

A Co-Design Protocol for a Serious Game Supporting Emotion Regulation in Children

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Abstract: Technological advancements have led to the development of serious games (SGs), which are now widely used in mental healthcare. These digital interventions are used for education and treatment and are effective in supporting emotion regulation (ER) in young people. Their engaging nature and accessibility make them a promising solution to gaps in traditional mental health services. This work presents a protocol for the development of a SG designed to promote emotional knowledge and ER skills in school-aged children in both school and clinical settings. The SG's development will be based on a co-design methodology involving the active participation of children, parents, teachers, and healthcare professionals throughout three phases: 1) conceptual design, 2) prototype testing, and 3) usability testing. The outcomes of SG will be assessed based on user experience and satisfaction, as well as system usability and clinical measures. Pre- and post-test assessments will be used to measure improvements in emotion recognition and ER skills. The final SG is expected to fulfill real-world needs and ensure that it is educational and enjoyable. This protocol provides a replicable framework for co-designed digital interventions in mental health, emphasizing user-centered design to enhance both effectiveness and involvement.

Keywords: Serious game, Emotion regulation, Children, Co-Design, User-Centered

1. Introduction

Serious games (SGs) are digital games designed for purposes beyond entertainment, with usage since the early 1970s to support learning and skill development. SGs are being explored as engaging tools to complement traditional therapy, particularly for younger audiences (Fleming et al, 2017). One key area of focus is ER, defined as the ability to influence one's emotions, when and how they are experienced and expressed (Gross, 2015). Children's difficulties in ER are often predictors of psychological problems in adulthood (e.g., anxiety, depression), making early intervention crucial (Crowell, Puzia and Yaptangco, 2015).

The research team conducted a systematic review to identify existing solutions and design strategies of SGs supporting ER development in children. We found that few SGs address ER as a standalone skill, instead embedding it within broader socio-emotional learning or focusing primarily on emotion recognition. Notable examples include *ReThink*, a SG to support emotional health of young people aged 10 to 16, with studies showing its improvements in ER skills (David, Magurean, and Tomoiagă, 2022). *Emodiscovery* is another relevant SG that presents emotional dilemmas to older children (8-11), who must select from pre-defined regulation strategies (Pacella and López-Pérez, 2018). Both games were designed only by researchers and target older age groups, limiting their developmental and contextual applicability for younger children.

In contrast, this work presents a protocol for developing an SG to help school-aged children (6-9) acquire emotional knowledge and ER skills. The game will be created following a co-design approach with direct involvement of multiple stakeholders, ensuring all relevant voices are considered, making the final game more likely to be accepted and attractive to users (Vargas et al, 2022).

1.1 Proposed SG

The proposed SG is expected to be a multiplatform narrative game in which players navigate through real-life emotional situations. Gameplay activities will involve identifying emotions and selecting from adaptive and maladaptive ER strategies. These elements integrate theoretical concepts, particularly Gross's Process Model of ER (Gross, 2015) and Paul Ekman's framework of basic and complex emotions (Ekman, 2004), to support both emotional awareness and adaptive response in gameplay. The co-design process will further refine these elements and guide the game's direction.

2. Method

2.1 Procedure

The key stakeholders are children, parents/guardians, teachers, and healthcare professionals. Children, as primary end-users, will provide insights into what they find fun and understandable, guiding the design of narratives, characters, and challenges. The game targets typically developing and at-risk children aged 6 to 9, recruited from both school and clinical settings. At this stage, children with diagnosed developmental or psychiatric disorders will be excluded, as the intervention focuses primarily on prevention and psychoeducation. Parents can clarify their child's emotional difficulties and effective strategies used in everyday life. Teachers bring expertise on integrating ER tools into school environments. Healthcare professionals can validate the game's alignment with best therapeutic practices in child development and emotional health.

The co-design process will consist of three phases, with at least 10 participants each and 25 for the usability evaluation phase (Borsci et al, 2014). Sessions with adults will be held online or in person, whereas children's sessions take place in educational and clinical settings. In educational contexts, the research team will conduct data collection directly with children, while in clinical settings, sessions will be facilitated by a healthcare professional.

2.1.1 First phase of co-design

Parents, teachers, and healthcare professionals will participate in semi-structured interviews to discuss emotional challenges observed in children and suggest game elements to address these challenges. These interviews will help to identify recurring emotional difficulties and the everyday situations in which children experience emotional challenges. Children's sessions include creative exploration activities to create an age-appropriate and relatable concept. These sessions will begin with playful, imaginative exercises to ease children into the topic. Through storytelling, drawing, and brainstorming, children will help design fun characters and scenarios, such as one character assisting another in managing an emotional situation.

These contributions will serve as the foundation for the game's narrative, visual style of characters, and emotionally resonant interactions. While the research team leads the technical development, input from co-design participants, particularly teachers and healthcare professionals, contributes directly to shaping core mechanics such as challenges, feedback, and rewards. Their expertise ensures that gameplay elements are developmentally appropriate, engaging, and pedagogically meaningful.

2.1.2 Second phase of co-design

Parents, teachers and healthcare professionals will test a prototype through an open-ended online questionnaire covering gameplay mechanics, character design, engagement and educational relevance. While playing the SG, children will be asked open-ended questions to capture real-time feedback and identify any challenges. After gameplay, they will participate in interactive feedback activities where they will be invited to describe or illustrate their ideas for improvement.

2.1.3 Third Phase of co-design

The completed SG will undergo usability testing to assess acceptance, feasibility, and potential impact on children's ER skills. Children will begin with a guided session introducing the game's concepts and mechanics, with opportunities to ask questions and explore freely. The research team will observe behaviour and reactions to identify any areas that may need further refinement, asking simple, open-ended questions to understand how the child feels about the game and whether they find it engaging and easy to play. Afterward, children will take the game home for a week, playing at their own pace, with the freedom to stop at any time. Parents may contact the research team for support if needed during the week. Following the play period, a follow-up session will be held where children complete a paper-based usability questionnaire and participate in an easy-going conversation to share their experiences and suggestions. Parents, teachers, and healthcare professionals will also test the final game and complete self-report questionnaires and open-ended questions covering usability, engagement, and educational value. Parents will be asked to complete a questionnaire about their child's emotional skills both before and after the week of gameplay, to assess any observable changes.

2.2 Data Collection

To summarize, data collection will involve the components in Table 1. Regarding the third phase of co-design, child-reported data will be collected using smiley face Likert scales, and parents may assist children during

questionnaire completion to ensure comprehension, following standardized instructions to minimize bias and preserve data integrity.

Table 1: Data Collection Methods

Method	Participants	Phase(s)	Purpose
Semi-structured interviews	Parents, Teachers, Healthcare Professionals	Phase 1	Gather opinions on emotional challenges and game design
Open-ended questionnaires	Parents, Teachers, Healthcare Professionals	Phase 2 & 3	Collect feedback on game usability, content, and engagement
Hetero-report questionnaire (e.g., Emotion Regulation Questionnaire, ERQ (Fernandes et al, 1997))	Parents	Phase 3	Assess changes in children's ER before and after gameplay
Self-report questionnaires (e.g., System Usability Scale, SUS (Martins et al, 2015); User Satisfaction Evaluation Questionnaire, USEQ (Domingos et al, 2021))	Children, Parents, Teachers, Healthcare Professionals	Phase 3	Evaluate game experience and usability
Observations and notes	Children	All Phases	Qualitative insights from behaviour, reactions, and drawings during sessions
Gameplay data	N/A	During gameplay	Analyse duration and completion

3. Expected Results

The co-design process is expected to provide insights for improvement, including refining gameplay or expanding scenarios, for future iterations. The SG is expected to be perceived as enjoyable, relatable, and educationally effective, possibly fostering emotional connections between children and the characters and scenarios. In terms of clinical effectiveness, success will also be measured by feedback from parents, highlighting improvements in their children's emotional abilities, particularly the application of learned strategies to real-world situations. Ultimately, the protocol aims to demonstrate that well-designed SGs can serve as accessible, engaging tools for promoting emotional development in children.

4. In Conclusion

Emotional learning plays a crucial role in childhood development, having a lasting impact on social functioning and life outcomes. SGs offer promising digital solutions that capture children's attention while bridging resource gaps. This paper presents a co-design protocol for developing an SG that targets children's ER and makes learning both meaningful and enjoyable. The protocol integrates the perspectives of the target audience and relevant stakeholders as equal partners throughout development. This means that feedback continuously shapes the game's design, ensuring it aligns with user needs and preferences. This protocol makes a significant contribution to the growing literature on user-centred digital interventions by combining co-design with a robust theoretical foundation in developmental psychology. Despite potential challenges in implementation, such as recruitment or technological constraints, the protocol demonstrates how SGs can serve as engaging, scalable tools for mental health interventions. In addition to guiding the development of the proposed SG, this framework provides a practical, replicable model for designing future child-centred games that focus on emotional learning and mental health promotion.

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Ethics Declaration: The project is being evaluated by the Ethics Committee of FEUP.

AI Declaration: No AI tool was used.

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