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A CBT-Based Serious Game on Social Anxiety: Narrative Design and Validation

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Abstract

Aim: The aim of this study was to design and validate a serious game-based cognitive behavioral therapy (CBT) for adolescent girls with social anxiety, using a structured scenario-writing protocol based on Hoffman's Social Self-Appraisal Therapy Model.

Method: The research employed a multi-phase approach encompassing scenario preparation, expert evaluation, face validity testing, usability assessment, and pilot implementation. Content validity was evaluated by ten psychologists and counselors utilizing the Content Validity Index (CVI) and Content Validity Ratio (CVR) metrics. Face validity was assessed utilizing the Story World Absorption Scale (SWAS) with a cohort of 10 adolescent participants. A pilot study including an additional cohort of 10 adolescents evaluated alterations in social anxiety utilizing the Liebowitz Social Anxiety Scale for Children and Adolescents (LSAS-CA). Usability and player experience were examined through the MEEGA+ instrument.

Results: The results demonstrated strong validity and efficacy of the serious game. Content validity was confirmed (overall CVI > 0.79, CVR > 0.62), along with robust face validity - evidenced by attention and transportation scores exceeding 0.81 (Kappa coefficients = 0.85, 0.81) and emotional engagement and mental imagery scores above 0.61 (Kappa coefficients = 0.78, 0.72). Additionally, a significant T-test result ($t(9) = 16.74$, $p < 0.025$) further supported these findings. Based on the MEEGA+ evaluation, the game was classified as 'good quality,' with θ scores ranging from 57.5 to 63.5 across usability and player experience subscales

Conclusion: The results revealed that the CBT-based serious game is both experientially effective and clinically promising. For adolescents with social anxiety, it provides a scalable and entertaining intervention tool, especially in situations where access to conventional therapy is restricted.

Keywords: Cognitive behavioral therapy, Adolescents, Usability, Narrative engagement, Counselor.

Keypoints

- A serious game grounded in Hofmann's CBT model was successfully designed and validated to reduce social anxiety in adolescent girls.
- The game demonstrated high usability, strong narrative engagement, and a significant reduction in social anxiety symptoms in the pilot study.
- The study supports the feasibility of implementing therapeutic games in school or digital settings as accessible, user-friendly mental health interventions for adolescents.

Introduction

Adolescence is a developmental period marked by accelerated biological, psychological, and social changes that have a profound influence on identity, emotional regulation, and interpersonal relationships (Sawyer et al., 2018). In adolescent girls, this period is typically accompanied by greater emotional sensitivity and susceptibility to internalizing disorders such as depression and anxiety, partly as a result of sociocultural pressures and gendered expectations (Salk et al., 2017). Social anxiety disorder (SAD) remains a prevalent mental health challenge among adolescents, with recent studies highlighting its increasing prevalence due to post-pandemic social re-adjustment pressures and digital communication dynamics. Salari et al. (2024) study has estimated that social anxiety disorder affects 8.3% of adolescents, while the WHO (2024) estimates that 5.5% of 15–19-year-olds experience an anxiety disorder. Higher rates are observed in urban environments, as the prevalence of anxiety amongst urban children and adolescents increased during the pandemic, whereas the prevalence of anxiety amongst rural children and adolescents remained stable (Nguyen et al., 2024). Neurodevelopmental studies suggest that the prefrontal cortex contributes to fear conditioning and anxiety symptoms, and this system appears to be interrupted among adolescents with anxiety disorders (Xie et al., 2021). Social anxiety during adolescence is of particular concern as it coincides with significant developmental tasks such as identity formation, peer acceptance, and academic performance (Erath et al., 2007) and affects a significant proportion of adolescents, disabling their academic performance, peer relationships, and emotional well-being (Beesdo et al., 2009). Longitudinal examining the relationship between depression and anxiety symptoms around age 13 years (Konac et al., 2021). While specific risk multipliers vary across studiey, research consistently shows that untreated social anxiety significantly increases the risk of developing comorbid depression in adolescents (Ernst et al., 2023). Therefore, there is an urgent need to develop accessible, evidence-based treatments - such as serious games- that are able to deliver cognitive behavioral therapy (CBT) in a way that is both enjoyable and developmentally appropriate.

Social anxiety disorder (SAD) is characterized as a fear of social or performance situations wherein the individual is exposed to possible scrutiny by others. This leads to extreme distress or impairment in social, occupational, or other areas of significant functioning (American Psychiatric Association, 2013). Research indicates that SAD usually begins in adolescence, with approximately 80% of cases starting before the age

of 18 (Otto et al., 2000). Notably, females are more vulnerable than males, perhaps due to interacting biological, psychological, and sociocultural factors (McLean et al., 2011). Hofmann & Otto (2008) address cognitive processes involved in its maintenance, and suggest CBT as an effective treatment modality. In particular, Social Self-Reappraisal Therapy (SSRT) seeks to alter individuals' perceptions of social norms and their competence in a bid to reduce the fear of negative evaluation (Hofmann & Scepkowski, 2006). This therapy has shown potential in preliminary research, with evidence of its efficacy in SAD treatment. However, access to standard therapy remains limited due to social stigma, cost, and shortages of experienced practitioners.

Serious games offer an innovative platform to address this gap, especially in adolescents who are receptive to interactive, digital media. Among the difficulties in developing such games is the alignment of therapeutic principles with emotionally engaging and developmentally appropriate narratives. To address this, we developed and piloted a systematic writing protocol for developing CBT-based scenarios within a serious game targeting social anxiety in adolescent girls.

Serious games have also been increasingly utilized for the treatment of social anxiety in adolescents, frequently offering appealing interactive formats with which this age group's digital engagement identifies. Such instances as Fractured Minds, providing players with an immersive window into the challenges of mental illness, and Sea of Solitude, communicating the challenges of loneliness and social isolation through emotionally guided narratives are notable (Green, 2020; Mitchell, 2019). While these games promote empathy and awareness, they do not ordinarily incorporate formal therapeutic protocols derived from evidence-based treatments such as cognitive behavioral therapy. Moreover, their design is not ordinarily intended for targeted intervention for social anxiety in adolescents.

By comparison, the serious game developed in the current study incorporates a writing protocol that is specifically based on CBT principles for addressing social anxiety in adolescent girls. Unlike commercially available games, this intervention incorporates the formal modules of CBT components - i.e., cognitive restructuring, Socratic questioning, and exposure hierarchies - within narrative gameplay. By simulating real-life social challenges (in the school environment) and offering player agency in managing them, the game fosters both emotional engagement and therapeutic learning. The inclusion of a skill tree, reflective journaling, and guidance from a psychologist guide character further distinguishes this game by enhancing both interactivity and clinical fidelity. This targeted and developmentally tailored approach presents a new and scalable instrument for the treatment of adolescents with social anxiety. As such, the current study seeks to create and validate a serious game based on the cognitive behavior therapy.

Theoretical Background

Cognitive Behavior Therapy and Game-Based Learning

Social Self-Reappraisal Therapy (SSRT) is a structured cognitive behavioral intervention specifically designed to target core maintaining factors of SAD, such as distorted self-beliefs and cognitive biases that exacerbate social fear and avoidance. Central to SSRT is the modification of unrealistic high social standards - rigid personal expectations like the need to be flawless or never to make mistakes in social interactions - which have been

empirically linked to negative self-evaluation and heightened social anxiety symptoms (Alden & Wallace, 1995; Wallace & Alden, 1995). Individuals with SAD often overestimate the likelihood and severity of negative social outcomes, a cognitive distortion that fuels anticipatory anxiety and avoidance behaviors (Hofmann & Otto, 2017; Sluis et al., 2017). SSRT addresses these distortions by facilitating realistic goal setting and social standards clarification prior to exposure tasks, enabling clients to evaluate social encounters based on goal attainment rather than subjective anxiety levels, thereby reducing maladaptive self-criticism and enhancing self-efficacy (Hofmann & Otto, 2017). Another critical component of SSRT is the focus on emotion regulation and perceived emotional control in anxiety-provoking social situations. By cultivating adaptive emotion regulation strategies, SSRT helps individuals reduce anticipatory processing - whereby socially anxious individuals expect catastrophic social outcomes and engage in excessive self-focused attention prior to social events, maintaining fear responses even before the interaction occurs (Sluis et al., 2017). SSRT employs experiential exercises and in vivo exposures to directly challenge negative self-views and feared outcomes, providing corrective emotional experiences that foster cognitive restructuring and reduce avoidance behaviors. Importantly, SSRT encourages a shift from an internal, self-focused attentional style to an external, objective focus during social interactions, which has been shown to diminish social threat appraisals and improve social functioning (Alden & Wallace, 1995; Hofmann & Otto, 2017).

Serious games offer a promising platform to extend SSRT principles by creating immersive, interactive environments where individuals with social anxiety can safely rehearse challenging social situations such as public speaking, initiating conversations, or maintaining eye contact. These virtual settings provide emotional safety and controlled exposure, reducing perceived threat levels and encouraging experimentation with new behaviors that might otherwise be avoided in real life (Fleming et al., 2017; Granic et al., 2014) The engaging nature of serious games facilitates experiential learning, allowing users to internalize cognitive behavioral strategies through repeated practice and immediate feedback, which enhances skill acquisition and behavioral change (Connolly et al., 2012; Fleming et al., 2017). Moreover, integrating CBT components such as cognitive restructuring and graded exposure hierarchies into gameplay can rescript maladaptive social responses, making serious games a viable adjunct or alternative to traditional therapy for SAD (Hofmann & Otto, 2017; Fleming et al., 2017).

Recent empirical evidence supports the efficacy of game-based interventions and Virtual Reality Exposure Therapy (VRET) for social anxiety and related conditions. For example, randomized controlled trials have demonstrated that gamified VRET can significantly reduce public speaking anxiety among adolescents, with effects comparable to or exceeding those of traditional psychoeducation and exposure programs (Lindner et al., 2021). Serious games have also been shown to produce meaningful reductions in anxiety symptoms by engaging users in challenging while still safe learning experiences that promote emotional and behavioral adaptation (Dewhirst et al., 2022; Gómez-León, 2025). These findings underscore the potential of combining SSRT's cognitive behavioral framework with serious game technology to enhance treatment accessibility, engagement, and effectiveness in SAD.

Narrative Design in Serious Games

Game stories are therapeutic delivery vehicles, incorporating psychological principles into engaging narratives. For adolescents, a robust narrative structure promotes emotional involvement and internalization of therapeutic principles (Baranowski et al., 2008). Accordingly, the writing protocol of this study integrates CBT steps into role-plays, conversations, and reflective activities to maximize therapeutic transfer.

Narrative Design in Serious Games is the conscious structuring of narrative elements-such as character, dialogue, plot progression, and emotional arcs (the emotional evolution or development that a character experiences throughout time) to support the learning, therapeutic, or behavioral goals of the game. In the example of the CBT-based serious game developed for adolescent girls with social anxiety, narrative design is central to the translation of psychological theory into emotionally engaging and relatable experience. Each scenario within the game is specially scripted to simulate common anxiety-provoking situations (i.e., introducing oneself to a group, answering a question in class, being the captain of a school project), which are embedded in a larger story world guided by a reliable in-game counselor (Baranowski et al., 2008).

This narrative framework mirrors the structure of cognitive behavioral therapy. For example, the narrative progression from fear to incremental exposure is congruent with the therapeutic goal of reducing avoidance and restructuring maladaptive beliefs (Hofmann & Otto, 2017).

Interactive dialogue choices allow the player to experiment with different thoughts and behavioral responses, thereby enhancing cognitive flexibility via narrative-driven decisions (Marsh, 2011).

In enabling players to assume the character of a relatable hero and observe the outcomes of a range of emotional and cognitive approaches, the narrative serves as a platform for experiential learning, emotional normalization, and behavior change (Granic et al., 2014). Therefore, narrative design in this game bears a direct connection to its therapeutic efficacy.

Methods: Writing Protocol for CBT-Based Game Scenarios

Game Structure and Therapeutic Components

The game comprises 62 scenarios, beginning with avatar selection and then the player going to a group counseling session. The counselor guides the player through psychoeducational content on social anxiety, followed by an in-game administration of the Approach to Social Situation Scale (ASSS). The activation of the respective therapeutic game module is determined by the player's highest scores on various subscales that measure high social standards, negative self-perception, high estimated probability and cost of negative outcomes, low perceived emotional control, anticipation of social adversity and threats, and poor social skills. Upon activation, the intervention starts with cognitive restructuring in group counseling, using Socratic questioning in two distinct cognitive scenarios. After guiding the participant through a school environment simulation that elicits the maladaptive thought, the counselor initiates another cognitive scenario. Following this, the player conducts graded exposure tasks, including easy,

medium, and difficult levels. These tasks entail avoidance and safety behaviors, all graded in terms of difficulty. This is followed by a review session between the counselor and player where task performance and rumination after the game are discussed, along with a cognitive reinforcement exercise. Each subscale has 10 unique scenarios. Upon completion of a scenario, the player receives a Courage Medal and homework. Successful completion of all the scenarios in a subscale unlocks the game module for the next highest-scoring subscale. After completing all the stages, a Mastery Celebration is conducted to reinforce the player's success. Therefore, the game process has six main steps that parallel the therapeutic order of CBT:

Stage 1: Entry and Initial Assessment

- Players customize an avatar and complete a personalized anxiety scale.
- Baseline negative thoughts and beliefs are documented.
- The CBT loop and Anxiety Meter are introduced.

Stage 2: Introducing CBT Concepts and Thought Awareness

- The in-game counselor explains automatic negative thoughts.
- Player chooses among typical thought choices and reflect within a journal.
- Situations and dialogue are structured to normalize anxiety.

Stage 3: Cognitive Restructuring via Socratic Questioning

- Player Identifies core beliefs and prioritizes belief strength and anxiety.
- Socratic guided questions challenge distorted thinking.
- player re-rates beliefs and anxiety to monitor cognitive changes.
- Accomplishment: "First Reframed Belief" badge.

Stage 4: Behavioral Exposure

- Graded tasks (simple to high-stakes) simulate feared social situations:
  - Example: Answering a question in class → giving a speech at an assembly.
- player selects from avoidance strategies, safety behaviors, or complete exposure.
- Pre/post ratings and journaling track anxiety and belief change.

Stage 5: Reflection and Skill Building

- Post-exposure review with counselor includes:
  - Current Anxiety Level
  - Skill Tree openings (for example, goal setting, relaxation breathing)

Stage 6: Mastery and Closure

- Final reflection on journey, achievements, and progress graphs.
- Assertion: “You have made remarkable advancements already.
- Final badge: "Anxiety Management Hero"

The following structured algorithm illustrates the implementation of the treatment process in the game system (see Figure 1).

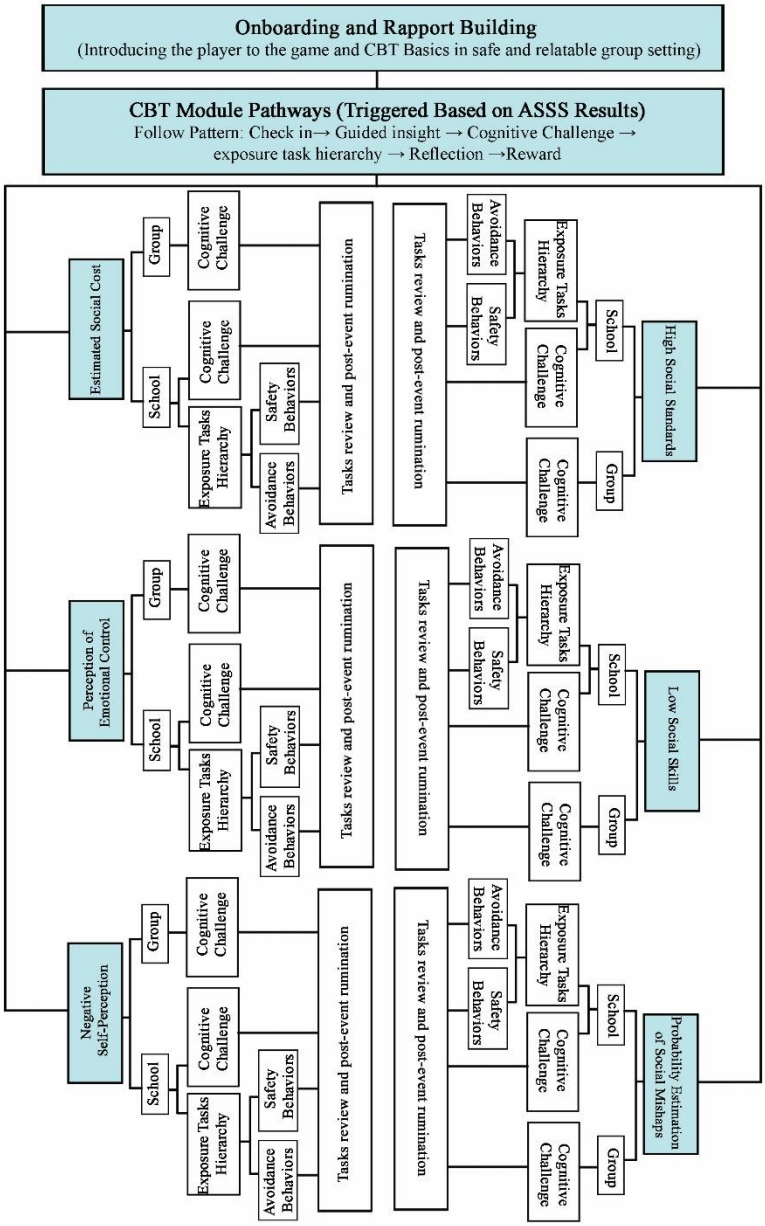

Figure 1 Structured CBT algorithm in the game

Validation

Participants

The sample of experts consisted of 10 counselor and psychologists with five or more years of work in the area of social anxiety. The sample of students consisted of 25 female high school students (grades 10 and 11) between the ages of 16 and 17 who were identified as having social anxiety. The students were recruited from two high schools (15 students from one school and 10 from another school) and were identified by means of convenience sampling. To identify those with social anxiety, the Liebowitz Social Anxiety Scale for Children and Adolescents (LSAS-CA) was administered. Students who met the criteria for social anxiety based on their scores were invited to participate in the study. Prior to inclusion, written informed consent was obtained from both the selected adolescents and their parents. The consent process ensured that all participants were fully informed about the study's objectives, procedures, and their rights, in alignment with the ethical standards approved by the Alzahra University Ethics Committee.

Procedures

Following receipt of ethical approval from the Alzahra University Ethics Committee (IR.ALZAHRA.REC.1402.073), the scenario-writing process was initiated in accordance with Hoffman's cognitive behavioral protocol. The drafted scenarios were submitted to psychologists and counselors specializing in social anxiety for expert review. Once the Content Validity Index (CVI) and Content Validity Ratio (CVR) were confirmed, the scenarios were administered to 10 high-school students (from school 1) diagnosed with social anxiety to evaluate narrative engagement, after which the Story World Absorption Scale (SWAS) was administered. This research was conducted in Tehran from January 2024 to February 2025.

Following the completion of the scenario content and therapeutic framework development, the finalized scenarios were provided to a professional software development team for game implementation. The development team designed and programmed the serious game using the Unity platform, specifically targeting Android smartphones as the primary deployment platform. The resulting application operates in offline mode, enabling users to engage with the therapeutic content without requiring an internet connection during gameplay. Upon completion of the first four game modules, the software was deployed to 5 (from school 1) students who engaged with the game daily over the course of one week. Based on their feedback, features were added to allow adolescents to customize the counselor's name, and sections for homework review and post-event rumination were incorporated following each subscale. Technical issues- such as unexpected program closures and typographical errors- were identified and rectified. Finally, after all game modules had been fully designed, a pilot study involving 10 students (from school 2) was conducted, and the MEEGA+ test and Liebowitz Social Anxiety Scale for Children and Adolescents (LSAS-CA) was administered to assess overall game quality. SPSS software version 27 was used for data analysis.

Measures

Leibowitz Social Anxiety Scale for Children and Adolescents (LSAS-CA) (Masia-Warner et al., 2003) This scale was designed for ages 7 to 18 years and consists of 24 items: 12 social interaction situations (e.g., *"looking into the eyes of people you don't*

know well") and 12 performance situations (e.g., *"asking a question in class"*). Each of the 24 items is scored for anxiety (0 = none, 1 = mild, 2 = moderate, 3 = severe) and for avoidance (0 = never, 1 = sometimes, 2 = often, 3 = usually). Thus, the LSASCA provides seven scores: *(1) anxiety related to social interaction, (2) performance anxiety, (3) general anxiety, (4) avoidance of social interaction, (5) avoidance of performance situations, (6) complete avoidance, and (7) the total LSAS-CA score*. A total score of 5.22 distinguishes between people with social anxiety and healthy people. A score of 55-65 indicates moderate social anxiety, a score of 65-80 indicates severe social anxiety, and a score of 80-95 indicates very severe social anxiety. The creators of this scale have reported its internal consistency as 0.90 to 0.97. In the Iranian sample, internal consistency was also obtained as 0.87 and 0.93 (Dadsetan et al., 2007)

Story World Absorption Scale (SWAS) (Kuijpers et al., 2014) comprises 18 self-report statements organized into four correlated dimensions- *Attention, Emotional Engagement, Mental Imagery, and Transportation*. Participants indicate their agreement with each statement (e.g., *"I felt as if I were transported into the story world"*) on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Scores for each subscale are computed by averaging their respective items, and an overall absorption score is obtained by averaging all 18 items. Higher scores indicate greater narrative absorption- that is, more sustained attention, stronger emotional resonance, and richer mental visualization of the story world. Overall internal consistency ($\alpha > .90$), with subscale alphas generally was reported in the .70 to .85 range.

Method for the Evaluation of Educational Games (MEEGA+) (Petri et al., 2024) contains 35 items divided into two factors- *Usability (four dimensions: Aesthetics, Learnability, Operability, Accessibility)*, and *Player Experience (which includes nine dimensions: Focused Attention, Fun, Challenge, Social Interaction, Confidence, Relevance, Satisfaction, Perceived Learning, and User-Error Protection*). The participants rated each statement with a 5-point Likert scale (-2 = strongly disagree to 2 = strongly agree), The $\bar{\theta}_{(0,1)}$ parameterized and produced by scaling individual responses on the (0,1) scale via Item Response Theory (IRT). To simplify interpretation, this mean was converted to a T-score (mean = 50; SD = 15) calculated using the formula $\theta_{(15,50)} = 50 + 15 \times \bar{\theta}_{(0,1)}$. According to the MEEGA+ classification thresholds, theta less than 42.5 indicates "low quality", theta greater than or equal to 42.5 to 65 indicates "good quality", and theta equal to and above 65 indicates excellent quality.

Results of Validation

Content Validity

To evaluate qualitative content validity, feedback was gathered from 10 experts (counselors and psychologists) regarding the scenarios. Their suggestions led to revisions such as simplifying language and broadening emotional response options. For quantitative assessment, the Content Validity Index (CVI) and Content Validity Ratio (CVR) were computed (Cook & Beckman, 2006). Ten experts rated each item on clarity, simplicity, and relevance using a 4-point Likert scale (1: not relevant at all, 2: somewhat relevant, 3: quite relevant, and 4: highly relevant) and essentiality on a 3-point scale (1:

not essential, 2: useful but not essential, and 3: essential). Both item-level and overall CVI scores were determined, with values above .79 considered acceptable (Polit et al., 2007). The findings showed that the overall CVI met this threshold. Additionally, the CVR values exceeded the required .62 for 10 experts (Lawshe, 1975). confirming that all scenarios had appropriate validity (see Table 1).

Table 1 :CVI and CVR for the scenarios of the Game

No	**Scenarios**	**CVI**			**CVR**
		Relevance (1-4)	Clarity (1-4)	Simplicity (1-4)	Essentiality (1-3)
1	**Onboarding and rapport building**	1	0.9	0.9	0.8
	High social standards				
	In the group:				
2	The first cognitive challenge	0.9	1	0.9	0.8
3	Second cognitive challenge	0.9	0.9	0.9	0.8
	At school:				
4	Cognitive challenge	1	0.9	1	1
5	Behavioral exposure (Avoidance; Simple)	0.8	0.9	0.9	1
6	Behavioral exposure (Avoidance; Medium)	1	1	1	1
7	Behavioral exposure (Avoidance; High stake)	1	0.9	1	1
8	Behavioral exposure (Safety Behaviors; Simple)	1	0.9	0.9	1
9	Behavioral exposure (Safety Behaviors; Medium)	0.9	1	0.9	1
10	Behavioral exposure (Safety Behaviors; High stake)	1	0.7	0.9	1
11	Tasks review and post-event rumination	1	1	1	1
	Negative self-perception				
	In the group:				
12	The first cognitive challenge	1	0.9	1	1

13	Second cognitive challenge	1	0.9	0.9	1
	At school:				
14	Cognitive challenge	1	1	0.9	0.8
15	Behavioral exposure (Avoidance; Simple)	1	0.9	0.9	0.8
16	Behavioral exposure (Avoidance; Medium)	1	1	1	0.8
17	Behavioral exposure (Avoidance; High stake)	1	0.9	0.9	1
18	Behavioral exposure (Safety Behaviors; Simple)	1	1	0.9	1
19	Behavioral exposure (Safety Behaviors; Medium)	1	0.8	0.9	1
20	Behavioral exposure (Safety Behaviors; High stake)	1	1	0.9	1
21	Tasks review and post-event rumination	1	0.8	1	1
	High estimated probability and cost				
	In the group:				
22	The first cognitive challenge	1	1	0.8	1
23	Second cognitive challenge	1	0.8	0.9	1
	At school:				
24	Cognitive challenge	1	0.8	0.9	1
25	Behavioral exposure (Avoidance; Simple)	1	0.8	0.9	1
26	Behavioral exposure (Avoidance; Medium)	1	0.9	0.9	1
27	Behavioral exposure (Avoidance; High stake)	1	1	0.9	1
28	Behavioral exposure (Safety Behaviors; Simple)	1	0.8	0.9	1
29	Behavioral exposure (Safety Behaviors; Medium)	1	0.8	0.9	1

30	Behavioral exposure (Safety Behaviors; High stake)	1	0.8	0.9	1
31	Tasks review and post-event rumination	1	0.8	1	1
	low perceived emotional control				
	In the group:				
32	The first cognitive challenge	1	0.8	0.9	1
33	Second cognitive challenge	1	0.8	0.9	1
	At school:				
34	Cognitive challenge	1	0.8	0.9	1
35	Behavioral exposure (Avoidance; Simple)	0.9	0.8	0.9	0.8
36	Behavioral exposure (Avoidance; Medium)	1	0.9	1	1
37	Behavioral exposure (Avoidance; High stake)	0.9	0.8	1	1
38	Behavioral exposure (Safety Behaviors; Simple)	0.9	0.8	0.9	1
39	Behavioral exposure (Safety Behaviors; Medium)	0.9	0.8	0.9	1
40	Behavioral exposure (Safety Behaviors; High stake)	1	0.8	0.9	1
41	Tasks review and post-event rumination	1	0.8	0.9	1
	Anticipation of social mishap and threats				
	In the group:				
42	The first cognitive challenge	0.9	0.8	1	1
43	Second cognitive challenge	0.9	0.8	0.9	1
	At school:				
44	Cognitive challenge	0.9	0.9	0.8	1
45	Behavioral exposure (Avoidance; Simple)	1	0.9	0.9	1

46	Behavioral exposure (Avoidance; Medium)	1	0.9	0.9	1
47	Behavioral exposure (Avoidance; High stake)	0.9	0.8	0.9	1
48	Behavioral exposure (Safety Behaviors; Simple)	1	0.9	0.8	1
49	Behavioral exposure (Safety Behaviors; Medium)	1	0.9	0.9	0.8
50	Behavioral exposure (Safety Behaviors; High stake)	1	0.8	0.9	1
51	Tasks review and post-event rumination	1	0.8	0.9	1
	Poor social skills				
	In the group:				
52	The first cognitive challenge	0.9	0.9	0.8	1
53	Second cognitive challenge	0.9	0.9	0.9	0.8
	At school:				
54	Cognitive challenge	1	0.8	0.8	1
55	Behavioral exposure (Avoidance; Simple)	0.9	0.8	0.9	0.8
56	Behavioral exposure (Avoidance; Medium)	1	0.9	0.9	1
57	Behavioral exposure (Avoidance; High stake)	0.9	0.9	1	1
58	Behavioral exposure (Safety Behaviors; Simple)	1	0.8	0.9	1
59	Behavioral exposure (Safety Behaviors; Medium)	1	0.8	0.9	0.8
60	Behavioral exposure (Safety Behaviors; High stake)	0.9	0.8	0.9	1
61	Tasks review and post-event rumination	0.9	0.9	0.9	0.8
62	**Celebration and Mastery**	0.9	0.9	0.9	1
	Overall	0.937	0.840	0.883	0.931

Face Validity

To evaluate the face validity of the game scenarios, which was based on the level of narrative engagement, the Story World Absorption Scale (SWAS) was used with ten high school students with social anxiety. The SWAS assessed four dimensions of narrative engagement and the students reported moderate to high levels of narrative absorption. Since this scale does not have a cut-off line for interpreting the results, the agreement coefficient for the evaluators was considered to examine the results. Due to the continuous nature of the data, the Fleiss' kappa coefficient was calculated. The results of calculating the Fleiss' kappa coefficient for the present data indicate a significant level of agreement between the evaluators in all subscales. Values of $k \leq 0$ indicate weak or random agreement, $0 \leq k < 0.2$ negligible agreement, $0.21 \leq k \leq 0.40$ fair agreement, $0.41 \leq k \leq 0.60$ moderate agreement, $0.61 \leq k \leq 0.80$ strong agreement, and $0.81 \leq k \leq 1$ excellent agreement (Fleiss, 1971). Table 2 shows the mean and standard deviation as well as the Fleiss agreement coefficient. Considering scores of 4 and 5, the attention and story transportation subscales have achieved excellent agreement, indicating very high agreement between raters in measuring these components. The *Emotional Engagement* and *Mental Imagery* subscales are also in the range of strong agreement. These findings show that the research instrument has appropriate face validity, especially in measuring high levels of performance (scores 4 and 5). Overall, the results indicate appropriate valid engagement of participants in the present study with game scenarios, which supports the face validity of the scenarios in this serious game aimed at addressing social anxiety in adolescents.

Table2:Kappa Coefficient, Mean, and SD for SWAS

	Kappa coefficient	**Mean**	**Sd**	**Interpretation**
Attention	0.85	3.82	0.52	Excellent
Emotional Engagement	0.78	4.4	0.50	Strong
Mental Imagery	0.72	4.26	0.66	Strong
Transportation	0.81	3.78	0.89	Excellent

Note. $k \leq 0$: Weak or random agreement, $0 < k \leq 0.20$: Negligible agreement, $0.21 \leq k \leq 0.40$: Fair agreement, $0.41 \leq k \leq 0.60$: Moderate agreement, $0.61 \leq k \leq 0.80$: Strong agreement, $0.81 \leq k \leq 1$: Excellent agreement.

Pilot study

After completing the four initial game modules, the software was installed on the Android smartphones of five students from School 1. The students played the game for 1 hour per day for a week.

Based on their feedback, several modifications were made to increase personalization and engagement. Specifically, two features were added to allow players to personalize the in-game counselor's name, and new sections were implemented to review assigned tasks and engage in rumination after each subscale.

At this point also revealed technical issues with the players' experience, including unexpected shutdowns of the application and typing mistakes. The pilot study occurred after the completion of the design of all the game modules. After completing the design of all game modules, a pilot study was conducted with ten students from School 2. The MEEGA+ questionnaire and the Leibowitz Social Anxiety Scale for Children and Adolescents (LSAS-CA) were administered to assess initial effectiveness, overall game quality, and time required to play. The study was conducted in the form of two 45-minute sessions per week, during which participants played the game under the supervision of the researcher. Students were instructed to record the time spent on each module after playing. The average time to complete the first module was 60 minutes, while subsequent modules averaged 90 minutes each. In total, the game required an average of 13 sessions, with an additional session dedicated to collecting participant feedback. After each session, participants completed a short three-question survey that addressed the following: (1) Which part of today's session was most helpful to you? (2) What could have been improved? (3) Are you ready for the next session?

Pilot results

To examine the effects of the intervention on participants' social anxiety, a paired t-test was used to compare pre-test and post-test scores. Before analysis, the Shapiro-Wilk test was used to assess the normality of the data distribution. As presented in Table 3, the results confirmed that the data were normally distributed.

Table3: Shapiro–Wilk Test of Normality for Pre-test and Post-test LSAS-CA

Variable	Statistic	df	Sig.
Pre-test			
Total Score	0.92	10	.35
Total Anxiety	0.93	10	.44
Performance Anxiety	0.93	10	.49
Interaction Anxiety	0.96	10	.74
Total Avoidance	0.93	10	.49
Avoidance of performance	0.93	10	.52
Avoidance of Interaction	0.97	10	.88
Post-test			
Total Score	0.87	10	.12
Total Anxiety	0.96	10	.76
Performance Anxiety	0.94	10	.53
Interaction Anxiety	0.91	10	.30
Total Avoidance	0.95	10	.71
Avoidance of performance	0.86	10	.08
Avoidance of Interaction	0.89	10	.17

Note. All p-values are greater than .05, indicating that the assumption of normality was met for each variable. **df** = degrees of freedom; **Sig**. = significance value.

Table 4 shows the means, standard deviations, and t-values for all social anxiety measures at the pre-test and post-test stages. The findings showed a statistically significant reduction in the total social anxiety scores as well as in all subscale scores, indicating that the intervention had a significant effect on the participants' social anxiety levels.

Table4: Means, standard deviation, confidence interval of difference and p-value of LSAS-CA

Variable	Pre-test	Post-test	95% CI	T-value (df)	Sig.
	Mean (SD)	Mean (SD)	Upper (lower)		
Total Score	80.8 (6.59)	48 (5.29)	37.23 (28.37)	16.74 (9)	.001*
Total Anxiety	40.2 (3.05)	25.4 (2.12)	17.27 (12.33)	13.54 (9)	.001
Performance Anxiety	19.3 (2)	11.2 (1.99)	9.69 (6.50)	11.47 (9)	.001
Interaction Anxiety	20.9 (3.72)	14.2 (3.29)	8.35 (5.04)	9.16 (9)	.001
Total Avoidance	40.4 (3.95)	21.4 (1.58)	21.69 (16.3)	15.83 (9)	.001
Avoidance of performance	18.9 (2.28)	10.9 (1.50)	10.21 (6.39)	9.83 (9)	.001
Avoidance of Interaction	21.3 (3.40)	11.5 (2.12)	11.64 (7.95)	12.04 (9)	.001

Note. All p-values are smaller than .05, indicating that the result is statistically significant for each variable.
df = degrees of freedom; **Sig.** = significance value**; CI** = confidence Interval

Game Useability

To assess the usability and overall quality of the developed game, the MEEGA+ tool was administered to the participants after the pilot phase. MEEGA+ (Petri et al., 2024) assess the usability and player experience of serious games and covers various dimensions such as aesthetics, functionality, interaction, satisfaction, and perceived learning. The usability dimension assesses the functional and aesthetic aspects of the game, including ease of use and visual appeal. Its subscales include aesthetics (evaluating whether the game's user interface facilitates enjoyable and satisfying user interaction), learnability (determining whether the game can be used effectively and safely by the intended users to achieve learning goals in a specific context), operability (evaluating how easily users can navigate and control the game's functions), and accessibility (evaluating the accessibility of the game for users with mild to moderate visual impairments or color vision deficiencies). The player experience dimension assesses the user's psychological and emotional engagement with the game. These include: User Error Protection (assessing the game's ability to prevent user errors or help users compensate for them), Confidence (assessing students' perceptions of their ability to make academic progress through their own effort and skills during the game), Challenge (assessing whether the game provides an appropriate level of challenge that is aligned with the learners' abilities, with gradual increases in difficulty and varied scenarios to maintain engagement and

reduce monotony), Satisfaction (assessing whether students believe the time and effort spent on the game leads to meaningful learning), Social Engagement (determining whether the game fosters a sense of shared experience and encourages interaction through collaborative or competitive activities), Fun (assessing the extent to which the game provides students with feelings of enjoyment, relaxation, happiness, and mental distraction), Focused Attention (measures the degree of immersion, focused attention, and disconnection from real-time awareness of students while playing the game), Relevance (assessing whether students perceive the educational content as aligned with their personal goals and relevant to their future academic or professional paths) and perceived learning (measuring students' overall perception of the impact of the game on their learning outcomes in the course).

The MEEGA+ tool has been used in several previous studies, Petri et al (2017) used it to evaluate educational games in software engineering education, and (Daud et al., 2024) used it to evaluate impact of usability components on user satisfaction in educational board games. In the present study, the use of MEEGA+ allowed for a systematic assessment of the strengths and areas for improvement of the game and helped to refine it repeatedly based on the end-user experience. In this study, theta scores obtained from item response theory were used to interpret the participants' responses. Theta scores for usability were 60.69 and for player experience were 62.02, both falling within the range of 42.5- 65, indicating good quality according to the MEEGA+ evaluation scale (see Figure 2).

For the usability subscales, the theta scores were as follows: aesthetics (61.63), learnability (62.5), functionality (60.31), and accessibility (58.5). For the player experience subscales, theta scores were: protection against user error (57.5), confidence (63.13), challenge (63.5), satisfaction (62.75), social interaction (62.38), fun (62.19), focused attention (60.13), relevance (63.03), and perceived learning (61.81). All values fall within the "good quality" range, indicating that participants found the game aesthetically pleasing, easy to use, challenging, and engaging, while also finding it educationally useful. These findings confirm that the game provided a positive user experience and met the necessary standards for serious usability and effectiveness of the game.

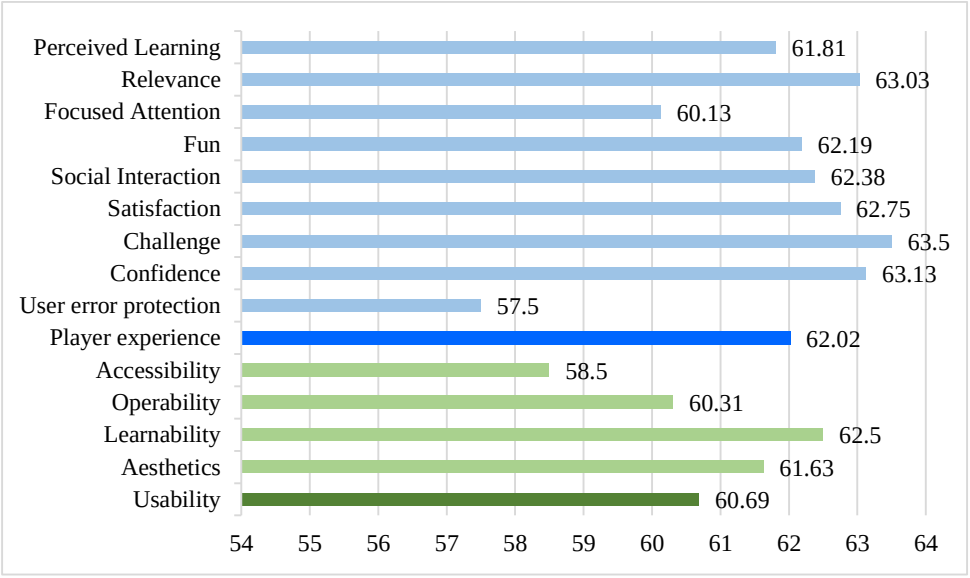

Figure 2 Theta scores for usability and player experience subscales based on MEEGA+ results.

Discussion

The aim of the present study was to design and validate a CBT-based serious game targeting social anxiety in adolescent girls by integrating a structured scenario-writing protocol based on Hoffman's Social Self-Reappraisal Therapy. Findings from multiple validation steps- including expert review, face validation, usability testing, and pilot evaluation- provide converging evidence in support of the therapeutic and experiential quality of the developed game. First, the content validity of the scenarios was confirmed through qualitative and quantitative feedback from subject matter experts. High CVI and CVR values across all treatment scenarios indicated that the narrative components of the game were relevant, clear, simple, and essential for the intended clinical goals. These results are consistent with other practices in scenario validation for educational and therapeutic interventions (Cook & Beckman, 2006; Polit et al., 2007).

The results of the face validity assessment for the serious game scenarios using the Story World Engagement Scale (SWAS) demonstrated satisfactory agreement levels across various narrative engagement components. In this study, the attention and transportation subscales achieved excellent kappa agreement levels, indicating the scenarios' capacity to attract and maintain evaluators' focus while facilitating knowledge transfer to real-world situations. These findings align with previous research on narrative-based serious games (Garneli et al., 2017; Kuijpers et al., 2014), confirming that purposefully designed scenarios can enhance cognitive processes related to learning and skill generalization (Fitzgerald & Ratcliffe, 2020).

Furthermore, the emotional engagement and mental imagery subscales showed strong agreement levels, suggesting the scenarios effectively elicited emotional responses and mental images associated with anxiety-provoking situations (Waters & Craske, 2016). These two components are particularly crucial as cognitive behavioral models consider emotional engagement and vivid imagery of feared situations essential prerequisites for cognitive restructuring and avoidance reduction (Hofmann & Otto, 2017).

Collectively, these results confirm that the designed scenarios in this serious game provide: (1) an appropriate foundation for acquiring coping skills through attention activation and transfer facilitation, and (2) necessary conditions for deeper processing of anxiety-inducing situations through enhanced emotional engagement and mental imagery. The high scores indicated the scenarios' success in triggering emotional responses and mental imagery - key components for learning, retention, and therapeutic processing (Kuijpers et al., 2014).

This combination of features makes the game an effective therapeutic intervention tool by simultaneously addressing both cognitive and emotional dimensions of social anxiety. These findings further support the notion that integrating compelling narrative elements with therapeutic principles can increase both acceptance and effectiveness of digital interventions among adolescent populations (Fleming et al., 2017). The results particularly highlight how narrative immersion combined with cognitive behavioral techniques creates an optimal environment for therapeutic change in youth mental health interventions.

The effectiveness findings of the CBT-based serious game for social anxiety can be understood through the lens of Social Self-Reappraisal Therapy (SSRT) theory combined with the specific game mechanics employed. SSRT focuses on modifying distorted self-beliefs and cognitive biases that maintain social anxiety by targeting unrealistic high social standards, negative self-evaluation, and anticipatory anxiety (Hofmann & Otto, 2017). The game's narrative design may incorporates these therapeutic principles by guiding players to set realistic social goals before exposure tasks, helping them evaluate success based on goal attainment rather than subjective anxiety. This goal-oriented approach aligns with SSRT's emphasis on clarifying social standards and shifting evaluation criteria, which empirical studies have shown to reduce maladaptive self-criticism and improve social self-efficacy (Alden & Wallace, 1995; Wallace & Alden, 1995). By embedding these cognitive restructuring techniques into interactive scenarios, the game probably facilitates cognitive shifts that mirror those achieved in traditional SSRT, thereby reducing social anxiety symptoms as reflected in the significant LSAS-CA score improvements.

Moreover, the game mechanics actively address key maintaining factors of social anxiety such as self-focused attention and low perceived emotional control, which SSRT theory highlights as critical targets for change. The immersive and emotionally engaging virtual environment perhaps encourages players to redirect their attention outward, reducing the excessive self-monitoring and negative self-imagery that exacerbate social fears (Hackmann et al., 2000; Hofmann & Otto, 2017). The experiential learning afforded by repeated in-game social exposures allows players to practice adaptive emotion regulation strategies and experience corrective feedback in a safe context, enhancing their perceived

control over anxiety responses (Barlow, 2004). This aligns with SSRT's use of video feedback and acceptance-based techniques to disconfirm catastrophic beliefs about anxiety symptoms and their visibility to others, which has been empirically linked to symptom reduction (Hofmann & Otto, 2017; Rapee & Hayman, 1996). The game's feedback and progress-tracking systems reinforce these mechanisms by enabling players to observe their gradual improvement, thus consolidating gains in emotional control and reducing avoidance.

Finally, the integration of SSRT principles with serious game technology leverages the motivational and engagement benefits of digital platforms to enhance treatment adherence and effectiveness. Serious games provide an emotionally safe, controlled environment where adolescents can repeatedly confront feared social situations without real-world consequences, lowering perceived threat and encouraging behavioral experimentation (Fleming et al., 2017; Granic et al., 2014). This experiential learning model - learning through doing rather than passive instruction - supports the internalization of cognitive behavioral skills and fosters generalization to real-life social contexts (Connolly et al., 2012). The game's narrative immersion and interactive challenges increase player absorption and emotional involvement, which are critical for activating the cognitive and emotional processes targeted by SSRT (Hofmann & Otto, 2017). Together, these factors explain the observed significant reductions in social anxiety symptoms and highlight the promise of combining SSRT with serious game mechanics to create an accessible, effective intervention for adolescent social anxiety.

Usability and experiential quality of the game were assessed using the MEEGA+ tool. All theta scores obtained from the IRT analysis fell within the "good quality" range (42.5–65) and accounted for overall usability and player experience. Notably, subscales such as learnability, challenge, satisfaction, and confidence scored highly, indicating that participants found the game engaging, appropriately difficult, and effective in promoting perceived learning. These results are comparable to MEEGA+ assessments in other domains, such as software engineering (Petri et al., 2017) and educational board games (Daud et al., 2024), supporting the generalizability of the tool across content areas. Furthermore, the addition of features such as counselor name customization and post-event rumination tracking- implemented based on feedback received from initial game reviews with 5 participants, further enhanced the game's personal relevance and therapeutic alignment.

Overall, the findings suggest that the developed game is aligned with core principles of CBT, while also fulfilling the experiential expectations of adolescent users. The integration of narrative design, therapeutic precision, and interactive customization appears to create an environment to facilitate change, supported by the preceding analysis. Most importantly, this research demonstrates how narrative-themed serious games can be developed as successful means to address adolescent mental health issues in environments lacking access to traditional therapeutic possibilities.

Future research should aim to replicate these findings in larger and more diverse samples and assess the long-term impact of gaming on anxiety symptoms. In addition, comparative studies examining CBT-based games in combination with traditional interventions should clarify the increased effectiveness and durability of results.

Nevertheless, this study provides strong initial support for the feasibility, usability, and clinical relevance of serious games integrated with CBT for adolescents with social anxiety. Given that the current study is part of a doctoral dissertation, a separate study will examine the effectiveness of this game with a control group.

Conclusion

The current research developed and validate a CBT-based serious game to help reduce social anxiety in adolescents. The serious game demonstrated solid content validity, high usability, and a clear reduction in symptoms of social anxiety through expert review, narrative engagement testing, and pilot implementation. This study illustrated the feasibility of using an evidence-based psychological model combined with engaging interactive game design to produce attractive, effective, and readily available mental health interventions for adolescents.

Limitation

This study had a number of limitations despite its encouraging results. The results cannot be applied to larger adolescent populations, such as boys and people from different socioeconomic or cultural backgrounds, due to the small sample size and restriction to female students from two high schools. Second, there was no control group and the intervention was only conducted as a short-term pilot, which limited the ability to draw conclusions about the effectiveness of the treatment. Third, the short follow-up period made it impossible to evaluate the long-term efficacy and maintenance of therapeutic benefits. Lastly, even though self-report measures were suitable for the situation, adding clinician-rated tests or behavioral observations to triangulate the data could be helpful for future research. Future studies must address these issues in order to completely demonstrate the clinical efficacy, scalability, and sustainability of the proposed game-interventions.

Implications

The findings suggest that serious games utilizing CBT can serve as effective and accessible tools for addressing social anxiety in adolescents. The structured scenario-writing technique offers a replicable foundation for integrating therapeutic concepts into interactive formats. Positive feedback on narrative engagement and usability highlights the significance of user-centered design principles. This method is a scalable addition to conventional therapy that can be successfully used in educational environments or on online mental health platforms.

Disclosure Statements

The Authors have no conflict of Interests.

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