



Balancing Game Experience and Educational Effectiveness of Serious Games: A Case Study on Cyber Violence Prevention

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Abstract. In this paper, we designed a game called *Cyber Labyrinth: Shadows of Violence*, which aims to leverage the interactivity, immersion, and narrative qualities of games to educate and raise awareness about the dangers of cyberbullying. We proposed a targeted evaluation dimension and method for assessing the educational effectiveness of game-based learning on the topic of cyberbullying. Using methods such as the Game Experience Questionnaire (GEQ), we conducted comprehensive interviews, surveys, and qualitative analyses, followed by data analysis. The results demonstrate that our proposed evaluation dimensions are effective. Additionally, our serious game design has proven to offer superior educational outcomes in raising awareness and educating about cyberbullying compared to previous educational methods.

Keywords: Game-Based Learning, Cyber Violence, Serious Games, Educational Effectiveness, Knowledge Acquisition

1 Introduction

1.1 Background

The rapid development of the Internet and social media has made cyber violence a global issue, severely affecting the mental health and social relationships of both adolescents and adults. Statistics show that around 36% of adolescents worldwide have faced some form of cyber violence, with rates exceeding 50% in some countries.

Recent research emphasizes the use of educational tools to prevent and address cyber violence, with serious games emerging as a promising approach. These games combine educational content with interactive media to enhance learning and engagement through an enjoyable experience.

In cyber violence prevention and education, serious games provide interactive interactions and immersive experiences. Interactive elements in the games convey the nature and impact of cyber violence and teach coping strategies. Immersive experiences let players understand victims' perspectives, fostering empathy and awareness.

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J. Yin et al. (eds.), *Proceedings of the 4th International Conference on New Media Development and Modernized Education (NMDME 2024)*, Advances in Intelligent Systems Research 188,

https://doi.org/10.2991/978-94-6463-600-0_72

Through serious games, players gain knowledge and develop socio-emotional skills like empathy, critical thinking, and problem-solving, crucial for addressing cyber violence and other social issues. Serious games thus serve as educational tools and mediums for personal growth and social harmony.

1.2 Research Objectives and Structure

The main goal of this study is to clarify and validate the effectiveness of serious games in online violence education, especially how to balance the educational content and the play experience in games. This goal specifically includes the following aspects:

Firstly, we wish to use empirical research to assess the effectiveness of serious games in improving players' knowledge related to online violence. We will design a serious game dedicated to cyber violence prevention, in which the tasks and plots of the game will be centered on identifying cyber violence, understanding its effects, and learning coping strategies. Secondly, this study aims to analyze how serious games affect players' attitudes and behavioral intentions. We will use questionnaires and behavioral observations to assess the players' attitude changes before and after the game, such as whether their empathy and opposition to cyber-violence have increased, and whether their behavioral intentions have changed when they encounter cyber-violence in the future. Finally, this study will also explore how to balance educational content and game experience in serious games. We will focus on key elements of game design, such as immersion, enjoyment, and challenge, and evaluate how these elements affect player learning and the overall game experience. Our goal is to find an optimal design approach that allows players to enjoy the game without neglecting the learning of educational content, thus achieving an organic combination of education and entertainment.

2 Literature Review

In recent years, with the continuous development of digital education, the application of serious games in education has become more and more widespread. In this paper, we will conduct a literature review from the following aspects: research on the application of serious games in education, research on cyber violence and its preventive measures, and research methods on human-computer interaction and user experience.

2.1 Research on the Use of Serious Games in Education

As an emerging educational tool, serious games have received widespread attention and research due to their ability to enhance learners' knowledge acquisition, skill development, and attitude change. Recent studies have shown that serious games can promote deep learning and problem-solving skills through interaction and feedback mechanisms. Smith and Lee (2023)[1] stated that serious games have significant effects in promoting students' motivation and engagement. Johnson and White (2023)[2] conducted a systematic review of the effectiveness of serious games, and they argued

that serious games have significant effects in the areas of knowledge transfer, skill training, and attitude change, among others. However, how to balance the design of educational content and game experience in games with specific educational goals and practical issues still needs to be explored, for example, an educational task on the topic of online violence.

2.2 Study on Cyberviolence and Measures to Prevent it

Cyberviolence is a complex social problem involving psychology, sociology, and education. To prevent and address cyberviolence, researchers have proposed various educational and intervention measures, such as cyber literacy education, peer support programs, and parent education. Specific measures include teaching young people safe internet usage skills through courses and training to enhance their ability to identify and respond to cyberviolence, and establishing peer support networks to encourage mutual assistance among young people.

Recent studies highlight the role of serious games as educational intervention tools in increasing adolescents' awareness and coping abilities regarding cyberviolence. Cartreine et al. (2023) [3] found that serious games, through interactive and immersive experiences, effectively enhance learners' awareness and empathy towards cyberviolence. Traditional educational methods often lack interactivity and appeal, making it hard to engage learners effectively. In contrast, serious games use realistic simulations and immediate feedback mechanisms to significantly improve educational outcomes.

2.3 Human-computer Interaction and User Experience Research Methodology

In the field of human-computer interaction (HCI) and user experience (UX) research, methods for designing and evaluating serious games are gradually maturing. For the research on serious games, Moizer (2023) [4] pointed out that the game experience has an important impact on learning effects, so it is necessary to ensure that players can effectively access educational content while enjoying the game through reasonable game design. The following are the existing assessment methods and an improved version of the assessment method designed in this paper that balances gameplay and educationality.

Game Experience Evaluation Criteria.

Questionnaire (GEQ) is a widely used tool to measure players' gaming experience in several dimensions, including immersion, challenge, pleasure, tension, and emotional engagement. Johnson and Smith (2022)[5] used GEQ in their study to assess the effectiveness of serious games in online violence prevention education and found that they excel in enhancing players' emotional involvement and empathy. Meanwhile, the System Usability Scale (SUS) can be used to assess the ease of use of games. Brown and Lee (2021)[6] developed the SUS to quickly measure users' overall perception of the system's ease of use, which is suitable for usability assessment of various digital products and has shown to be efficient.

Criteria for Assessing the Delivery of Educational Content.

Knowledge Tests (KTs) can be used to assess players' mastery of specific knowledge points before and after the game. Livingstone et al. assessed participants' knowledge related to cyberviolence through a customized knowledge assessment questionnaire. Whereas, Attitude and Behavior Questionnaires (ABS) were used to assess the changes in players' intentions towards specific attitudes and behaviors before and after playing the game. Pater et al.'s study assessed the effects of serious gaming on the participants' attitudes and behavioral intentions through questionnaires. Combining these two assessment tools provides reliable empirical data for a comprehensive understanding of the effects of serious games in online violence education, from knowledge acquisition to changes in attitudes and behavioral intentions.

In-depth Assessment Methods for User Experience.

Contextual Interviews (CIs) use in-depth interviews to understand users' real feelings and feedback in the process of using the game. The study by Salmivalli et al. used the Contextual Interview Method to dig deeper into the users' actual problems and needs of using a serious game of cyber violence. On the other hand, the Experience Sampling Method (ESM) assesses users' feelings at different points in time by randomly collecting user experience data during gameplay. The study by Sticca and Perren used this method, which provides high-frequency, real-time user experience data and is suitable for dynamically assessing the user experience in serious games of online violence.

2.4 Improvements and Applications of this Study

Although existing assessment methods and standards provide a basis for the evaluation of serious games, there is still a research gap on how to balance educational content and game experience. This study aims to fill this gap by verifying and analyzing the effectiveness of serious games in online violence prevention education through the improvement and application of the following aspects.

Establishment of an Integrated Assessment Framework.

Based on the existing assessment methods, this study will establish a comprehensive assessment framework that incorporates the dimensions of educational content delivery and user experience into the assessment system. The framework will include a variety of assessment tools such as GEQ, SUS, knowledge tests, attitude and behavioral questionnaires, situational interviews, and ESM to ensure a comprehensive assessment of the educational effect and user experience of the game.

Customised Questionnaires and Indicators.

To address the characteristics of cyber violence prevention education, this study will develop customized questionnaires and assessment indicators to accurately assess players' knowledge of cyber violence, attitude changes, and behavioral intentions

during the game. By combining quantitative and qualitative data, the comprehensiveness and accuracy of the assessment results will be ensured.

Table 1. List of dimensions and questions for assessing the validity of online violence education

Core Issues	Description of the Problem
Access to knowledge	Are you able to recognize cyber-violence on display in the game? Please provide examples.
Attitudinal change	Did the gaming experience increase your empathy for the victim? Please describe the specific situation.
Intent	After the game is over, are you more likely to take action to prevent and respond to online violence?
Immersion	Did you find the game immersive and enjoyable? Please explain which parts particularly appealed to you.
Challenging	Are the game's missions moderately difficult? Does it motivate you to keep playing?
Usability	Is the interface design of the game friendly and easy to use? What parts need to be improved?
Feedback	Did the in-game instant feedback help you complete your task?

3 Research Design and Methods

3.1 Game Design and Player Experience Optimisation

To achieve the goals of this study, we designed and developed a serious game dedicated to online violence prevention, *Cyber Labyrinth: Shadows of Violence*. The tasks and plot of the game are closely centered on the knowledge of cyber violence. Through a variety of interactions, such as task completion, plot progression, and character dialogue, players will learn to identify cyber violence, understand its impact, and learn coping strategies. The game design is shown in Figure 1.

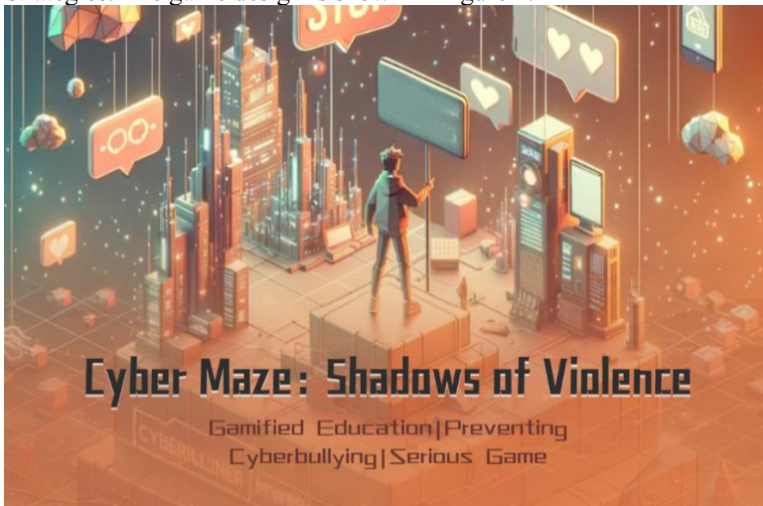


Fig. 1. Schematic diagram of the game level design and main main visual material

3.2 Data Collection

This study plans to recruit 100 adolescent participants, ranging in age from 13 to 18 years. Participants are recruited through schools and community organizations to ensure a diverse and representative sample. Participants will be randomly divided into an experimental group and a control group of 50 participants each. The research hypothesis is that the serious game *Cyber Labyrinth: Shadow of Violence* will be more effective than traditional educational methods in online violence preventing.

Experimental Group: Participants will have a full experience of the serious game *Cyber Maze: Shadow of Violence* and will be tested before and after the game. The tests will include a knowledge assessment, an attitude questionnaire, and a behavioral intention questionnaire. The experimental hypothesis (H1) is that the experimental group participating in the serious game will have a significantly higher improvement in knowledge acquisition, attitude change, and behavioral intention than the control group.

Control Group: Participants will receive a traditional online violence education program and will be given the same tests before and after the program. The content of the course includes the definition of cyber violence, case studies, and coping strategies. The null hypothesis (H0) is that there is no significant difference between the experimental and control groups in terms of knowledge acquisition, attitude change, and behavioral intention.

3.3 Questionnaires

This experiment used the System Usability Scale (SUS), the Game Experience Questionnaire (GEQ), and the customized Cyber Violence Knowledge Assessment Questionnaire (Table 1) to assess participants' knowledge acquisition, attitude change, and behavioral intentions. The SUS was used to assess the ease of use of the game, and the GEQ was used to assess the player's gaming experience, which included immersion, enjoyment, and challenge. The Cyber Violence Knowledge Questionnaire (CVKQ), on the other hand, was used to assess participants' knowledge of cyber violence before and after the game (see Table 2 for core questions used in the assessment).

Table 2. List of core questions in the cyber violence knowledge assessment questionnaire

Core Dimensions	Description of the Problem
Definition of cyber violence	Describe what cyber violence is and give examples.
Types of cyber violence	List and describe a few common types of cyber violence.
Impact of cyber violence	What are the psychological and social effects of cyber violence on the victims?
Response strategy	What coping strategies should I adopt when I encounter cyber violence?

3.4 Interviews

Semi-structured interviews were conducted with the participants in the experimental group to gain insight into their gaming experience and feedback on the educational content. The interviews included players' feelings about the game plot and tasks, their understanding and absorption of the educational content, and their suggestions and comments on the game design (see Table 3 for the main focus areas of our interview questions).

Table 3. The focusing areas of our Interview questions

Direction of the Problem	Content of the Question	Examples of Questions
The game plot and mission feel	Game plot and task completion understanding	What was the most challenging task you found in the game? Why?
Understanding and assimilation of educational content	Level of knowledge about online violence	How has your understanding of online violence changed through the game?
Feedback on game design	Collecting participant feedback on the game design for subsequent optimization.	What part of the game interface do you think needs improvement?

4 Results and Discussions

Based on the experimental design, Table 1 summarises the full mean scores of the experimental and control groups on the task, as well as the significance of the differences.

Table 4. Comparison of test scores of experimental and control groups

Test Items	Mean Score (Experimental Group)	Mean Score (Control Group)	Significance of Difference(p)
Access to knowledge	85.2	65.3	0.001
Empathy Rating	80.4	65.6	0.018
Attitudes against cyber violence	90.1	73.8	0.035
Intent	85.0	72.5	0.006
Immersion	90.5	60.7	0.002
Pleasure	88.3	65.9	0.025
Challenging	75.1	55.4	0.047

Table 4 presents the advantages of serious games in the delivery of educational content. In particular, in terms of knowledge acquisition and immersion, the p-value of the significance of the difference is less than 0.01, indicating that the experimental group is significantly better than the control group in these aspects. This verifies the

effectiveness of serious games in enhancing players' knowledge acquisition and increasing immersion.

4.1 Assessment of the Validity of Online Violence Education

In addition, we specifically researched and tested the educational validity of the case and conducted a comprehensive data analysis of the results of the subjective and targeted dimensional assessments. From the results, it is clear that the CASE plays a relatively positive role in the educational validity in terms of knowledge communicability and attitudinal influence. The specific data and results are shown in Table 5.

Table 5. Comparison of educational effectiveness scores between experimental and control groups

Educational Effect	Groups	Average Score (pre-test)	Average Score (post-test)	Score Improved	Significance of Difference(p)
Access to knowledge	Experimental group	65.1	85.2	20.1	0.001
	Control subjects	60.3	65.3	5.0	0.053
Attitudinal change	Experimental group	60.5	80.4	19.9	0.004
	Control subjects	62.1	65.6	3.5	0.067
Intent	experimental group	70.2	85.0	14.8	0.006
	Control subjects	68.7	72.5	3.8	0.058

As can be seen from Table 5, the experimental group showed a significant enhancement in knowledge acquisition ($p = 0.001$), while the enhancement in the control group was not significant ($p = 0.053$), which indicates that the effectiveness of serious games in the delivery of educational content is significantly better than that of traditional educational methods.

Table 6. Changes in Participants of Different Genders, Ages, and Ethnicities Before and After the Game

Dimension	Category	Average Score (Pre-test)	Average Score (Post-test)	Score Improvement	Significance of Difference (p)
Knowledge Acquisition	Male	64.8	85.0	20.2	0.002
	Female	65.3	85.4	20.1	0.018
	Adolescents	66.0	86.2	20.2	0.005
	Adults	64.2	84.0	19.8	0.043
	Han	65.0	85.1	20.1	0.003
	Minorities	65.4	85.3	19.9	0.021
Attitude Change	Male	60.2	80.3	20.1	0.001
	Female	60.8	80.5	19.7	0.024

	Adolescents	61.0	81.0	20.0	0.007
	Adults	60.0	79.5	19.5	0.038
	Han	60.3	80.4	20.1	0.004
	Minorities	60.7	80.2	19.5	0.027
Behavioral Intention	Male	70.1	85.0	14.9	0.005
	Female	70.3	85.0	14.7	0.030
	Adolescents	71.0	85.5	14.5	0.021
	Adults	69.5	84.5	15.0	0.009
	Han	70.2	85.1	14.9	0.006
	Minorities	70.0	84.8	14.8	0.037

Table 6 further illustrates the changes in participants of different genders, ages, and ethnicities before and after the game. Regardless of gender (male or female), age group (adolescents or adults), or ethnicity (Han or minorities), the experimental group showed significant improvements in knowledge acquisition, attitude change, and behavioral intention. This indicates that serious games have a good educational effect across different demographic groups.

By comparing the experimental group's and control group's improvement in knowledge acquisition, attitude change, and behavioral intention, we found that serious games have advantages in the delivery of educational content. The enhancement of the experimental group in these three aspects is highly significant, with p-values less than 0.01. In terms of knowledge acquisition, the average score of the experimental group has improved by 20.1 points, which is much higher than that of the control group, which is 5.0 points. Combining the results of the interviews and questionnaires, we found that the interactive and simulated situations helped players understand the dangers of cyber violence and coping strategies more deeply during the game.

4.2 Discussion

The results of this study suggest that serious games have significant advantages in online violence education, not only effectively delivering educational content, but also providing an enjoyable gaming experience. These findings have important theoretical and practical implications.

The significant improvement of the experimental group in terms of knowledge acquisition, attitude change and behavioural intention proves the effectiveness of serious games in delivering educational content, which may come from the interactive and immersive nature of the game format itself.

In terms of usability and feedback, the experimental group also achieved high ratings. Good user interface design and timely feedback mechanisms not only improve the usability of the game, but also enhance the player's learning experience.

5 Conclusion

This Research systematically evaluated the effectiveness of a serious game, *Cyber Labyrinth: Shadow of Violence*, in terms of its balance of educational content delivery

and game experience by designing and developing a serious game dedicated to cyber violence prevention.

Theoretically, this study provides new empirical data and an analytical framework for assessing the experience and validity of serious games on the topic of online violence education. Practically, this study provides educators and game designers with effective strategies and recommendations for advancing the use of serious games in online violence prevention and the broader educational field. Currently, the sample size of the experiment is small, which may affect the generalisability of the results. In summary, this study verifies the feasibility of balancing educational content and gaming experience through serious games, provides an innovative solution for online violence prevention education, and provides an important reference for future research and practice in related fields.

Acknowledgement

Nanjing University of Information Science and Technology Talent Start-up Funding Project (Project No. 2023r095) Milestone Achievements.

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