In summary, by situating its content in the lived experience of its players, *Midlife Affliction* maximizes relevance, engagement, and pedagogical effectiveness. It also demonstrates how context-sensitive educational tools can promote sustainable behavior change, an outcome essential to achieving both SDG 3 and SDG 4 in culturally diverse populations.

3.6. Alignment with SDGs and Future Application

The *Midlife Affliction* educational card game is purposefully designed to contribute to two interrelated United Nations Sustainable Development Goals: SDG 3 (Good Health and Well-Being) and SDG 4 (Quality Education). Through its content, structure, and delivery method, the game functions as a health literacy intervention and a pedagogical innovation, addressing both prevention and empowerment.

3.6.1. Contribution to SDG 3: Good Health and Well-Being

The game addresses target 3.4 of SDG 3, which aims to reduce premature mortality from non-communicable diseases (NCDs) through prevention, treatment, and awareness by 2030. By simulating real-life health consequences of poor lifestyle choices, *Midlife Affliction* promotes:

- (i) Early awareness of risk factors such as poor diet, physical inactivity, and substance use,
- (ii) Understanding of disease mechanisms and their behavioral causes,

(iii) Critical thinking about everyday decisions that impact long-term well-being.

This game facilitates a preventive mindset during the formative years of late adolescence—a crucial period for establishing lifelong health patterns.

3.6.2. Contribution to SDG 4: Quality Education

Simultaneously, the game advances target 4.7 of SDG 4 by integrating health, sustainability, and life skills into an inclusive and active learning experience. It supports educational transformation by:

- (i) Offering an interactive, learner-centered tool that departs from didactic instruction,
- (ii) Enhancing critical health literacy, a key 21st-century competence,
- (iii) Encouraging peer learning, social interaction, and discussion-based education,
- (iv) Being replicable, scalable, and adaptable to different learning contexts.

It also has the potential to be embedded in curricula for health education, character education, or co-curricular learning activities, especially in high schools, universities, and community youth programs.

3.6.3. Future Application and Expansion

Moving forward, the *Midlife Affliction* card game can be adapted and extended in several ways:

- (i) Curricular integration: As an educational module in health education or civic education.
- (ii) Wider age range: Adaptation for middle or high school students, or even general community outreach.
- (iii) Digital development: A mobile or web-based version can expand accessibility and engagement, particularly in remote or tech-oriented learning environments.
- (iv) Customization by region: Cards and scenarios can be tailored to reflect the dietary habits, environmental factors, or health challenges of specific populations.

Additionally, the mechanical framework of this game can serve as a template for developing other educational games in different disciplines (such as environmental awareness, reproductive health, or mental health), providing educators with a model that combines fun, relevance, and depth.

In essence, this study not only presents a game, but it introduces a pedagogical model that transforms how we educate youth about health, behavior, and consequence. Its alignment with global development goals ensures that it is not just an academic exercise but a sustainable tool for real-world impact.

3.7. Limitations and Recommendations

While the development and playtesting of *Midlife Affliction* have demonstrated promising educational and health-promotion outcomes, several limitations should be acknowledged in order to inform future research and design improvements. The Identified Limitations are in the following:

- (i) Limited Playtesting Scope. The game underwent only one playtesting session with four participants. Although the feedback provided valuable design insights, the small sample size limits the generalizability of the results.
- (ii) Short-Term Evaluation Only. The study did not assess long-term knowledge retention or behavioral change post-gameplay. Therefore, while immediate engagement and reflection were observed, the lasting educational impact remains to be tested.
- (iii) Lack of Visual Finalization. Although high-fidelity prototypes (Figures 9–13) were developed, the visual design of the final product (including illustration style, typography,

and packaging) was not yet complete during this study. This may influence the perception of professionalism and aesthetic appeal in future educational use.

- (iv) Manual Format Only As a physical, analog game, it may face limitations in scalability, especially for distance learning environments or schools with limited access to printing and materials.

Recommendations for Future Research and Development are in the following:

- (i) Multiple Playtesting Sessions. Conducting iterative playtests with larger and more diverse samples, including students from different educational programs, age ranges, and regions, would provide a richer understanding of the game's effectiveness and adaptability.
- (ii) Pre- and Post-Testing Design. Future studies should implement quantitative measures of health knowledge, attitude shifts, and behavioral intentions before and after gameplay to capture the educational efficacy of the tool.
- (iii) Integration into Formal Education. Collaborating with educators to pilot the game in health, biology, or civic education classes can provide real-world insights on classroom feasibility and curriculum alignment.
- (iv) Development of Digital Versions. A mobile or online version of *Midlife Affliction* could significantly broaden its accessibility, particularly in the context of online or hybrid learning. This would also allow for automated tracking of learning metrics and engagement patterns.
- (v) Localization and Thematic Expansion. The mechanical framework can be adapted to cover other themes such as mental health, reproductive health, environmental sustainability, or financial literacy, with the same educational approach.

By recognizing its current limitations and leveraging its strengths, *Midlife Affliction* has the potential to evolve into a nationally scalable educational innovation that bridges the gap between health knowledge and behavioral awareness. Its foundation in experiential learning and alignment with SDG 3 and SDG 4 ensures that future developments can contribute meaningfully to sustainable education and public health outcomes.

4. CONCLUSION

The design and development of *Midlife Affliction*, an educational card game aimed at increasing awareness of non-communicable disease (NCD) risks among late adolescents, has successfully demonstrated the potential of game-based learning to promote health literacy. Using an iterative design method, the game evolved through cycles of prototyping, playtesting, and revision, guided by real student feedback and anchored in epidemiological and behavioral data.

The results indicate that the game not only engaged players through strategy, humor, and interaction but also effectively conveyed the consequences of lifestyle decisions on long-term health. The integration of disease triggers, preventive behaviors, and competitive dynamics made the learning process immersive and impactful. Moreover, its strong cultural and contextual grounding enhanced relevance and learner motivation.

Theoretically, this study contributes to the growing field of educational game design and demonstrates how experiential learning can be applied in health education. Practically, it offers a replicable model that can be implemented in schools, universities, and health campaigns to address the increasing prevalence of NCDs.

Aligned with Sustainable Development Goal 3, the game supports public health objectives by promoting early prevention and awareness of modifiable risk factors. Concurrently, it advances SDG 4 by serving as an inclusive, engaging, and learner-centered pedagogical innovation.

Recommendations include further development of the game's visual components, repeated playtesting with broader participant groups, and the creation of a digital version for wider access. Educators and institutions are encouraged to adopt or adapt the game as part of health promotion strategies, while researchers may explore its application across other themes such as mental health, environmental sustainability, and financial behavior.

In conclusion, *Midlife Affliction* illustrates that serious topics like chronic illness prevention can be taught through fun and meaningful interactions. By empowering youth to understand the link between daily choices and long-term health outcomes, the game becomes more than a tool—it becomes a catalyst for sustainable, transformative education.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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