

FACULDADE DE ENGENHARIA DA UNIVERSIDADE DO PORTO

Emotions in the Family: Co-Creation of a Serious Game for Training Emotion Regulation Skills

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Master in Informatics and Computing Engineering

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Resumo

A adolescência é uma fase crucial do desenvolvimento humano, marcada por uma crescente independência e auto-exploração, mas também apresenta desafios significativos relacionados com a regulação das emoções. Este período é crucial para o desenvolvimento de competências emocionais e bem-estar mental. No entanto, os adolescentes podem enfrentar vários problemas de saúde mental relacionados com dificuldades de regulação de emoções, como a ansiedade, a depressão e envolvimento em comportamentos de risco, que podem ter consequências duradouras. Os pais continuam a desempenhar um papel fundamental no desenvolvimento emocional dos seus filhos durante esta fase, moldando as suas competências emocionais e sociais através de interações e respostas. O uso de estratégias eficazes de regulação das emoções são essenciais para os adolescentes e para os seus pais, fornecendo as ferramentas para lidar com as emoções de uma forma adaptativa.

Considerando o potencial comprovado das intervenções com base em jogos sérios para promover a saúde mental e reforçar as competências emocionais em adolescentes, foi desenvolvido o jogo sério multijogador *Emotion Odyssey* usando a plataforma Unity2D, para ensinar e treinar estratégias de regulação emocional em adolescentes, com idades entre os 10 e os 14 anos, e seus pais. Utilizando o conceito de escape room, *Emotion Odyssey* introduz várias estratégias de regulação de emoções através de cenários e desafios envolventes, ao mesmo tempo que promove a reflexão, a expressão e a compreensão de seis emoções básicas.

O desenvolvimento do *Emotion Odyssey* utilizou uma abordagem multifásica e colaborativa que envolveu adolescentes, pais e profissionais de saúde. O processo de co-criação foi conduzido em três fases distintas. Primeiro, foram realizadas entrevistas semi-estruturadas com quatro psicólogas, uma mãe e a sua filha adolescente para desenvolver o conceito do jogo. A segunda fase envolveu a recolha de feedback estruturado de um subconjunto mais pequeno dos participantes iniciais - uma psicóloga e a díade mãe-filha - sobre o protótipo em desenvolvimento. Por fim, a avaliação da usabilidade foi feita com 10 participantes (psicólogas, $n = 2$, mães, $n = 4$, adolescentes, $n = 4$).

No estudo de usabilidade, *Emotion Odyssey* demonstrou uma elevada aceitabilidade por parte da população-alvo e dos profissionais de saúde, refletida por uma pontuação total média de 1,82 no Post-Study System Usability Questionnaire (PSSUQ), sugerindo uma percepção muito positiva em termos de usabilidade.

A aceitação desta ferramenta poderá contribuir para melhorar a regulação emocional de adolescentes e pais, incentivar uma comunicação mais eficaz entre ambos sobre questões emocionais e, assim, promover o desenvolvimento positivo dos jovens.

Palavras-chave: Regulação Emocional, Adolescentes, Pais, Jogos Sérios, Saúde Mental, Co-Design

Abstract

Adolescence is a pivotal stage in human development, marked by increasing independence and self-exploration, yet it also presents significant challenges related to emotion regulation. This period is crucial for the cultivation of emotional competencies and mental well-being. However, adolescents may face various mental health issues related to difficulties in regulating emotions, such as anxiety, depression, and engaging in risky behaviors, which can have lasting consequences.

Parents continue to play a pivotal role in their children's emotional development during this phase, shaping their emotional and social skills through interactions and responses. The use of effective emotion regulation strategies is essential for adolescents and their parents, providing the tools to navigate emotions in an adaptive manner.

Considering the proven potential of interventions based on serious games in improving overall mental health and enhancing emotional skills in adolescents, the multiplayer serious game *Emotion Odyssey* was developed using the Unity2D game engine to teach and train emotion regulation strategies in adolescents aged between 10 and 14 years old and their parents. Leveraging an escape room concept, *Emotion Odyssey* introduces various emotion regulation strategies through engaging scenarios and challenges while promoting the reflection, expression, and understanding of six basic emotions.

The development of *Emotion Odyssey* utilized a multi-phase, collaborative approach involving adolescents, parents, and health professionals. The co-creation process was conducted in three distinct phases. First, semi-structured interviews were held with four psychologists, one mother, and her adolescent daughter to develop the game's concept. The second phase involved gathering structured feedback from a smaller subset of the initial participants—a psychologist and the mother-daughter dyad—on the evolving prototype. Finally, the usability evaluation was carried out with 10 participants (psychologists, $n = 2$, mothers, $n = 4$, adolescents, $n = 4$).

In the usability study, *Emotion Odyssey* demonstrated high acceptability among both the target population and health professionals, reflected by an average total score of 1.82 on the Post-Study System Usability Questionnaire (PSSUQ), suggesting a very positive perception in terms of usability.

The acceptance of this tool could help improve the emotional regulation of adolescents and parents, encourage more effective communication between the two on emotional issues, and thus promote the positive development of adolescents.

Keywords: Emotion Regulation, Adolescents, Parents, Serious Games, Mental Health, Co-Design

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Last but certainly not least, I extend a heartfelt thank you to everyone who contributed to the development of my game. I am deeply grateful to all the psychologists, school staff, parents, and adolescents who offered their support and participation.

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“Rivers know this: there is no hurry. We shall get there some day.”

A.A. Milne, Winnie-the-Pooh

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Abbreviations

ER	Emotion Regulation
SG/SGs	Serious Game/ Serious Games
GEQ	Game Experience Questionnaire
PSSUQ	Post-Study System Usability Questionnaire
IMIp	Portuguese version of the Intrinsic Motivation Inventory
UI	User interface
HUD	Heads-Up display
ASD	Autism spectrum disorder
ADHD	Attention deficit hyperactivity disorder
CBT	Cognitive behavioral therapy
RCT	Randomized controlled trial

Chapter 1

Introduction

1.1 Context

This dissertation is part of a larger project conducted at the LIACC (*Laboratório de Inteligência Artificial e Ciência de Computadores*), focusing on the development of emotion regulation (ER) games for adolescents in a family context. Notably, two specialized games have already been developed: one for adolescents and another designed specifically for parents. The unique contribution of this dissertation work lies in the development of a serious game (SG) for mental health promotion and psychopathology prevention by teaching and training ER skills in adolescents and their parents, encouraging them to play and learn together. Importantly, this project is being developed with the input and feedback of health professionals, adolescents and their parents to match their specific needs and interests, hoping it will be an effective tool for promoting mental well-being in these target audiences.

The reason for carrying out this project is grounded on various concerns and issues that have been identified in the field of mental health and the promotion of ER skills in adolescents, as the lack of access to mental health services for families is a barrier that limits early intervention and the promotion of healthy development, particularly in adolescents. The period of adolescence is a crucial stage in the emotional growth of adolescents, in which the ability to regulate emotions plays a key role in adapting to challenges and promoting wellness. In addition, parents' caretaking practices and emotional socialization habits significantly impact adolescents' ER. However, few interventions focus on parents and their children together.

These factors, coupled with the imperative for innovation in interventions, the demand for effective strategies to enhance mental well-being and cultivate emotional competencies, and the lack of available resources for families, collectively constitute the driving force behind this project.

1.2 Motivation and Objectives

Mental health is a crucial factor for people's well-being and development, especially for adolescents going through a critical stage of life. Adolescence is a time of increased independence and

self-exploration, but it also involves many ER challenges and risks, such as anxiety, depression, or harmful behaviors. Parents still have a significant impact on their children's mental health as they shape their emotional and social skills through their interactions and responses. Therefore, it is vital to provide adolescents and their parents with effective ER strategies to help them cope with their feelings adaptively.

In this context, this project aims to answer the research question: "Is it possible to adapt to a SG the psychoeducation and training of ER strategies to adolescents and their parents?"

The objective is to collaboratively design and develop a multiplayer SG aimed at teaching and training ER strategies in a family context, promoting a diverse set of ER strategies for adolescents and parents, thus contributing to the prevention of mental health problems, the encouragement of positive development, and enhance emotional understanding and communication within the familial context.

The SG will seek to teach players concepts, strategies, and ER techniques through different scenarios, challenges, and activities that stimulate their reflection, expression, understanding, and management of emotions. The game will be played together by adolescents and their parents, thus creating an opportunity for them to interact and learn from each other about their emotions.

Chapter 2

Emotion Regulation

2.1 Introduction

In this chapter, we explore the concept of ER and its importance in mental health and well-being. Thus, it will provide a comprehensive understanding of ER, its development, its significance for adolescents, and the crucial role of parents.

2.2 Understanding Emotion Regulation

To understand the regulation of emotions, it is essential to define the term 'emotion' itself. Emotions are intricate, comprehensive reactions that involve synchronized alterations in subjective feelings, behaviors, and physiological aspects [1]. Therefore, regulating emotions means using different strategies to influence or modify one's emotional state [2].

When people regulate their emotions, they may enhance, sustain, or diminish both positive and negative emotional states. In this way, ER often involves changes in emotional responses, which can manifest in the types of emotions individuals feel, the timing of these emotional experiences, and the manner in which they perceive and convey their emotions [2].

There are many different ways that people can regulate their emotions. The field of ER aims to categorize the various methods that people employ to manage their emotions and to explore how different methods lead to different results [3].

ER is a multifaceted process that can occur within and between individuals. Intrapersonal regulation involves controlling one's emotions through cognitive and self-regulatory strategies, such as reappraisal. Intrapersonal regulation can happen both in solitude and in social situations. Conversely, interpersonal ER happens in the context of social interaction. This involves influencing and being influenced by the emotions of others through social support, guidance, or consolation [4].

Regarding the ER goal, it can be explicit when a person consciously wants to modify their emotions and implicit when they do not have such a deliberate intention to change their emotional state [5].

Adaptive ER facilitates individuals' ability to manage diverse situations and challenges. Influenced by biological and social factors, adaptive ER differs among individuals and exhibits flexibility and responsiveness to environmental changes. However, people's ER approaches can become maladaptive when they are not able to change their emotions according to the situation. This can lead to emotional dysregulation [6], which serves as a defining characteristic in most manifestations of psychopathology [7].

2.3 Gross's Extended Process Model of Emotion Regulation

The extended process model of Gross [3] serves as a comprehensive and integrative framework for comprehending how individuals regulate their emotions in diverse contexts and situations, expanding upon the earlier process model of Gross [8]. This model, backed by substantial empirical evidence and the subject of extensive research, has been chosen as the foundation for this dissertation work.

The model builds on Gross's previous process model of ER, which outlines the mental and emotional operations that underlie how individuals regulate their emotions. It explains how people use different ways and methods to control their emotional experiences, including how they comprehend, change, and react to their emotions in different situations [8].

It follows the standard model of emotion, which describes how emotions are generated and regulated in a sequence of steps over time. It starts with the **situation**, where an emotionally relevant context triggers an emotional reaction. Then comes **attention**, where people pay attention to, disregard, or shift their attention to control the effect of the emotional situation on their emotional state. The next step is **appraisal**, which involves assessing the importance and meaning of the emotional situation. Lastly, in the **response** phase, individuals produce an emotional reaction that results in alterations in their feelings, expressions, or physiological responses.

The ER process model views each stage as possible points for influence or management. This perspective leads to the recognition of five different types of ER strategies, each having their main impact at different stages in the process of emotion generation. **Situation Selection** is the first type. It involves intentionally choosing actions or situations that affect the likeliness of experiencing specific emotions. People might seek out situations they expect to evoke positive emotions or avoid those likely to lead to negative ones. The second family of strategies is **Attentional Deployment**, which involves purposefully directing attention to shape emotional reactions. By directing their attention, individuals can change their emotional experience, emphasizing certain aspects of a situation while downplaying others. Next is **Situation Modification**, which involves taking direct actions to alter a situation's emotional impact. This can include changing the environment or context to make it more emotionally favorable or less distressing. The fourth family is **Cognitive Change**. This means changing the way one views or understands a situation to affect how it makes

one feel. A well-known method within cognitive modification is reappraisal, which can involve reshaping the significance of a situation that may evoke emotions or altering its personal relevance. Lastly, the fifth approach is **Response Modulation**. This strategy aims to directly affect various aspects of the emotional response, such as how a person feels, acts, or responds physically, even after the emotion has fully emerged. Expressive suppression is extensively researched in response modulation, involving ongoing efforts to restrain outward emotional expressions.

With this in mind, Gross divided the extended process model of emotions into three stages: the **identification** stage, which is when a person becomes aware of the emotion that they are feeling and then decides on whether to act on it or not, based on how they value it, the **selection** stage that focuses on choosing an ER strategy from the ones described earlier in this section and finally the **implementation** stage where the strategy is converted into specific tactics tailored to the current situation [3].

Moreover, Gross also specified that each of these stages is supported by loops involving perception, action, and valuation, where individuals perceive their current state, evaluate it, and make modifications based on that evaluation [9].

2.4 Emotion Regulation in Adolescents

The shift from childhood to early adolescence is depicted as a period marked by substantial and unpredictable change. This feeling of change and unpredictability can trigger anxiety, as nearly all aspects of their personal growth and social environment are in flux. This includes trying new things, modifications in school structure and format, and the introduction of fresh aspirations and expectations for young individuals [10].

A review on this subject suggests that emotional experiences during adolescence are highly changeable, and there is no one-size-fits-all pattern for all adolescents. Instead, factors specific to individuals or common among adolescents explain why and when their emotional experiences vary. Also, adolescents usually have more often and stronger positive and negative emotions than adults, as well as more fluctuating emotions [11]. As adolescents develop, they gradually build their ER skills. With their growing cognitive abilities in late childhood and early adolescence, they can employ more advanced ER strategies. This developmental phase also involves the formation of a self-concept that bounds their emotional and interpersonal characteristics, as well as their chosen methods for managing emotions [12]. Despite the cultivation of emotional competencies, adolescents face many mental health challenges, such as depression, anxiety, and behavioral disorders, which may confront lasting repercussions [13].

Adolescence is a period of important developmental tasks, such as becoming more autonomous from caregivers and coping with different changes, that require a lot of self-regulation. While many adolescents improve their ER skills as a result, some face new or increasing problems with ER [14]. Numerous studies have shed light on the risks of emotion dysregulation in adolescents. A systematic review by Paulus et al. showed that emotional dysregulation is a common and transdiagnostic construct that is associated with various psychiatric disorders in children and adolescents.

The authors identified 15 categories of disorders that are related to emotional dysregulation, such as ADHD, mood disorders, eating disorders, personality disorders, and psychosis [15]. Furthermore, a comprehensive exploration of the existing literature on the subject conducted by Young et al. concluded that disruptions in ER correlate with an increased probability of adolescents experiencing anxiety and depression symptoms [16]. While these studies highlight the risks of emotional dysregulation, they also reveal the focus on the association with the resulting psychopathologies rather than the underlying cause, which is ER issues.

The research underscores the pivotal role of ER in various domains of well-being in adolescence and emotional dysregulation as a transdiagnostic factor in the development of various psychopathological symptoms. The deliberate use of ER strategies enhances overall well-being by promoting active social and emotional engagement. Additionally, individuals with strong ER skills tend to exhibit better social adaptation. These findings emphasize the significance of ER in promoting welfare across adolescence [17].

2.5 Emotion Regulation in Parents

In the family setting, parents play a significant role in teaching children how to display and manage emotions. This early exposure to their parent's emotional expressions helps children learn the "rules" for showing emotions and how to interpret the emotions of others [18]. Parents actively guide their children, often offering specific advice and techniques to help them cope with negative emotions. Overall, how parents act and how much they care affect the emotional atmosphere in the family. This, in turn, influences how children manage their emotions [19].

Parents often face the difficult task of managing their own emotions and staying calm when taking care of their upset and emotionally dysregulated child, all the while helping their child regain emotional stability. Consequently, for a parent to effectively help their child learn about emotions, the parent needs to both understand their own emotions well and be capable of managing their emotions in a healthy and adaptive manner [20][18].

Adolescents already have basic ER skills through emotion socialization. Still, they also face new challenges in their social and emotional lives, so they keep learning from the people around them how to apply these skills in different and adaptable ways. Parents have been the main source of emotional learning for adolescents since early age and still have a lot of influence as socialization agents [21]. Some evidence suggests that adolescents may emulate their parent's methods of regulating their emotions. A study done with adolescents and their parents involving the evaluation of the use of ER strategies discovered connections between adolescents and their mothers in how they use ER strategies, particularly cognitive reappraisal and expressive suppression [22].

Additionally, a study investigating the influence of parental emotional manipulation on adolescent adaptation, mediated by the regulation of adolescent emotions [23], demonstrated indirect effects on adolescent aggressive behavior and identified both direct and mediated impacts on depressive symptoms. These findings highlight how parenting practices, such as psychological control, affect adolescent ER.

In conclusion, fostering positive interactions between parents and adolescents is a critical factor in promoting adolescents' mental health and overall well-being. This includes recognizing that mothers and fathers play substantial yet separate roles in imparting emotional skills to their children. Understanding and addressing these dynamics can lead to more effective support for adolescent emotional development and well-being [24][25].

Chapter 3

Serious Games

3.1 Introduction

In this chapter, we delve into the domain of serious games (SGs), exploring their multifaceted applications and methodologies. From defining the concept of serious gaming to its practical applications in emotion regulation and the collaborative co-design process, we navigate through various approaches and examples.

3.2 Serious Gaming: A Comprehensive Overview

Video games cater to a diverse audience and represent an industry that's been expanding over the years. According to Video Games Europe, in 2023, there were 124.4 million video game players across five major European markets. Of the population aged 6 to 64 years, 53% engage in video gaming. Additionally, 73% of video game players play for at least one hour per week [26].

Furthermore, market insights on the video game industry in Portugal indicate a significant expansion, with over one million individuals—accounting for 10.6% of the population—currently engaged in gaming. This percentage is projected to rise to 11.7% by 2027 [27] [28].

Notably, a significant percentage of European video game players recognize the positive effects of video games on well-being. Specifically, 67% agree that playing offers a healthy way to cope with everyday challenges, 74% find them mentally stimulating, and 68% consider them effective for stress relief. These statistics highlight the broad consensus on the value of video games in supporting mental health and well-being among players [26].

With this in mind, the field of SGs has grown into a well-known area of research and many attribute the term's origin to Clark Abt in 1970 [29] or its widespread use to Ben Sawyer in 2002 [30]. However, the roots of repurposing play stretch far back [31]. Nowadays, SG definition centers on the concept of a computer application that purposefully blends serious elements such as educational, communicative, or informational components with the engaging and playful nature commonly found in video games. This fusion isn't limited to specific serious elements but seeks to integrate them cohesively. By employing various aspects like sound, graphics, narratives, and

rules, SGs aim to transcend mere entertainment, aiming for utility and departure from pure amusement [32].

SGs serve a wide array of purposes across various fields, spanning from educational games for children to games that train professionals to work together in different sectors and health-focused games. They're also utilized in diverse areas like cultural and tourism experiences, marketing, and societal impact games addressing significant topics like religion and climate [33]. Indeed, SGs prove to be a dependable and efficient educational method as players tend to feel more motivated and retain the ideas introduced by them better compared to traditional teaching methods [34].

Also, it is important to mention that multiplayer SGs are a powerful tool that contribute a notable positive effect on collaboration learning, as in players learning together the educational content of the game [35][36], one essential aspect to consider in the design of the SG stemming from this work.

According to the Entertainment Software Association's 2024 Essential Facts About the U.S. Video Game Industry, 83% percent of parents who engage in video gaming report playing games with their children, while 51% percent do so on a weekly basis, underscoring the potential of a SG as a valuable educational tool that maintains engagement within this specific segment [37].

Serious gaming is incredibly versatile, offering value in education, training, health enhancement, social collaboration, and leisure. Investigating this field is critical as it allows us to grasp the pros and cons of employing games across educational, health, and various other sectors [38].

3.3 Serious Games applied to Emotion Regulation

The increased use of gaming methods in mental health interventions serves multiple purposes. Firstly, it extends access to those who might not otherwise seek help. Additionally, these approaches are engaging, drawing users in with the enjoyment of gameplay. Moreover, serious gaming demonstrates promise in effectiveness by offering both conventional and innovative pathways for behavior change and learning, making therapeutic processes more accessible and enjoyable [39].

Video games shouldn't solely be viewed as mere sources of entertainment or interactivity. Instead, they should be acknowledged for their intricate and multifaceted nature as communicative and narrative mediums, possessing valid potential in comprehending and influencing ER [40]. Indeed, video games present diverse mechanisms to explore. For example, the narratives within games provide a platform for conveying information, influencing, and evoking emotions [41].

Furthermore, studies investigating how video games impact ER demonstrate that games can aid individuals in managing their emotions. For instance, engaging in video games has been associated with heightened positive emotions and reduced stress levels [42]. Moreover, research underscores the advantages of video game training for enhancing cognitive and emotional abilities among adults, especially in the young adult demographic [43].

Recent research demonstrates that SG's effectiveness is particularly evident in strengthening social and emotional skills, specifically in ER. As a case in point, SGs hold considerable potential

in aiding children with autism, enhancing diverse skills by involving players' emotions, enabling them to pursue game goals, and overcoming challenges [44]. Furthermore, progressive technologies such as an interactive virtual reality serious game-based system can offer a new approach to preventing mental health disorders in adolescents by effectively training and assessing ER strategies [45].

Overall, recent findings demonstrated that SGs have a significant impact on improving quality of life by nurturing and enhancing emotional intelligence abilities and overall mental health [46][47].

3.4 Exploring Participatory Action Research Methods

The core idea behind the participatory research approach is to engage stakeholders actively in the development and implementation of projects regarding concerns that matter to them [48].

Terms like co-creation and co-design have emerged to illustrate particular methods included in Participatory Action Research. Co-creation is a process that engages various stakeholders in the joint exploration and resolution of problems across the entire project cycle. On the other hand, co-design is a process that involves the collective design of outcomes for a specific problem that is already defined [49]. Both collaborative approaches will be explored throughout this work in the form of a study. Further detailed explanations and comprehensive insights into the study will be provided in subsequent chapters.

Co-creation and co-design are processes that rely on the principle of engaging stakeholders throughout the design process. When stakeholders are effectively involved, they can establish cooperative bonds and acquire a feeling of responsibility for the design outcomes that emerge from the process [50]. These design approaches are gaining recognition as the optimal methods for developing new public interventions as co-design, for example, enables collaborative problem-solving, creativity, and community engagement [51]. Moreover, it has been identified that methodologies such as participatory design have been used intensively in the design process of educational games [52]. Co-design demands time and space for deliberation, which can be enabled by various means, such as workshops and online platforms. Co-design means can be categorized into processes, methods, and tools, which assist design activities, such as extracting knowledge, stimulating reflections, projecting futures, or testing ideas. Co-design mechanisms have different roles, depending on the situation and the aims of the design project [53]. The importance of this process lies in the development of products that address a variety of user needs while also being deemed acceptable and useful through creative collaboration [54].

Ultimately, focusing on this specific work, researchers defend that a game design strategy like co-creation is indispensable in the creative process. Involving ideas from the target audience not only offers valuable insights into their priorities but also serves as a collaborative effort to achieve a shared objective [55].

3.5 Examples of Co-Creation in Serious Game Design

This section examines and elaborates on SGs designed to promote mental health and used collaborative development approaches, such as stakeholder involvement. Additionally, this section covers the limitations of each intervention.

3.5.1 Quest-Te Whitianga

Quest-Te Whitianga is a mobile game designed to assist youths in managing intense emotions. The game targets the young population who struggle with mental health issues such as anxiety and depression.

Quest - Te Whitianga is a game in a fictional island chain affected by a volcano. The player helps Tata, the game's host, find her five friends, who are guardians of the islands and have ancient knowledge of well-being. Tata guides the player to learn skills and improve well-being. The app consists of several modules that use various gamification elements to facilitate the uncovering of knowledge, such as points or feedback, rewards, progression, narrative, and challenges. Additionally, it has a fantasy storyline to deliver the game's educational content.

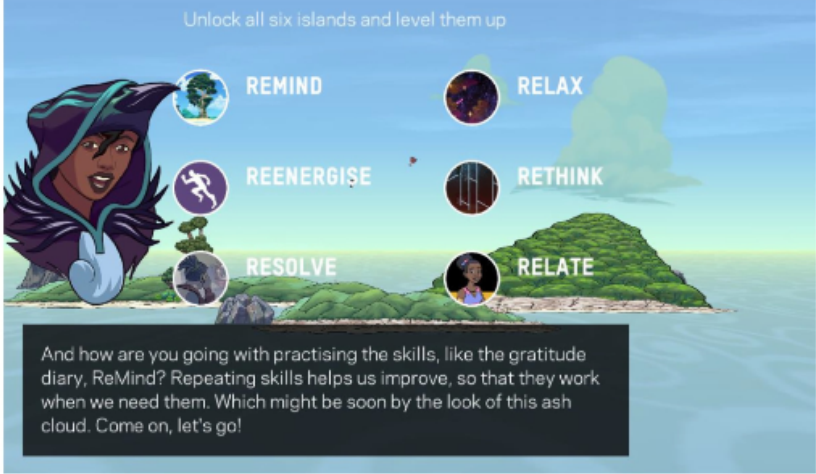
Module / Island	Image / screenshot
Onboarding, game play arena and narrative story	 Unlock all six islands and level them up REMIN REENERGISE RESOLVE RELAX RETHINK RELATE And how are you going with practising the skills, like the gratitude diary, ReMind? Repeating skills helps us improve, so that they work when we need them. Which might be soon by the look of this ash cloud. Come on, let's go!

Figure 3.1: Gameplay and narrative of *Quest-Te Whitianga*.

The co-creation process included qualitative approaches to collect input from stakeholders, including youth organizations, primary healthcare professionals, educational institutions, and especially the young population, gathering valuable insights. Moreover, an iterative and inclusive process was also included, where expert advice, software development, and user feedback were integrated. The prototype app was evaluated by 30 members of the target population. Their early feedback was crucial in guiding the game's development, highlighting the importance of co-design. Positive responses to the app's aesthetics and reward system, combined with narrative critiques, directly influenced subsequent improvements [56][57].

3.5.2 The Adventures of DoReMiFa

The Adventures of DoReMiFa is a digital sectioned game designed to promote mental health among primary school students. Its core objectives revolve around fostering emotional intelligence, problem-solving skills, and social competence.

The intervention uses cognitive behavioral therapy and positive psychology to reduce anxiety and enhance mental well-being.

The narrative unfolds with four monster creatures embarking on a quest within a primary school to discover a secret book capable of enhancing mental health. They encounter two students who help them locate the book and navigate various challenges.

A multidisciplinary team developed the intervention's content, incorporating feedback from teachers, parents, and students through focus groups. The game lessons featured a narrative of adventure, dialogue, critical thinking, and collaboration.

School-based lessons were also included in the intervention to reinforce learning.

A usability study with 459 primary school students evaluated *The Adventures of DoReMiFa*. While it did not show significant reductions in anxiety or negative thoughts, the results were optimistic, indicating the program's potential to enhance children's mental well-being [58] [59].



Figure 3.2: Characters from *The Adventures of DoReMiFa SG*

3.5.3 Limitations

In these interventions, there's a notable absence of active parental involvement in the game's creation process and/or during gameplay, which could be beneficial since parents are an important influence on the well-being of their children. Another significant aspect is the lack of feedback

integration from healthcare professionals, which could enhance the effectiveness and relevance of the approach.

Table 3.1: Limitations of the approaches

Interventions	Limitations
Quest-Te Whitianga	The design primarily addresses treating adolescent mental health issues, with no emphasis on preventive strategies. Additionally, it lacks engagement with crucial socialization agents, namely parents, who play a crucial role in adolescents' development and well-being.
The Adventures of DoReMiFa	Lack of more active parental involvement might limit the program's impact. The program's efficacy might differ among various groups of students and within diverse cultural settings. Significant assets are needed to implement this intervention in schools.

Chapter 4

A Systematic Review of Design Elements in Serious Games for Children and Adolescents: The Role of Parents

4.1 Introduction

A notable gap exists in the literature concerning the role of parents in serious games designed to promote mental health for children and adolescents. This systematic review, currently in progress, aims to fill this gap by synthesizing existing research on the design elements of serious games for promoting mental health of children and adolescents, focusing on the role of parents.

4.2 Literature Search Approach

The literature search was conducted across multiple academic databases, specifically Web Of Science, IEEE Xplore, and PubMed, to ensure comprehensive coverage of relevant studies.

The search approach employed the following terms: *“serious game” AND (“family” OR “parent*” OR “adolescent*”)*. This combination of terms was designed to identify studies focusing on serious games involving family dynamics, parental involvement, or targeting adolescents. The asterisk (*) was used as a wildcard to capture variations of the words (e.g., “parenting,” “adolescents”).

4.3 Inclusion and Exclusion Criteria

Inclusion criteria for the review required that studies involve an intervention delivered through a SG, primarily focusing on preventing or treating mental health issues. In addition, the studies had to offer clear insights into the game mechanics, specifically detailing aspects such as game goals and interactions that support mental health objectives.

The target population for these interventions included adolescents aged 10 to 19 or children from

normative or clinical populations. Furthermore, the studies needed to involve parents or caregivers, whether through active gameplay, providing support to the adolescent or child during gameplay, or participating in related activities such as completing questionnaires.

Studies were excluded if they did not have explicit descriptions of game mechanics, were review articles, were not published in or available in English, did not have a clear focus on mental health improvement, did not include members of the target population (adolescents or children), or did not involve relevant parental or caregiver participation.

4.4 Study Selection

Screening titles, abstracts, and full texts were managed using Covidence [60], facilitating an efficient and systematic literature review. Covidence allowed for streamlined data management and consensus among reviewers.

Eighteen studies met the eligibility criteria for inclusion in this systematic review. The PRISMA diagram 4.1 illustrates these studies' selection process, which was generated using Covidence.

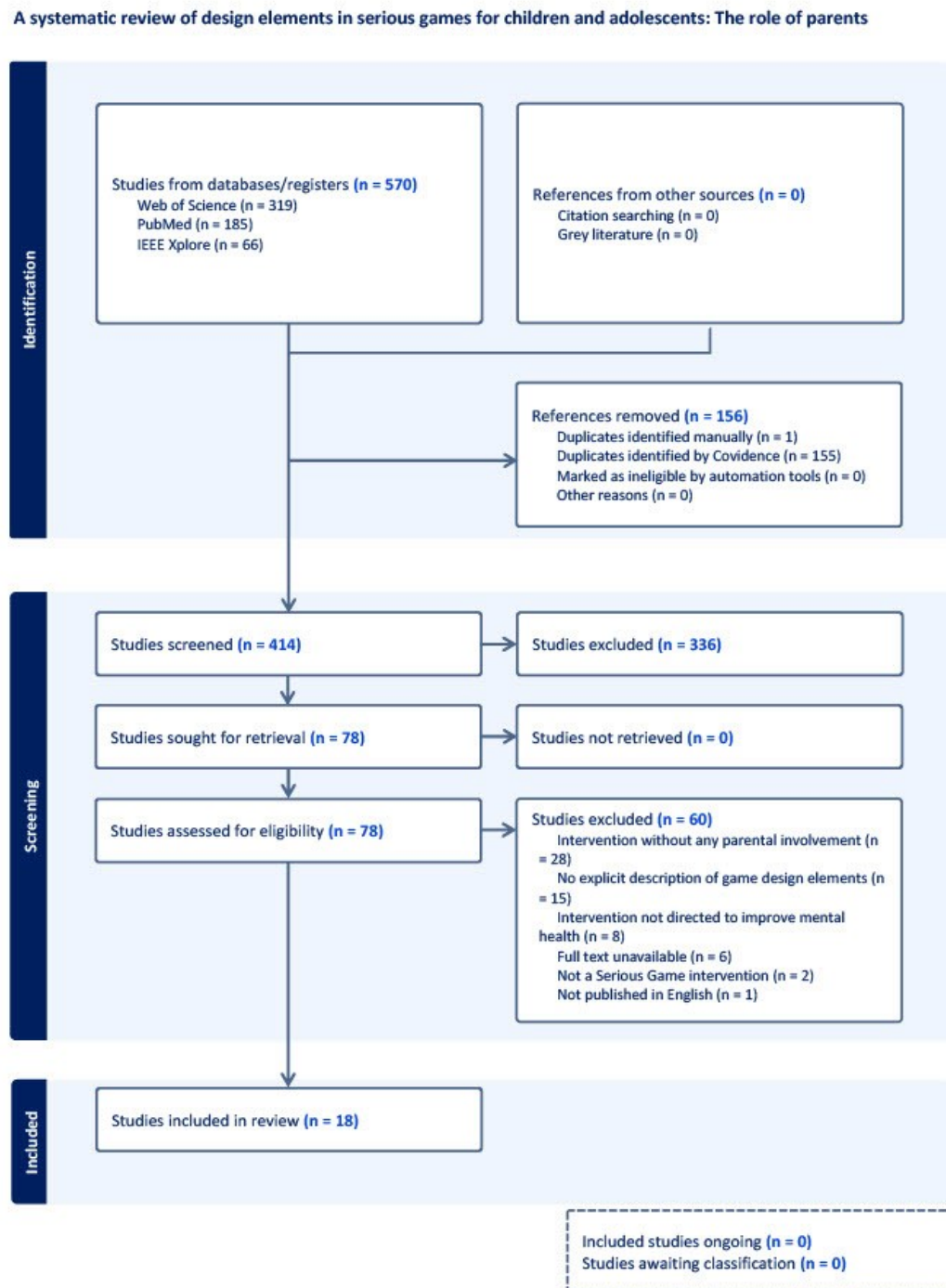


Figure 4.1: Study selection process illustrated by the PRISMA flow diagram.

4.5 Data Extraction

Data from the selected studies were systematically extracted based on a predefined set of variables. Each study was evaluated, and relevant information was recorded according to these specific variables to ensure consistency and thoroughness in the data collection. The predefined variables include game name, intervention objectives, target audience, parental participation, gameplay description, game mechanics, platform, technologies, study design, sample size, and study findings.

4.6 Results

The data extraction results are presented in Table 4.1, which details the information for each included study according to the predefined variables.

The review revealed a significant predominance of SGs designed specifically for children compared to those specific for adolescents. Moreover, the majority of these interventions are predominantly targeted toward individuals diagnosed with Autism Spectrum Disorder (ASD). The reviewed SG interventions include objectives to enhance various competencies, including emotional regulation, social interaction, communication skills, and attentional control. Additionally, some of the interventions are designed to reduce symptoms associated with anxiety and stress within the target population.

Regarding the primary focus of this systematic review, the involvement of parents in the reviewed serious games was generally minimal and largely passive. In most interventions, parents were primarily engaged in completing questionnaires, providing assessments of their child's condition, or offering support during gameplay. None of the reviewed SG-based interventions was designed for interactive play between parents and adolescents. However, one SG-based intervention reviewed was designed for active participation by parents and children. Specifically, the *GOLIAH* platform is designed to support children with autism spectrum disorder through home-based gaming activities involving both parents and children in the games provided. Additionally, parents provide feedback on their experience with the intervention [61] [62].

Among the SGs reviewed, various game mechanics were identified that enhance their educational value. Many SGs incorporate reward systems, such as point-based incentives, to motivate players. These games often feature multiple difficulty levels, allowing specific experiences that accommodate varying skill levels. Additionally, an in-game currency system is commonly used, enabling players to customize and unlock additional features. Positive reinforcement feedback is frequently employed to encourage continued engagement and achievement. Furthermore, immersive storylines and narratives are integrated to support and enhance the educational objectives of the game. In the studies reviewed, the platform utilized for playing the games was often unspecified. However, among the studies that provided details, the predominant platform was a computer. Moreover, various technologies are employed across the various interventions analyzed for numerous purposes. Notably, the Unity game engine is a predominant technology prominently utilized in most reviewed games.

Finally, the findings consistently indicate positive user evaluations and favorable outcomes aligned with the objectives of each intervention. The reviewed SGs were generally associated with reported enhancements in the target population in various domains, including emotional and social capabilities.

4.7 Conclusions

The results reveal a significant gap in the current landscape of SGs designed for mental health interventions, particularly concerning active parental involvement. Most interventions have limited parental engagement and are often restricted to passive activities, highlighting a need for SGs that foster collaborative learning and active interaction between parents and their children. Additionally, the few games that do incorporate active parental involvement are not targeted at adolescents. Consequently, there are no existing interventions that promote mental health among adolescents through active parental participation. Even among the games involving parental passive involvement, such as completing questionnaires, most are aimed at younger children. This suggests that parental involvement in adolescent mental health is often overlooked, possibly due to the perceived greater autonomy in adolescents, despite evidence showing that parents significantly influence adolescent ER, with adolescents often adopting their mothers' ER strategies [21] [22]. This systematic literature review highlights several crucial elements that have been integrated into the development of the SG presented in the next chapter. Notably, the strategic use of reward systems, in-game currency, customization options, and immersive storylines has been emphasized as essential for enhancing player motivation and engagement. Furthermore, the review identifies the computer as the predominant platform for serious game development, with the Unity game engine being the preferred choice for creating these interventions.

The SG developed aims to serve as a pivotal tool in addressing the lack of active parental involvement in interventions designed to promote adolescent mental health by directly engaging parents.

Table 4.1: Summary of Studies: An Overview of Interventions, key characteristics, and outcomes [63].

Study	Game Name	Intervention Objectives	Target Audience	Parental Participation	Gameplay Description	Game Mechanics	Platform	Technologies	Study Design	Sample Size	Study Findings
Wijnhoven, L.A.M.W., Creemers, D.H.M., Engels, R.C.M.E. et al. (2015)	Mindlight	Reducing anxiety symptoms in children with Autism Spectrum Disorder (ASD).	Children with ASD.	Parent report of child anxiety, depressive symptoms, and social behavior issues.	Mindlight incorporates cognitive-behavioral therapy (CBT) and neurofeedback. Players must navigate a scary mansion and overcome fears.	Players earn points by staying calm in the presence of threats, helping them habituate to fears. Rewards are given for focused concentration in attention bias modification puzzles.	Not precisely specified (maybe computer).	Neurofeedback Headset.	Randomized controlled trial (RCT) with two groups (experimental and control).	Experimental group: N = 60 Control group: N = 60	Not applicable (NA).
Kirst, Simone, et al. (2022)	Zirkus Empathico	Foster empathy and emotional understanding in children on the autism spectrum disorder through self-awareness, facial expression recognition, inferring others' emotions, and promoting prosocial responses to distress.	Children with ASD.	Parental report on child behavior during gameplay. Advised to play together with their children.	Players are guided by a fox character that guides the participants through the training modules focused on emotion awareness, recognition, inference, and appropriate reactions. Training includes video stimuli and emotion-eliciting situations.	Different levels according to the child's progress. Freedom to select open modules. Players are provided with instructions, explanations, prompts, and rewards.	Tablets	Tablet-based Videos.	RCT	N = 82	Moderate improvements in emotional awareness, regulation, and social symptoms related to autism.
Schultz, B. K., Evans, S. W., Bowditch, J., Carter, K., Rogers, E. E., Donelan, J., & Dembowski, A. (2023)	ATHAMOS	Planning/organization skills training in young adolescents with ADHD.	Young adolescents with ADHD, ages 10-15 years.	Participate in the focus groups and make assessments.	Players pilot the "ATHAMOS" spacecraft to gather intel on extraterrestrial threats. Mini-games involve scheduling meetings, organizing intel, taking notes, and mirroring real-world tasks to improve problem-solving and organizational skills in players, particularly those with ADHD.	Difficulty increases each round but adjusts when players encounter challenges.	Personal Computer (PC), using a two-joystick gamepad.	Unity real-time development platform, Autodesk Maya, Adobe Photoshop, GRID Lab's 24-camera OptiTrack motion capture system, Autodesk MotionBuilder, Motive software, Avid Pro Tools and Yamaha Nuendo.	Focus groups with young adolescents with Attention-Deficit/Hyperactivity Disorder (ADHD), followed by a pilot study in a school-based intervention.	Focus groups: N=72 Pilot study: N = 16	Game positively perceived. Overall, user satisfaction was high.

Note. RCT: randomized controlled trial; ASD: Autism Spectrum Disorder; ADHD: Attention-Deficit/Hyperactivity Disorder; CBT: cognitive-behavioral therapy; GOLIAH: Gaming Open Library for Intervention in Autism at Home; SAGA: Social Games for Autistic Adolescents; ER: emotion recognition; SG: serious game; EFs: executive functions; NA: not applicable;

Study	Game Name	Intervention Objectives	Target Audience	Parental Participation	Gameplay Description	Game Mechanics	Platform	Technologies	Study Design	Sample Size	Study Findings
Löyrymäki, J., Ohtonen, P., & Huttunen, K. (2024)	Emotion Detectives	Improving social-emotional skills of children with neurodevelopmental disorders.	Children with neurodevelopmental disorders.	Provided information about their children's emotion recognition skills and behaviors through questionnaires. Evaluate how much they played together with their children.	Players set up their own detective office and work with a virtual assistant named Aksu to solve various social and social-emotional problems.	The virtual assistant gives positive feedback. Different levels of difficulty. Design of competitive environments. Reward system in the form of points, specific tools and positive validation. All game text can also be listened.	NA	All vocal and photo materials were recorded and edited in a professional sound-recording studio and a professional photographer's studio.	Applied Behavior Analysis research design (intervention group and control group).	Intervention (N=30) Control Group (N = 20) Group of typically developing peers (N = 106)	Improved children's emotion discrimination skills Positive effects on emotion recognition and behavioural skills (reported by parents).
Scherf, K. S., Griffin, J. W., Judy, B., Whyte, E., M., Geier, C. F., & Elbieh, D. (2018)	NA	Train individuals with ASD to understand that eye contact and gaze direction convey important information about the world around them.	Adolescents with ASD.	Answer autism, social and behavior questionnaires.	Adventure game in which participants solve mysteries in a 3D environment. Players solve narrative-related questions by interpreting non-verbal behaviors of game characters.	Immersive storyline and long-term goals. Individualized training and choice provision. Rewards and feedback for goal progress.	Computer.	Unity.	RCT (intervention game and control condition).	Adolescents (10-18 years, N = 34) with ASD and their parents.	NA.
Johnston, D., Egermann, H., & Kearney, G. (2020)	SoundFields	A Virtual Reality (VR) Game Designed to Address Auditory Hypersensitivity in Individuals with ASD The objective is to help players build tolerance and reduce anxiety associated with problematic sounds.	Adolescents with ASD and auditory hypersensitivities to single or multiple auditory stimuli.	Complete questionnaires	The gameplay involves interacting with the virtual world and gradually facing more challenging auditory scenarios.	Reward system. Virtual shop where earned currency can be spent. Avatar customization. Player freedom to choose which game level they play and can repeat it as many times as they want.	Not specified, probably a computer.	Unity3D, eReaper digital audio workstation, Wwise, 3D binaural-based spatial audio rendered via the Google Resonance spatial audio SDK.	Pilot study.	6 adolescents.	Anxiety levels related to specific sounds significantly decreased.

Study	Game Name	Intervention Objectives	Target Audience	Parental Participation	Gameplay Description	Game Mechanics	Platform	Technologies	Study Design	Sample Size	Study Findings
Carlier, S., Van der Paelt, S., Ongenaes, F., De Backere, F., & De Turck, F. (2020)	New Horizon and SpaceControl	Help children with Autism Spectrum Disorder (ASD) and their parents manage anxiety and stress.	Children with ASD and their parents.	Parents participated in usability studies with their children and filled questionnaires. Parents use a parenting app (SpaceControl).	2D mobile game where players explore an endless universe. The game features two standard mini-games without CBT techniques and two with relaxation techniques.	Language and text as clear as possible. Reward system. Simple background story. Visual and sound effects in actions during the mini-games. Game visually simple.	Android Device.	Unity, Procedural Generation.	Feasibility and usability study.	Three children between 6-10 years old and their parents.	Game shows potential for stress and anxiety reduction in children with ASD.
Serret, Sylvie, et al. (2014)	JeStiMuIE	Improvement in performance on emotion recognition (ER) tasks.	Children and adolescents with ASD.	Answer a question-naire about tactile sensory of their children.	Virtual reality game where players engage in a multi-sensory environment to train emotion recognition skills. Emotions are displayed on avatars and linked to visual, verbal, and tactile cues to aid understanding. Players use colors, symbols, and tactile patterns to identify and distinguish between emotions.	Short sequences with immediate feedback Visual rewards Innovative vibrotactile gamepad Customizable avatars Free movement in a virtual environment Choice in how and when to interact with other avatars Experimentation with various social situations similar to real life Multi-sensory stimulation (visual, audio, and tactile) to enhance immersion and attractiveness Adapted for both non-verbal and non-reading children and adolescents with ASD.	Gamepad.	Unity3d.	Pilot Study.	Thirty-three children and adolescents with ASD, aged between 6-17 years old.	Suitable adaptability, effectiveness and efficiency of the game. Appears to be a promising tool to teach ER in individuals with ASD.
Abd El-Sattar, H. K. H. (2023)	EMOCASH	Improve the ability of children with (ASD) to manage finances and recognize emotions using a novel virtual agent-based multiplayer online serious game.	Children with Autism.	Answered question-naires.	Varying difficulty levels. Six types of 3D mingames.	Rewards (e.g., points, badges). Best Moments storage feature. Implementation of the status of the player. Leaderboard feature. Existence of competitive behavior. Difficulty adjusting according to levels.	Not specified, probably computer.	Unity, Blender	Longitudinal.	14 children with ASD between 7-15 years old. 7 typically developing volunteer children.	Using virtual agent technology within online gaming, especially when enhanced by sensory design features, could be a highly effective method for teaching individuals with ASD.

Study	Game Name	Intervention Objectives	Target Audience	Parental Participation	Gameplay Description	Game Mechanics	Platform	Technologies	Study Design	Sample Size	Study Findings
Jouen, Anne-Lise, et al. (2017)	GOLIAH (Gaming Open Library for Intervention in Autism at Home)	Treat children with ASD by delivering intervention at home to simulate and improve imitation and joint attention.	Children with ASD.	The game is specifically designed for parents to play with their children. Parenting Stress Index (PSI) questionnaire that assesses parental stress levels during the study.	The GOLIAH platform offers a series of 11 serious games. The multi-player gaming platform requires two computers, one operated by the therapist and the other by the child designated as the player. Goals are set by therapists or parents to be achieved by the child.	Different levels of difficulty which are adjusted by the therapist/parent according to the cognitive skills. Difficulty can also be dynamically adjusted by the player's performance. Reward system... Positive reinforcement (smiley face) Scoring system.	Computer.	Not specified.	Exploratory study with two groups (experimental and control).	Experimental group: N=14 Control group: N=10	GOLIAH intervention did not affect Parental Stress Index scores. Both groups (experimental and control group) present a significant improvement in Autism Diagnostic Observation Schedule scores, Parental Stress Index scores, and other measures.
Bernardini, S., Porayska-Pomsta, K., & Smith, T. J. (2014)	ECHOES	Help young children with ASD practice social communication skills.	Children with ASD.	The activities in the game were manually selected by the parent through a graphical interface.	ECHOES has an intelligent agent that interacts with the children. The game includes twelve learning activities.	Non-verbal narratives. Goal-oriented activities. Cooperative turn-taking activities.	42-inch multitouch LCD display.	Eye-gaze tracking technology.	Large-scale multi-site intervention study.	N=29	Evidence shows that some children have benefited from their exposure to the ECHOES environment.
Yang, Z., An, P., Yang, J., Strojny, S., Zhang, Z., Sun, D., & Zhao, J. (2021)	Starkids	Enhance social and attentional capabilities in children with autism.	Children with ASD.	Parents were interviewed during the design process of the game.	The game contents of Starkids currently include 12 animated games and 24 games that use video clips of people.	The game has an overarching storyline with twelve Zodiac Animals. All 12 games are designed with different collaborative tasks.	Tablet.	EEG sensor-kit (neurofeed-back headset).	Cross-sectional	Children with ASD: N=19 Therapists: N=12 Parents: Not precisely specified	During the Co-Design process, the authors found that they should emphasize hand movements and simplify facial expressions for characters, and they should diversify gameplay experiences while having a coherent overarching story.

Study	Game Name	Intervention Objectives	Target Audience	Parental Participation	Gameplay Description	Game Mechanics	Platform	Technologies	Study Design	Sample Size	Study Findings
Elhaddadi, M., Maazouz, H., Alami, N., Drissi, M. M. H., Mènon, C. S., Latif, M., & Ahami, A. O. T. (2021)	JeStiMulE	Teach social cognition, including emotion recognition for children and adolescents with autism.	Children with ASD.	Parents filled questionnaires.	JeStiMulE is an interactive and multi-sensory computer game.	The game presents six basic emotions and one complex emotion (pain) displayed in both static and animated avatars. Each emotion is then associated with a specific color.	Computer; played with a gamepad.	Gamepad.	Experimental protocol consisting of the Faces Test, The Rimland E2 questionnaire, and the JeStiMulE serious game.	N=32	Results show suitable adaptability, effectiveness, and efficiency of JeStiMulE. Participants were more accurate at recognizing emotions after JeStiMulE.
Fridenson-Hayon, Shimrit, et al. (2017)	Emotiply	Teach ER to children with ASD in an entertaining and intrinsically motivating way.	Children with ASD.	Parents participated in the session with their children. Parents filled questionnaires. Parents were also asked for their feedback on the system's effectiveness.	It has an introduction explaining what emotions are. Then, it progresses to teaching different emotions to the child.	The game's storyline includes the user in the role of an explorer. Provision of choice includes the ability to design an avatar. The game combines educational material with a reward system. Players receive positive reinforcement adjusted to their level. The game also includes a variety of characters.	Computer.	NA	Cross-cultural evaluation.	N=15 (in the UK) N=39 (in Israel) N=36 (in Sweden)	Results revealed that participants' improved their performance on ER body language, showed reduced ASD symptoms, and improved their adaptive socialization.
Bul, Kim CM, et al. (2016)	Plan-It Commander	The game seeks to act as an adjunct to treatment for children with ADHD. The study seeks to determine the effects of the game on daily life skills of children with ADHD.	Children with ADHD.	Parents completed questionnaires.	The SG is a mission-guided game divided into 10 different missions and several side missions. During the missions, the player has to solve problems requiring time management, planning, and organizing skills.	The players can help or/and be helped by other players through messages. The game also has a reward and progression system. When the player completes certain challenges, an achievement is unlocked.	Online Game (possibly computer).	NA	RCT	N=170	Participants who received the SG intervention showed significantly greater improvements in time management skills, social skills of responsibility, and working memory.

Study	Game Name	Intervention Objectives	Target Audience	Parental Participation	Gameplay Description	Game Mechanics	Platform	Technologies	Study Design	Sample Size	Study Findings
Griffin, J. W., Geier, C. F., Smyth, J. M., & Scherf, K. S. (2021)	SAGA (Social Games for Autistic Adolescents)	Improve adolescents' sensitivity to eye gaze cues.	Adolescents with ASD.	Parents were included in the sessions but were advised not to intervene except to help the adolescent in case of technical difficulties. Parents completed questionnaires.	SAGA is a serious game in which participants solve puzzles.	The game provides a narrative storyline, and the player can interact with animated characters. There are different levels of difficulty which are dynamically altered.	Computer.	Unity.	RCT	N=40	The treatment group developed increasing sensitivity to human eye gaze cues in opposition to the standard group. They also showed improvements in social skills.
Bono, Valentina, et al. (2016)	GOLIAH	Help stimulate and improve imitation and joint attention in children with autism spectrum disorder.	Children with Autism Spectrum Disorder.	The game is designed for both children and parents. Parents also reported on their experience with the game by answering an online questionnaire.	The platform has eleven games. The goals are set by the parent/therapist. The game requires two devices to play.	The games have a scoring and feedback system.	Computer.	Not specified.	Pilot study.	N=10	The children had an improvement in concentration, flexibility, and self-esteem.
Dovis, S., Van der Oord, S., Wiers, R. W., & Prins, P. J. (2015)	Braingame Brian	Train multiple executive functions (EFs) to reduce EF-related ADHD symptoms in children.	Children with a clinical diagnosis of ADHD (aged 8–12).	Parents reported on the condition of their child post-intervention.	The game is an open world with a main character named Brian. The game consists of 25 training sessions.	The game has an external reward system with stickers, ribbons, and medals. The game has increasing levels of difficulty.	Computer.	NA	Randomized Double-Blind Placebo-Controlled Trial.	N=89	Children showed improvement in visuospatial short-term memory.

Chapter 5

Emotion Odyssey: Unlock The Secrets

5.1 First Phase of Co-Design: Interviews

In the design of *Emotion Odyssey*, we conducted exploratory co-design studies that integrated qualitative data collection methods.

5.1.1 Procedure

The initial co-design phase involved active collaboration between adolescents, their parents, and psychologists. Recruitment of adolescents and their parents was conducted through educational institutions with institutional approval, utilizing leaflets for dissemination (Annex B.1). Informed assent from the adolescents and consent from their parents were obtained prior to participation. Psychologists were recruited via convenience sampling.

The initial session with each participant began with an introduction to the study and its objectives, followed by semi-structured interviews to gather preliminary ideas for the game’s conceptualization. Depending on the participants’ availability, this session was conducted remotely or in person. These interviews employed a flexible script to adapt to the interviewees’ responses, typically lasting approximately 30 minutes. A semi-structured interview guide (annex B.2) was created to explore initial concepts for the SG, concentrating on participants’ views regarding the theme, narrative elements, game environments, difficulty levels, and strategies for enhancing the experience for each individual. Following the structured questions, participants were invited to offer further insights or recommendations at the end of the interview. The interviews were recorded and transcribed verbatim while maintaining participant anonymity.

An inductive thematic analysis was utilized to identify and interpret recurring themes and patterns in the data [64].

This procedure received approval from the ethics committee of the Faculty of Engineering of the University of Porto (Doc. N° 10 /CE FEUP/2024) and the procedures adhered to the principles outlined in the Declaration of Helsinki.

5.1.2 Participants

The first co-design phase included target users—adolescents and parents—to gather insights for creating an engaging and accessible game, and health professionals, which commonly provide expertise on therapeutic goals, aligning the intervention with skill development and real-life application [65].

Adolescents were selected based on the criterion of being between 10 and 14 years of age, representing the early adolescence phase.

Participants in this co-design phase from the target population include a 45-year-old married mother with a bachelor's degree and her 14-year-old daughter, currently in her ninth year of schooling.

Additionally, the study sample included 3 full-time psychologists and 1 intern psychologist, all female and of Portuguese nationality, aged between 22 and 29 years ($M = 26.75$; $SD = 3.20$), with years of experience ranging from 0 to 6 years ($M = 3.75$; $SD = 2.63$).

Detailed sociodemographic characteristics of the psychologist's participants are presented below:

Table 5.1: Health Professionals Sociodemographic characteristics ($n = 4$)

Variable	n	%
Gender		
Male	0	0%
Female	4	100%
Other	0	0%
Total	4	100%
Age		
22	1	25%
28	2	50%
29	1	25%
Total	4	100%
Nationality		
Portugal	4	100%
Other	0	0%
Total	4	100%
Occupation		
Psychologist	3	75%
Intern psychologist	1	25%
Total	4	100%
Years of Professional Experience		
0	1	25%
4	1	25%
5	1	25%
6	1	25%
Total	4	100%

5.1.3 Data Collection Methods

The data collection for this first phase of the co-design included semi-structured interviews to understand the participants' experiences and perspectives comprehensively.

For the interviews with health professionals, the interview guide was organized around the following themes:

- **Opinion on the Theme:** Psychologists' perspectives on the importance of a game with this purpose and their views on its potential to promote ER competencies among parents and adolescents.

- **Game Conceptualization:** Suggestions on the type of story, situations, and environments that should be included in the game to make it engaging for parents and adolescents.
- **Objective of the Game and Integration with Theory:** Insights on ensuring the learning experience is challenging yet achievable for parents and adolescents and how to link game-play with theoretical concepts effectively.
- **Game Experience:** Strategies to adopt to make the game relatable and suitable for all players.

Similar to the approach used for health professionals, interviews were conducted with parent and adolescent participants. However, there were some differences in the interview guide and objectives. For the interviews with parents and adolescents, the guide was organized around the following themes, with some specific questions for each group:

- **Participant Contextualization:** Exploration of participants' experiences with playing games, the types of devices used, and the characteristics of their favorite games.
- **Interest in the Subject:** Opinions on the proposed game and the potential for collaboration between parent and adolescent. For parents, the interview focused on the knowledge beneficial for understanding their children's emotions, including examples of situations where they found it challenging to respond appropriately to their children's emotional needs. For adolescents, the interview focused on the knowledge about emotions they believe is important for parents to acquire.
- **Game Motivation:** Preferences regarding the multiplayer nature of the game (cooperative vs competitive), desired game mechanics, environments, characters, and stories.
- **Rewards and Feedback:** Preferences for types of rewards and feedback within the game and their intended purposes.
- **Game Experience:** Desired personalization options within the game and suggestions for improving the in-game experience for both parents and adolescents.

5.1.4 Data Analysis

A thematic analysis [64] was conducted on the interview data. The initial phase of thematic analysis involved thoroughly familiarizing ourselves with the data through repeated readings of the transcripts. This process allowed for a comprehensive understanding of the content and context of the participants' responses. Subsequently, themes encapsulating the core of participants' ideas were identified and described.

Direct participant quotations were integrated verbatim into the analysis to underscore the identified preliminary themes.

For clarity and consistency, participants were coded as follows: psychologists were referred to as P1 to P4, the adolescent as A1, and the parent as PA1.

5.1.5 Results

The data analysis revealed four distinct general themes, which will be elaborated upon and subdivided according to specific concepts identified. The themes include: **Target Users' Engagement with Video Games**, **Integration of Technology in Mental Health Interventions**, **Conception of Relatable Game Content** and **Game Design Elements**.

5.1.5.1 Theme 1: Target Users' Engagement with Video Games

Experience with Games

PA1 and A1's experience with games is limited, primarily engaging with casual mobile games designed for time-occupying entertainment.

Target Users Gaming Habits

On average, PA1 plays for 10 to 15 minutes on weekdays and does not play on weekends. A1's gaming duration is higher than PA1, averaging around 45 minutes on weekdays and one hour on weekends.

Preferred Game Features

The types of games PA1 prefers are typically simplistic, lack narrative, and with minimal environmental variety. Specifically, PA1 favors games such as *Mahjong* and *Candy Crush*, known for their straightforward mechanics. There is a preference for games of intermediate challenge in terms of game difficulty.

A1 primarily engages with casual games that typically lack characters and narrative, focusing instead on completing missions or achieving specific objectives without an overarching storyline. In terms of difficulty, A1 prefers games that are easy to play.

5.1.5.2 Theme 2: Integration of Technology in Mental Health Interventions

This theme examines the intersection of technology and mental health care, focusing on two aspects: health professionals' adoption of technological tools and the psychologists' perspectives on the value of an SG-based intervention for enhancing ER skills in adolescents and their parents, compared to traditional methods.

Health Professionals' Use of Technology

All three psychologists (P2 to P4) reported regularly using new technologies in their professional practice, particularly during consultations. Specifically, they utilized various applications to communicate with patients, devices such as tablets, and interactive applications to enhance their therapeutic interventions. Conversely, the intern psychologist (P1), with less professional experience than the others, indicated that she did not use any new technologies in her practice.

Psychologists' Perspectives on the SG-Based Intervention for Enhancing ER Skills

All psychologists concurred on the efficacy of this format in motivating adolescents to acquire ER skills.

P1 emphasized that it is a more interactive and enjoyable approach that could effectively teach ER skills to adolescents and their parents. Additionally, it underscored the importance of parents possessing strong ER skills:

[...] an interesting way to train these emotion regulation skills, perhaps in a more interactive and fun way [...] very important that this is done in this way, because often when you try to train emotion skills with the adolescents themselves, they won't be as effective if there's no emotion regulation on the part of the parents either. (Quote 1, P1)

P3 noted the potential that the intervention can have to address the resistance adolescents often show toward traditional psychological treatments:

they're very resistant to going to the psychologist for psychological counseling. It's a bit difficult to win them over [...] if there's a game that we can use, there's no doubt that kids like that, in that age group, will love it. (Quote 2, P3)

Furthermore, P4 particularly emphasized the crucial role of playful activities in capturing adolescents' attention and fostering cooperation: *"we use it a lot in our sessions, even with schools [...] because we think we can reach this type of audience more easily, especially in terms of conflict resolution. "* (Quote 3, P4).

5.1.5.3 Theme 3: Conception of Relatable Game Content

This theme focuses on participants' views regarding scenarios, environments, and situations that would be relevant and relatable for adolescents and parents to integrate into the game.

Importance of Gathering Input Directly from Target Users

Gathering input directly from parents and adolescents is essential for creating relevant and engaging content for them:

" it would be better to collect this information from the parents and the adolescents, because I think that what will be most interesting for them will be what they want [...] try to look for age-appropriate things, and the preferences of adolescents [...] things that have to do with them . " (Quote 4, P1)

Narratives

Participants agree on the importance of including examples of real situations in the most representative contexts of adolescents' daily lives: *"I think the part of family members and school contexts. It seems to me that yes, it has to be, it's very relevant" (Quote 5, P2)*. Participants also highlighted the importance of peer interaction scenarios: *" I think the influence that peer pressure has on young people is important to be one of the stories [...] so that parents can understand the challenges their children are often faced with on a daily basis" (Quote 6, P4), "conflict with friends, I think that's something that should be explored" (Quote 7, PA1)*, allowing parents to understand better and support their children's social problems.

Additionally, both PA1 and A1 emphasized the importance of scenarios that focus on recognizing and understanding emotional responses: *"when I'm angry about situations with friends, and sometimes my parents don't always understand my anger [...]" (Quote 8, A1), "I'd like to be able to identify why my daughter is sad [...]" (Quote 9, P1).*

Moreover, the adolescent suggested incorporating more creative scenarios that matched personal experiences: *"when you're little and get lost in the supermarket aisles."* (Quote 10, A1). By doing so, the game could provide a more relatable experience for adolescents, improving their connection to the content and its educational objectives.

Game World

The design of game environments was a subject of discussion, reflecting divergent views on balancing realism with fantasy. Participants expressed varied preferences, with some favoring environments that reflect familiar settings, such as home divisions and classrooms, while others supported more imaginative and fantastical environments. P3 endorsed a hybrid approach: *"The fact of being something very real and that they can compare it to their own lives, I think it has the advantage of making it easier for them to adapt that to their reality. On the other hand, I don't know if they would look for something else [...]" (Quote 11, P3).*

5.1.5.4 Theme 4: Game Design Elements

This theme explores the comprehensive approach to optimizing the gaming experience by integrating several key aspects: engaging gameplay, effective game rewards, accessibility, support options, and diversity. The goal is to create a gaming environment that captivates players while

ensuring the challenges are achievable. This necessitates a thorough understanding of the motivations and engagement patterns of players, specifically parents and adolescents. It is crucial to design features that effectively capture and sustain their interest, ensuring continued engagement with the game over an extended period.

Help Mechanics

Regarding additional design elements, P4 emphasized the necessity of implementing a guidance system to aid players: *"a kind of instruction manual or script that explains things a little"* (Quote 12, P4), allowing a better understanding of the game's core concepts, including emotions and ER strategies.

Feedback and Rewards

P1 underscored the importance of utilizing rewards to motivate players and reinforce positive feedback with the game: *"at the end of the game or at the end of the person [...] being able to regulate their emotions [...] there's a reward"* (Quote 13, P1). Additionally, A1 suggests a design element to enhance player engagement and provide an efficient way to use the given rewards: *"Diamonds to buy clothes for the characters."* (Quote 14, A1), diamonds or similar forms of in-game rewards serve as a mechanism through which players can access additional features. This approach aligns with design features that capture player interest and sustain it by offering meaningful rewards. PA1 further emphasized the importance of incorporating meaningful rewards into the game, highlighting how such rewards can enhance player satisfaction by providing valuable incentives: *"[...] give coins and with those coins you can then buy, for example, difficulty levels."* (Quote 15, PA1).

In-Game Language

Linguistic constructs are crucial in the game, as they ensure clear communication of goals, instructions, and educational content. P4 detailed the specific language characteristics that should be used in-game: *"as simple and up-to-date as possible, really"* (Quote 16, P4).

Customization

Participants underscored the significance of developing a universally accessible game involving the capacity for individual users, be they adolescents or parents, to select an avatar that resonates with their identity. P1 strengthened: *"when it comes to choosing characters, there should be variety"* (Quote 17, P1). Additionally, P2 noted that incorporating certain personal details could enhance the game's immersion and increase its credibility for players: *"I think it could be possible to give them their own name, couldn't it? or whatever name they want, because they might not want to represent themselves."* (Quote 18, P2) and:

In terms of characters, I was thinking that if each character had a story, we'd create some adolescents here with different experiences. I think it would be interesting if they could read the story of each character and choose one (Quote 19, P1).

5.1.6 Conclusions

The insights gathered from the first phase of co-design provided valuable guidance for the development of the game. By analyzing the results, meaningful conclusions that influenced the design and functionality of various game elements were drawn.

An important conclusion is the necessity, as identified by psychologists, for an intervention targeted at both adolescents and their parents. The delivery of such an intervention through a digital game format presents a method with high potential of effectiveness, particularly for the engagement of the adolescents. These reasons underscore the rationale behind the development of this serious game, aligning with the intention of the psychologists to incorporate it into their professional practice.

The target population reported limited gaming experience, minimal playtime, and a preference for medium to easy difficulty levels. This feedback was carefully considered during the intervention development. The SG was designed so that completion in a single session is possible, with added features such as extra clues and extended time to accommodate the difficulty of game levels, ensuring the game aligns with the player's needs.

In developing the game's educational narrative, real-life adolescent experiences shared by participants were incorporated, including a wide range of family-related emotional scenarios, peer interactions like peer pressure, conflicts with friends, and specific situations reported by adolescent participants. These contributions were instrumental in shaping the storylines within the SG. Furthermore, additional educational content, such as theoretical concepts concerning the characteristics and key features of emotions and ER strategies, as suggested by the psychologists, was also integrated into the game. This approach ensured that the educational material was not confined to the narrative alone but was weaved together throughout various aspects of the game. Discussed game elements, including feedback and reward systems and the use of appropriate in-game language, were integrated to complement and enhance the game's educational content.

The intervention incorporated specific customization elements highlighted in the interviews, particularly the diversity of characters and the personalization of information, such as the player's name.

The interviews conducted with the target population were instrumental in refining key game mechanics, particularly those related to rewards, customization and game difficulty. Additionally, these interviews provided valuable insights into the creative environments and scenarios that resonated with the target audience. The participants' input on the visual aesthetics and situational contexts within the game was incorporated into the final design, playing a crucial role in developing an engaging and immersive experience specific to the preferences of the intended users.

5.2 Game Design

This section presents the design framework for *Emotion Odyssey*, based on the serious game design document created by Diane P. Pozefsky [66]. It outlines the development approach and critical design considerations for the game. Additionally, the section details the design elements derived from the initial co-design process.

5.2.1 Game Overview

5.2.1.1 Purpose of the Game

The purpose of *Emotion Odyssey* is to promote in adolescents and parents understanding and competencies in the identification of emotions and ER strategies, as well as training in their adaptive use. This SG is designed to present various emotion management strategies through various scenarios, promoting a comprehensive understanding and practical application of these skills in real-life contexts. The game aims to improve the emotional well-being of its players.

5.2.1.2 Intended Use

The aim is that the game can be utilized in the future in both clinical and non-clinical settings after all validations are done, serving as a valuable tool for health professionals and families. Adolescents do not need a clinical condition to benefit from the game since it is designed to promote positive developmental growth and serve as a preventative measure against potential psychopathologies.

5.2.1.3 Target Audience

The target audience for *Emotion Odyssey*, defined since the early stages, includes adolescents aged 10 to 14 along with their parents or tutors.

5.2.1.4 Genre

Emotion Odyssey is classified as a Puzzle/Adventure multiplayer collaborative game. This genre is characterized by three main elements: puzzles, narrative, and exploration [67]. The escape room format, combined with situational narratives in each room, solidifies *Emotion Odyssey*'s place within this genre. The game provides a proper adventure that promotes ER competencies in adolescents and their parents through engaging puzzles, immersive storytelling, and exploration.

5.2.2 Gameplay

5.2.2.1 Objectives

Emotion Odyssey is structured into seven distinct levels, each offering a unique escape room challenge. The first six levels are designed around the six basic emotions identified by Ekman [68]:

Sadness, Enjoyment, Anger, Surprise, Disgust, and Fear. The primary objective of these levels is for players to identify the specific emotion represented by each room. This is achieved through situational scenarios that symbolically represent the emotion, often involving interactions with adolescents and/or their parents.

The final level features a more complex escape room that focuses on teaching and training ER strategies from Gross's model [3]: Cognitive Reappraisal, Situation Selection, Situation Modification, Attentional Deployment, and Emotional Suppression. In these last escape room players—both adolescents and parents—are tasked with learning about these ER strategies, applying them to practical examples. After, players must solve a final puzzle, thereby completing the game. Within these escape rooms, players are tasked with solving various puzzles, including anagrams, color-ordering puzzles, code-writing tasks, and cooperative challenges such as musical or cooking activities. Successful completion of these puzzles grant players essential rewards to progress.

Players must also search for standard clues that provide valuable information.

To advance to subsequent rooms, or to win the game in the case of the final room, players must complete each room within a stipulated time limit, fostering a sense of urgency throughout the game.

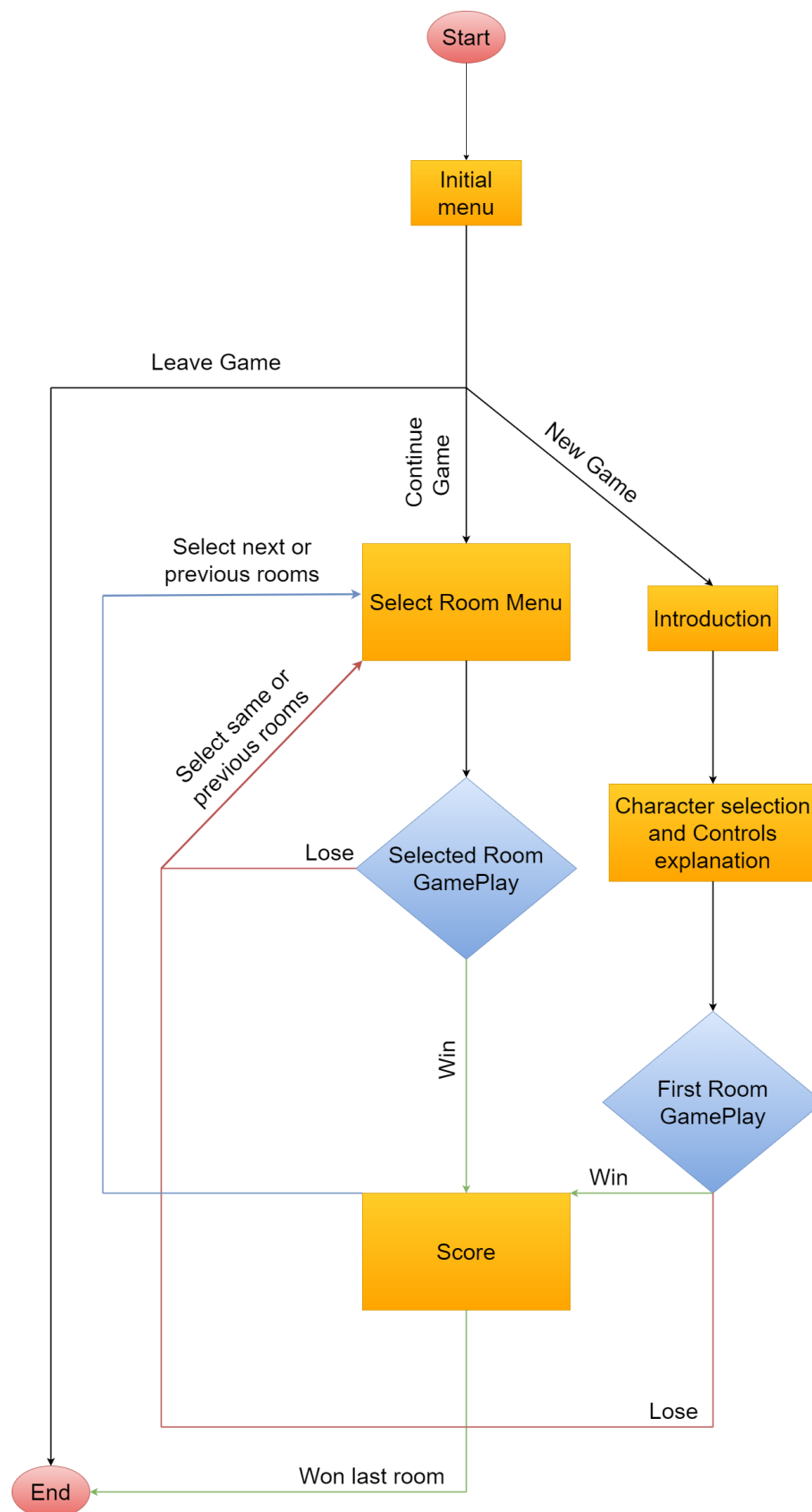
5.2.2.2 Game Progression and Play Flow

Emotion Odyssey is designed with a structured game flow that guides players through a logical sequence of levels. At the game's start, players can only access the first escape room. As they progress, there are three possible outcomes for each room:

1. **Leave:** Players may exit the room.
2. **Time Expiration:** Players may run out of time and fail to escape, so they can attempt the room again.
3. **Successful Completion:** Players may successfully solve the puzzles and escape the room, which unlocks and advances them to the subsequent room.

This sequence continues until players reach the final room, where they have the opportunity to complete the game. Importantly, players can revisit and replay from the start any previously completed rooms at any time during their gameplay.

Figure 5.1 illustrates the game flow chart for *Emotion Odyssey*, detailing the progression and interactions within the game.

Figure 5.1: Game flow chart of *Emotion Odyssey*.

5.2.3 Mechanics

Emotion Odyssey incorporates a variety of essential game mechanics:

1. **Players mechanics:** This multiplayer game is designed for two players, each with distinct movement and interaction mechanics. Player 1 navigates the rooms using the arrow keys or the WASD keys, while Player 2 moves by clicking on the destination point on the map with the right mouse button or touchpad. For interactions, Player 1 uses the B key to interact with objects in the game, whereas Player 2 interacts by directly clicking on the object with the left mouse button or touchpad.
Additionally, players have access to various other mechanics throughout the game, some specific to certain implemented puzzles and will be detailed later in the game design section. One notable mechanic is the ability to read in-game items, such as hints on paper, which is achieved by pressing the P key.
2. **Time management:** In each escape room, players must discover all clues and solve all puzzles within a predefined time limit specific to each room. During the early levels, time constraints are not as punishing, allowing players to familiarize themselves with the basic mechanics and get acquainted with the game. As the game progresses, each subsequent escape room increases in difficulty, with more stringent time limits being a crucial factor in this escalation. Consequently, players must cooperate to manage their time efficiently and complete the challenges.
3. **Scoring system:** The game includes a feedback mechanism featuring a star-based scoring system to assess and reward player performance in each room. Players are awarded a star rating from 0 to 3 stars, determined by their completion time and overall performance. This system offers immediate and clear performance evaluations, motivating players to enhance their skills and strategies in future rooms.
4. **In-Game currency and reward system:** The game features a currency system where coins serve as the primary reward for players who solve each room. Players start the game with a defined amount of coins, in this case, ten, and the number of coins earned after each room depends on their star rating from the scoring system. The distribution of coins is proportional to performance.
5. **Help and Guidance mechanics:** Players can use their in-game currency to purchase assistance features, such as additional time or supplementary clues, to help solve challenges within each room. The cost of these features varies, with their minimum cost being two coins, ensuring strategic use to balance the gameplay experience.

5.2.4 Game Options

In *Emotion Odyssey*, players can access various options designed to enhance their gameplay experience.

Players can start a new game from the main menu or continue from where they left off, accessing the most recently unlocked room.

At the initiation of a new game, players can select a character model and assign a nickname to their avatar. During transitions between levels, players may acquire additional character models, which can be utilized in subsequent game environments.

During gameplay, pressing the ESC key brings up the pause menu, which offers several options: restarting the current escape room level, viewing the control scheme, and exiting the game.

Additionally, the game includes a help system that players can utilize. This system allows players to purchase extra time to solve puzzles or additional clues beyond those already provided, thereby assisting them in successfully escaping each room.

5.2.5 Replaying and Saving

Emotion Odyssey features a progress-saving system. Upon completing an escape room level, the system marks that level as completed and unlocks the subsequent level for the players. When players exit the game and return, they are presented with a room selection menu, which displays the levels they have already conquered and the next available level to play. Furthermore, this menu allows players to replay any escape rooms they have previously completed.

5.2.6 Characters

In *Emotion Odyssey*, players begin by selecting one of six available characters, each with distinct attributes. Players can also choose a name to represent their character, which will accompany them throughout the game, as discussed by participants in the initial co-design interviews.

As depicted in Figure 5.2, the available characters range in age and appearance, offering both adult models, such as in images (a) and (b), and smaller, childlike models, such as in images (d) and (e). This variety is intended to provide options that resonate with parent or adolescent players. The character design also incorporates a spectrum of features, some intentionally androgynous, allowing players to choose characters with traits that do not strictly conform to traditional gender norms. This approach enhanced inclusivity and allowed players to select avatars that best represent their identity or preference within the game.



Figure 5.2: List of characters available initially to players

Players can use their in-game currency, earned as a reward for completing escape room levels, to purchase additional character models. Figure 5.3 illustrates the available character models that players can acquire. The models are priced differently, encouraging players to manage their currency strategically. Players may need to do well in certain levels or make careful decisions about their purchases to unlock certain character models. This system adds a layer of personalization and reinforces the importance of financial strategy within the game.



Figure 5.3: List of character models each player can buy in-game

5.2.7 Levels

In *Emotion Odyssey*, all levels uniformly employ the escape room concept. The first six levels are dedicated to the educational objective of recognizing a specific emotion. The seventh and final level diverges from this pattern by focusing on acquiring and practicing ER strategies.

At each level, narratives are integral to achieving the objectives. Based on co-design insights, the game delivers engaging storylines, which facilitate the recognition of emotions and the learning and practice of ER strategies. In the first phase of *Emotion Odyssey*, which focuses on emotion recognition, each escape room has its own unique environment and narrative. These individual narratives are designed to symbolize specific emotions within adolescent or parenting situations, thereby aiding players in recognizing and understanding these emotions. All narrative examples presented in this section are written in Portuguese in-game, the selected language for the game.

Regarding game world design, each escape room has been carefully designed to align with the core objectives of emotion recognition associated with each room or ER strategies training. Therefore, this section delineates thematic elements and environmental details constituting the game's immersive world.

Finally, level progression in *Emotion Odyssey* adheres to a structured sequence, requiring players to complete each level before advancing to the next. The initial two levels are designed with a time limit significantly longer than the estimated completion time. It is an introductory phase where players can familiarize themselves with the game mechanics and puzzle types. These early stages function as a tutorial, allowing players to become acquainted with the foundational elements that will recur throughout the game. Following these introductory levels, the time limits are calibrated more precisely to match subsequent levels' increasing complexity and difficulty, thereby ensuring a gradual and challenging progression.

5.2.7.1 Game Introduction

Before engaging in the gameplay phase, *Emotion Odyssey* initiates with an introductory sequence. In this sequence, *Professor Emoções*, a Non-Playable Character (NPC), functions as the receptionist of the building that contains all the escape rooms. This NPC delivers the game's backstory to the players, setting the context for their upcoming challenges:

"Dear visitors, welcome to the Emotional Regulation Institute. My name is Professor Emoções. Here, you will not only explore the various emotions but also learn various strategies to better deal with emotions in your daily life.

Let me introduce you to the concept of the game: The goal is simple but challenging: there will be 7 rooms in which you must join forces to solve puzzles and challenges to find out how you can get out of them within a time limit.

The first 6 rooms will be for recognizing emotions such as Anger, Surprise, Enjoyment, Fear, Sadness, and Disgust.

The last room will be for learning various emotional regulation strategies.

Each room has its own time limit.

And remember, there is also an associated score depending on the time taken to discover the solution.

But don't worry if time starts to run out at a certain price, there is an option to stay in the room longer or to receive hints. Good luck in this adventure, and unravel the mysteries that await you inside the rooms! "

5.2.7.2 Sadness room

Game World

The *sadness room* (see Figure 5.4) is systematically designed to reflect a typical adolescent environment, featuring elements reflective of a young individual with a keen interest in sports and music. This thematic configuration integrates specific environmental cues and objects that align with the adolescent's hobbies and interests. It features sports-related items, including a ball, basketball hoop, and skateboard. Additionally, it contains music-related objects such as guitars, a microphone, drums, and speakers. Complementing these, the room also includes standard furnishings typical of an adolescent's personal space, such as a bed, posters, drawers, a television, and carpets.



Figure 5.4: Sadness Room

Level Design

This level serves as the initial challenge that players encounter in *Emotion Odyssey*. The primary objective is for players to collect four pieces of paper scattered throughout the room. These pieces of paper can be obtained through thorough exploration within the room. Figure 5.5a depicts a paper on the ground, while Figure 5.5d illustrates a paper hidden within a book. Players must search the room to uncover these items, emphasizing the importance of detailed exploration in progressing through the game.

Additionally, players must solve various puzzles to obtain the remaining pieces. One such puzzle, depicted in Figure 5.5b, is an anagram that, when solved, forms the word "Emotion" in Portuguese. Another puzzle, shown in Figure 5.5c, involves arranging colors in a specific order, corresponding to the colors of the four guitars in the room, also visible in Figure 5.5c.

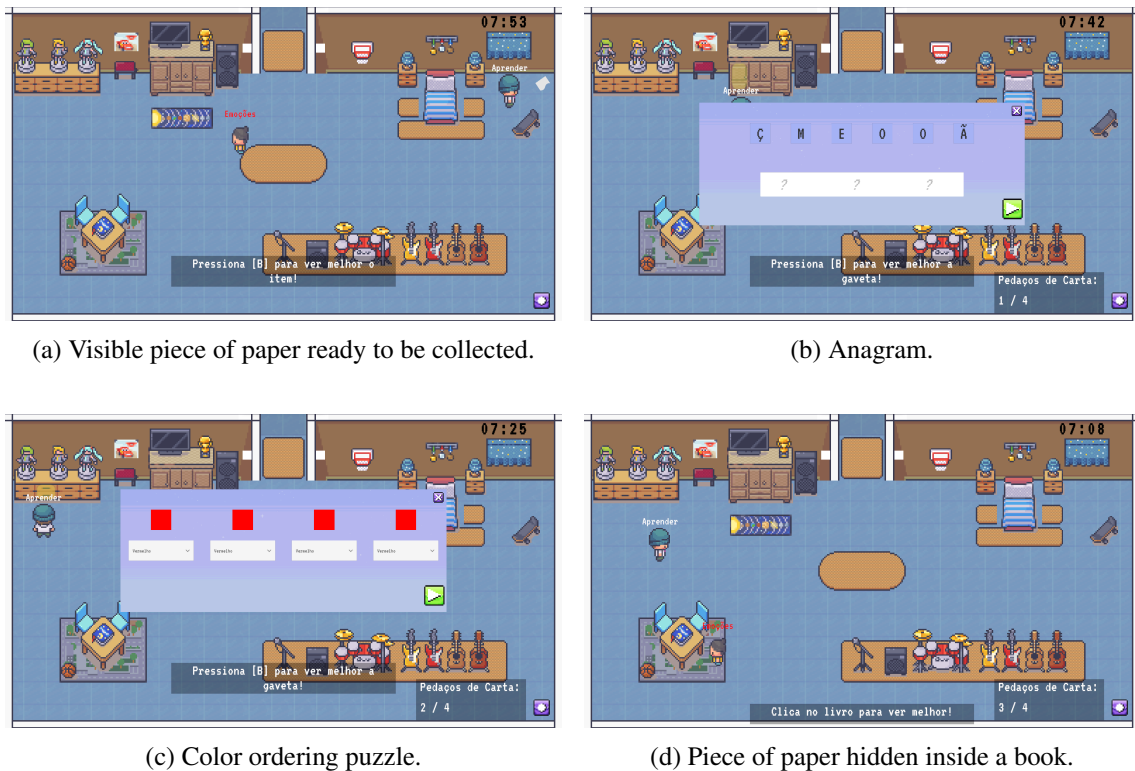


Figure 5.5: Procedures for the collection of all paper pieces.

Upon collecting all four pieces of paper, the players enter the final phase of the level, where a concluding clue is revealed in the form of a letter that players can interact with. Initially, however, the letter appears without useful information that might help players identify the emotion in the room. To uncover the crucial clue, players must work collaboratively to reveal the hidden message. The initial version of the letter provides subtle hints on how to accomplish this task, encouraging teamwork and critical thinking (see Figure 5.6).



Figure 5.6: Letter's initial version.

To reveal the final content of the letter, players must collaborate to activate a specific "light" in the room, as indicated by the hint included within the initial letter. This task requires players to interact simultaneously with two switches in the room. Upon completing this coordinated action, the final clue is revealed (see Figure 5.7). This clue exhibits the main narrative of the room:

"Jorge loves music and football. But his grades at school started to drop a lot, and his parents were disappointed. They said: "Jorge, you can't play guitar or football until your grades improve." That made Jorge very sad. He missed the sounds and the games. At night, he would cry quietly, thinking of the day when he could do what he loved best again."

This narrative symbolizes the emotion of **sadness** and enables the players to effectively identify and recognize this emotion.

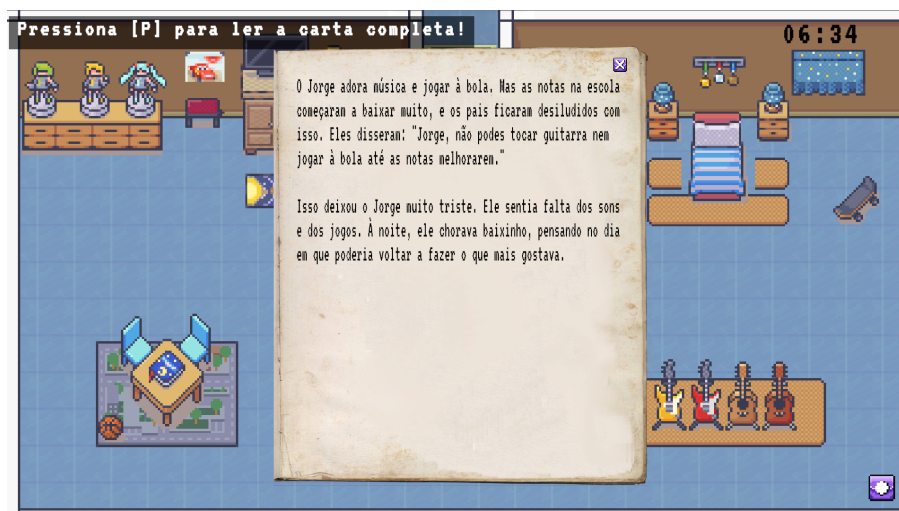


Figure 5.7: Final Narrative Clue.

The final task required for players to successfully "escape" this room involves solving a final

puzzle at the door (see Figure 5.8) by correctly identifying and entering the emotion associated with the scenario. In this case, players must input the word "tristeza," which translates to "sadness" in Portuguese.

This level reinforces the ability of both adolescents and parents to recognize and correctly label sadness, within the context of a typical adolescent experience.

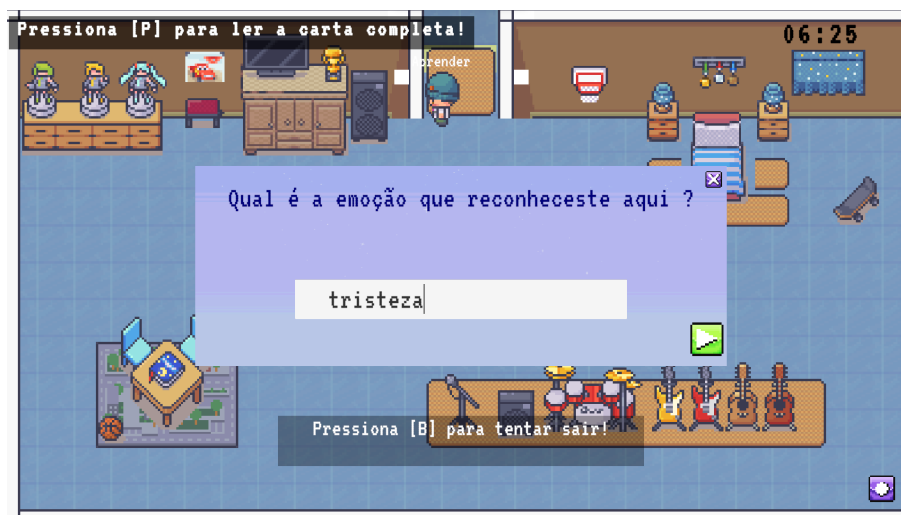


Figure 5.8: Final emotion recognition question (Sadness).

This room also serves as an introductory level, intentionally designed with a lower difficulty to facilitate the player's adaptation to the game's mechanics and overall concept. Players are allocated a generous 8-minute time limit to complete the challenges. A duration intentionally set higher than necessary, given the level's complexity. This extended time frame ensures that players can familiarize themselves with the gameplay mechanics without feeling rushed, allowing them to comfortably grasp the foundational aspects of the game before progressing to more challenging levels.

5.2.7.3 Anger room

Game World

The *anger room* (see Figure 5.9) is designed to depict a kitchen environment. The kitchen is deliberately designed to symbolize a disorganized environment, which can aggravate emotional responses such as anger, aligning with the emotional objectives of the room.

Disorganized elements within the kitchen environment include food items scattered across the room, a book on the floor, and chairs not aligned with their usual arrangement. These elements contribute to a sense of disorder in the room. The kitchen also features essential components for identifying its function and executing the room's objectives. Key elements include a pot, recipe

lists, and a variety of ingredients. These items are integral to the gameplay and contribute to the thematic coherence of the room as a functional kitchen setting.



Figure 5.9: Anger Room

Level Design

This second level of *Emotion Odyssey* introduces a moderate increase in challenge complexity and the incorporation of new game mechanics that may recur in later stages.

As with any level, players initiate gameplay by thoroughly exploring the room. An intuitive starting point is encountering an interactive book on the floor (see Figure 5.10a), which prompts players to enter a code (see Figure 5.10b). The code, composed of numbers, can be deduced by examining a specific piece of paper in the room. This paper, designed to resemble the paper objects from the first room, allowing players to recognize them more easily, lists ingredients and their quantities (see Figure 5.10c). Players must engage in associative reasoning, linking the quantities and the sequence of ingredients to decipher the code required by the book (see Figure 5.10d).

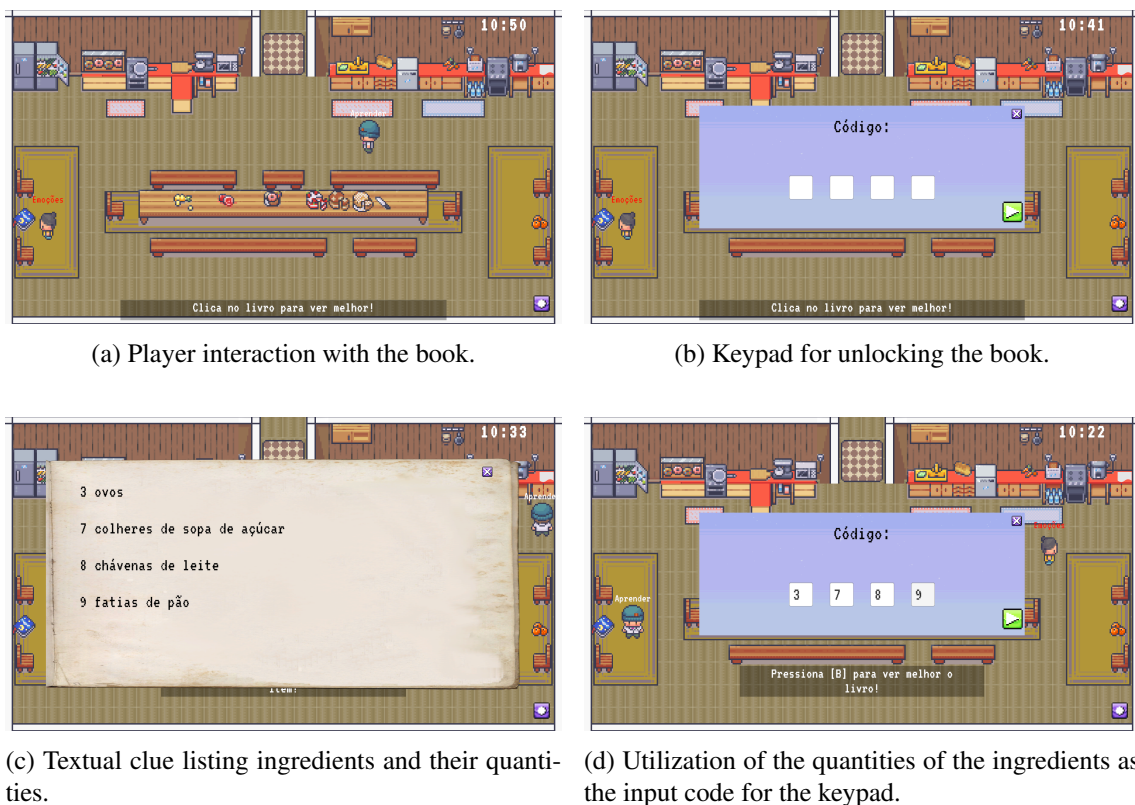


Figure 5.10: Procedure for unlocking the recipe book.

After entering the correct code, the book reveals itself as a recipe book, displaying a detailed recipe the players must follow (see Figure 5.11a). This recipe is meticulously outlined, providing a comprehensive list of ingredients and a step-by-step explanation of the procedure. The execution of the recipe requires significant teamwork and coordination between the players. Specifically, the procedure mandates that two ingredients must be delivered simultaneously into a pot located within the room and in a precise order.

Initially, players must engage in discussion to determine their method of execution, deciding which player will pick up which ingredient. As Figure 5.11b illustrates, each player collects their designated ingredient once the roles are assigned. The critical collaboration phase starts, where players must locate the pot within the room (see Figure 5.11c) and drop the ingredients simultaneously. Successful execution of this task allows the players to proceed to subsequent steps in the recipe (see Figure 5.11d). However, failure to synchronize their actions results in the pot resetting, compelling the players to restart the recipe from the beginning.

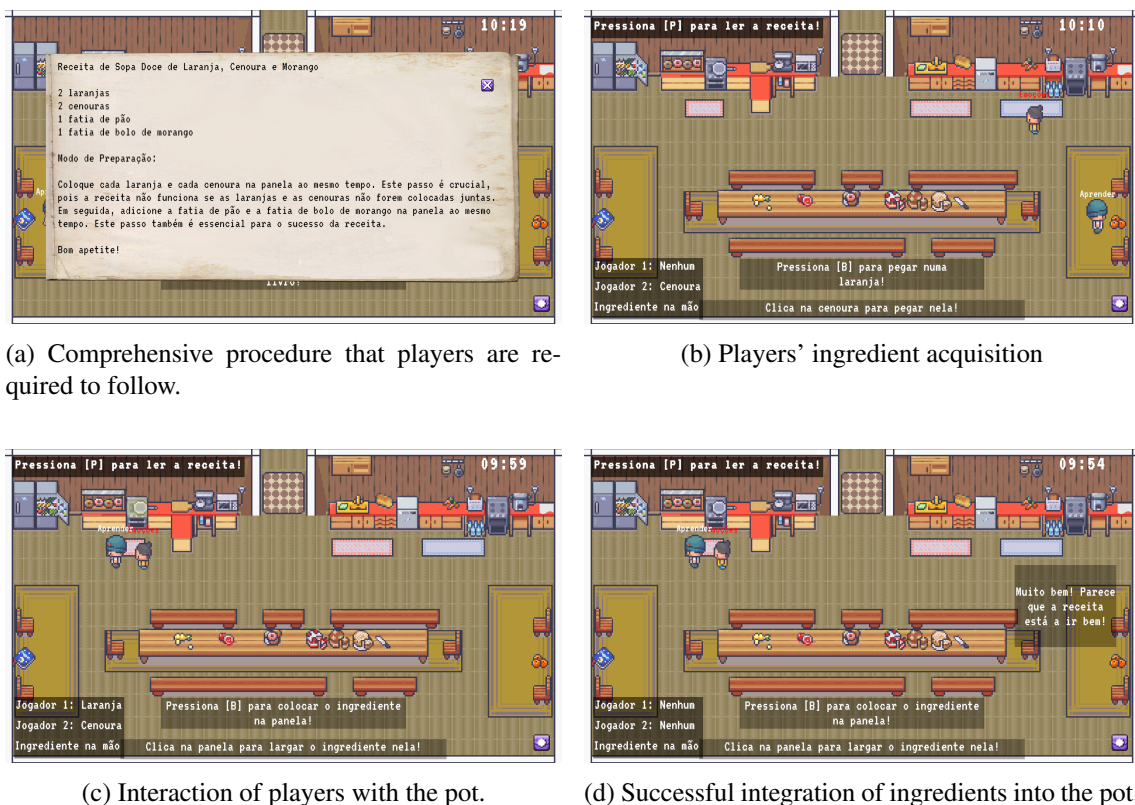


Figure 5.11: Detailed procedure for executing pot recipe challenge.

After successfully completing the steps outlined in the recipe, the recipe book reveals the final clue for the room. This clue (see Figure 5.12) presents a scenario between a mother and her son, where the primary objective is to identify the presence of anger within their dialogue. The final clue is creatively structured as a recipe, mirroring the initial one, which not only aligns with the kitchen setting of the room but also offers a more engaging and associative approach to illustrating an anger-related situation:

Emotions Recipe:

Ingredients:

- 1 tired teenager
- 1 worried mother
- 1 family argument
- 1 dinner in preparation

Preparation Method:

It was a Sunday afternoon, and the mother was in the kitchen, preparing dinner. Her son, Jorge, entered the kitchen looking angry.

"Jorge, can you set the table, please?" asked the mother with a smile.

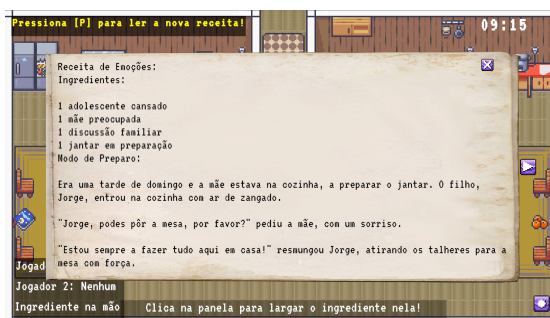
"I'm always doing everything around here!" grumbled Jorge, throwing the cutlery onto the table with force.

"That's not true, Jorge. I only ask for your help occasionally. We all have our responsibilities," replied the mother, trying to stay calm.

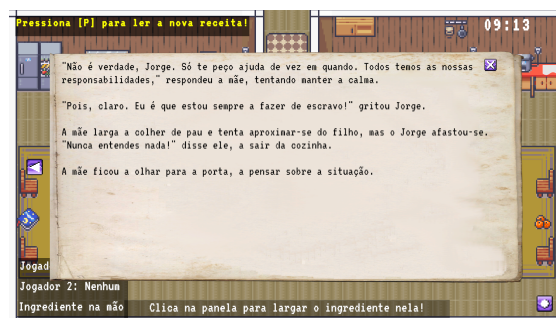
"Yeah, right. I'm always the one doing the slave work!" shouted Jorge.

The mother put down the wooden spoon and tried to approach her son, but Jorge stepped back. "You never understand anything!" he said, leaving the kitchen.

The mother stood looking at the door, thinking about the situation.



(a) First page of the clue.



(b) Second page of the clue.

Figure 5.12: Final narrative-based clue formatted as a recipe

Like the first, this level concludes with a final puzzle requiring players to discuss and identify the emotion represented in the scenario presented to them. The correct answer is "raiva," which translates to "anger" in Portuguese (see Figure 5.13).

Although this level's complexity is higher than the first, the room is also designed with a generous time limit that exceeds what is typically necessary (11 min). This approach is intentional, as it is still early in the game, and players are introduced to new challenges and mechanics. The extended time allows players to familiarize themselves with these new elements and explore the environment more thoroughly. Additionally, given the increased number of interactive objects at this level, the extra time is crucial to ensuring that players can engage with and fully explore these objects.



Figure 5.13: Final emotion recognition question (Anger).

5.2.7.4 Surprise room

Game World

The environment of the *surprise room* (see Figure 5.14) is designed to effectively represent the emotion of surprise through a suggestive setting: a birthday party. This environment was selected for its intrinsic association with surprise, as birthday parties typically involve unexpected elements such as surprise gifts, which are ideal for illustrating and exploring the emotion in question. The room is designed to incorporate essential elements of a birthday party. It features an array of typical components, including gifts, balloons, vibrant decorations, and desserts, noticeably showcasing a birthday cake.



Figure 5.14: Surprise Room

Level Design

This third level marks the beginning of a more challenging phase in *Emotion Odyssey*, where the levels transition from introductory or tutorial-based to more demanding and time-sensitive. The time limits imposed on these levels are designed to be sufficient for completing all challenges but tight enough to prevent players from making multiple errors or wasting time on specific tasks. Consequently, this level is also where the game's help system becomes a crucial tool for players to rely on.

The primary objective of this level is to collect four keys, which are obtained by completing the challenges presented. The level is themed around a birthday party, and the key interactive objects are present boxes (see Figure 5.15), which are easy to locate. Each present box triggers a new task, either as a multiple-choice quiz or a puzzle. The quizzes, as illustrated in Figures 5.16 and 5.17, assess the players' knowledge of the emotions introduced in previous levels (sadness and anger), requiring them to identify characteristics of these emotions or their recognition in practical scenarios:

Which of the following is a common characteristic of the emotion anger?

Answer: Feeling angry and wanting to shout

Which of the following is a common characteristic of the emotion sadness?

Answer: Feeling discouraged and wanting to cry

You're not chosen to be part of your school's soccer team, and you feel discouraged and disheartened. What emotion are you probably feeling?

Answer: Sadness

One of the key collaborative challenges in this room is a musical puzzle (see Figure 5.18), where the parent and adolescent must work together to replicate a melody by using their specific controls to play musical notes. This puzzle is notably complex and is often where players spend the most time within the level. Successfully answering the quizzes and solving the musical puzzle rewards the players with the keys needed to progress further.



Figure 5.15: Player interaction with a gift box



Figure 5.16: Quiz on the characteristics of the emotion 'Anger.'

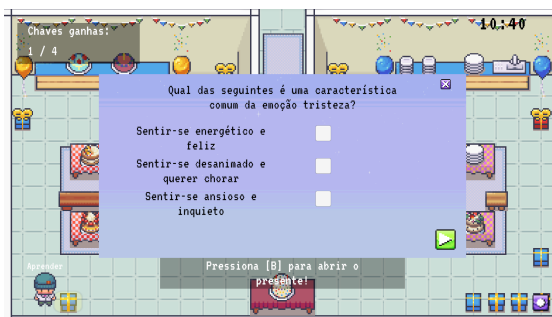


Figure 5.17: Quiz on the characteristics of the emotion 'Sadness.'

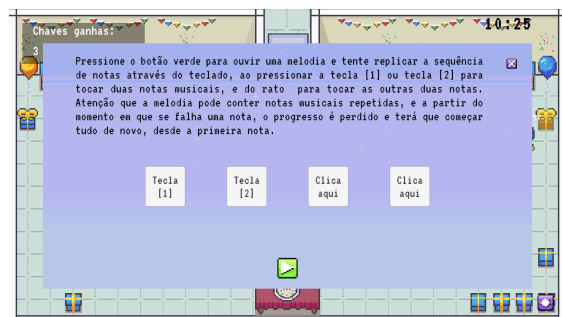


Figure 5.18: Musical puzzle.

The final set of clues (see Figure 5.19) emerges within the room upon collecting all four keys. These clues include two white squares on the floor that act as platforms, activating when a player steps on them, three colored squares featuring letters, and a notification alerting the players to a newly available present box. The players' instinctive response is to search for this present. When the present is accessed, it reveals the last crucial clue needed to complete the level. This clue provides essential information on how to successfully navigate the final phase of the level. It includes two images that clearly depict the emotion of surprise, as shown in figure 5.20 and a story illustrating the emotion within a practical context relevant to the players:

"Jorge came home from school. His parents were in the living room, smiling. On the table was a box of colored paper. Jorge wasn't expecting this and opened the box. Inside was the video game console he wanted. He looked at his parents, speechless. "

Furthermore, the clue offers guidance on utilizing the white platforms, revealing the importance of teamwork and coordination.



Figure 5.19: Final set of clues revealed.



Figure 5.20: Narrative-based emotional clue.

At this game stage, the door remains inactive, preventing players from attempting to escape the room. To progress, players must collaborate and critically analyze the clues provided. When activated together by both players, the white platforms will unlock the door (see Figure 5.21). This coordination leads to the final puzzle (see Figure 5.22), which introduces a higher level of complexity through a color-coding challenge. Initially, this puzzle might appear perplexing, as it requires players to correctly order a sequence of colors according to specific letters. The puzzle's instructions direct players to associate each letter of the emotion represented in the room with a particular color. Here, the colored squares become essential, with each square corresponding to a specific pair of letters. In this scenario, the emotion in question is "surpresa" (surprise in Portuguese), and players must engage in discussion to determine first the emotion represented and second, the correct color association for each letter in the word.

The time limit for this level remains set at 11 minutes, consistent with the second level, despite the increased puzzle complexity and the demand for higher-order deductive reasoning. This deliberate design choice underscores a shift in gameplay, emphasizing the need for effective time management and strategic use of in-game aids. By doing so, the game introduces a new layer of challenge, balancing complexity with sustained player motivation for subsequent levels.

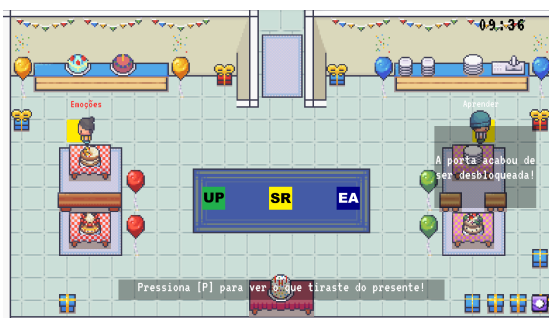


Figure 5.21: Unlocked door notification.

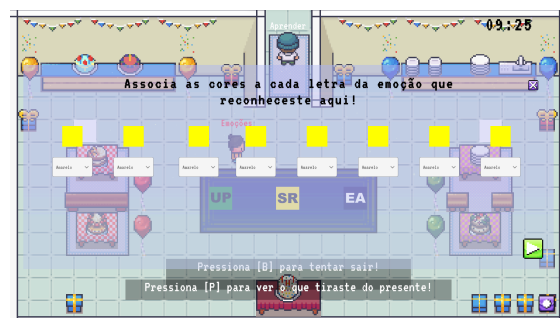


Figure 5.22: Final color ordering puzzle.

5.2.7.5 Disgust room

Game World

The *disgust room* (see Figure 5.23) is intentionally designed without a specific real-world environment in mind, instead focusing on a generalized space filled with elements that evoke the emotion of disgust. These elements include dirt stains on the floor, objects smeared with blood, pots containing green liquids, and unsettling items such as bones and oddly colored brains. The cumulative effect of these chosen details hopes to elicit a sense of disgust in the players, aligning with the room's emotional theme.



Figure 5.23: Disgust Room

Level Design

This fourth level of *Emotion Odyssey* achieves part of its complexity from its rigorous time limit, set at 8 minutes and 20 seconds—the shortest duration encountered by players up to this stage. While the level introduces some new puzzles, their overall complexity is consistent with what players have experienced in previous levels.

As with earlier levels, players must begin by thoroughly exploring the room until they identify the initial and central objective of the level. In this instance, players discover an object on the ground identified by the game as a "potion" (see Figure 5.24). Upon interacting with it, they learn that they have found one of three potions needed to progress. However, the other two potions are not immediately visible, prompting players to continue exploring and interacting with various objects in the room.



Figure 5.24: Player interaction with a potion object.

The two other interactable objects are panels that can be activated. Through experimentation, players realize that activating a single panel produces no results (see Figure 5.25). Drawing on their experience from previous levels, players should recognize the need for cooperation—activating both panels simultaneously (see Figure 5.26). Once this cooperative action is performed, the remaining two potions appear in the room.

This sequence exemplifies the effectiveness of the game's introductory levels in teaching mechanics, as players are required to apply previously learned strategies to solve new challenges. The level's design ensures that players must rely on their accumulated knowledge and teamwork.



Figure 5.25: Unsuccessful interaction with the panels.



Figure 5.26: Successful completion of the collaborative task reveals the remaining clues.

As players approach the final two objects to be collected, they are introduced to a new type of puzzle that emphasizes synchronized teamwork and is tied to the emotional theme of the level (see Figure 5.27). This challenge requires players to discover words based on provided descriptions—specifically, "garbage" and "vomit," which are words players can link to the emotion of disgust:

Garbage: (This word describes something dirty)

Vomit: (Stomach contents coming out of the mouth, usually associated with illness or nausea)

The puzzle mechanics involve a list of hidden letters. One player reveals a letter at a time, while the other must decide whether the revealed letter belongs in the target word in a specific spot. If the letter is correct and matches the corresponding spot in the hidden word, it is locked in place. The process continues until the entire word is correctly formed. However, if an incorrect letter is chosen, any progress made on the word resets, requiring players to start over from the beginning.

Successfully completing both iterations of the puzzle and collecting the two potions marks the fulfillment of the initial objective. This accomplishment unlocks further progression in the game, as it transforms the television into an interactable object, guiding players to other clues and challenges within the room (see Figure 5.28).



Figure 5.27: Word-forming puzzle.



Figure 5.28: Notification of all potions collected.

Interacting with the television in the game triggers a new multiple-choice quiz focused on the characteristics of the emotion players have previously identified—specifically, the emotion of surprise (see Figure 5.29).

Which of the following best describes the characteristics of the emotion “Surprise”?

Answer: It is an emotion that arises from unexpected events, is short-lived and can be both positive and negative.

Completing this quiz unveils the final clue (see Figure 5.30), which includes an emotional narrative element:

"Jorge, a teenager who loved football, was playing with his friends. During the game, the ball ended up near a corner full of garbage. As he ran to get the ball, he stepped on a food waste pile. His boot got dirty, and the smell was unbearable. He felt so bad that he decided to go home straight away."

This crucial narrative clue allows players to deduce the emotion represented in the current level based on the emotional context described in the narrative. Additionally, a final puzzle challenges players to associate consonants with the number 1 and vowels with the number 2. This puzzle serves as a crucial hint, guiding players to the key information necessary to "escape" the room.



Figure 5.29: Quiz on the characteristics of the emotion 'Surpresa.'

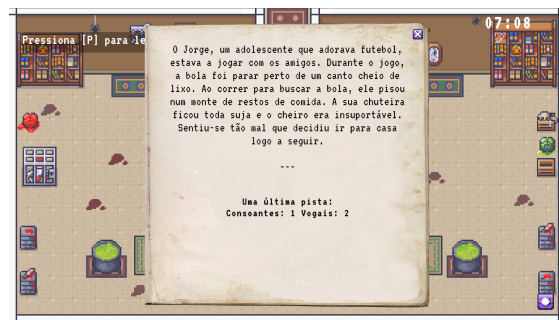


Figure 5.30: Narrative-base final clue.

Finally, to complete the level, players are presented with a final puzzle (see Figure 5.31), which, while similar in structure to those in previous levels, introduces a new challenge. This puzzle requires players to input the emotion represented in the room—disgust—using a numerical code. The solution hinges on the players' ability to recall and apply the final clue provided earlier. Specifically, they must associate each consonant and vowel in the Portuguese word "nojo" (meaning "disgust") with the corresponding numerical values, 1 and 2.



Figure 5.31: Final emotion recognition puzzle.

5.2.7.6 Enjoyment room

Game World

The *enjoyment room* (see Figure 5.32) is set within a classroom environment, a highly relatable space to adolescents. While the physical setting itself does not openly carry the theme of happiness, the emotional connection is established through the clues present throughout the room.

This environment has typical classroom elements, including desks, chairs, books, lockers, computers, and a teacher's board.



Figure 5.32: Enjoyment Room

Level Design

In the game's fifth level, textual clues are pivotal in guiding players through the challenges. The interpretation of these clues is essential for uncovering the meanings included within the text.

At the onset, players are presented with a single visible clue on a table (see Figure 5.33). This clue consists of a series of abstract phrases (see Figure 5.34), each of which can be associated with a specific color (e.g., "The sun at noon"). While these phrases may appear cryptic at first look, they are crucial for solving a subsequent puzzle in the level.

As players progress, they encounter two central challenges. The first challenge involves a color-ordering puzzle (see Figure 5.35), which players can access by interacting with a locker. The solution to this puzzle lies in the set of phrases previously encountered. Completing this puzzle reveals another text clue (see Figure 5.36), prominently featuring an important number.

The second challenge requires the players to work collaboratively to open a drawer in the room. This task can only be accomplished when both players interact with the drawer simultaneously (see Figure 5.37). A subtle hint is provided to push the players toward this cooperative solution. Upon successfully opening the drawer, players discover yet another text clue, with a different, equally significant number highlighted (see Figure 5.38).

These interconnected clues and challenges underscore the importance of careful reading interpretation and teamwork in progressing through this level.

Additionally, the textual clues collected are narrative elements characterized by their joyful themes, which incorporate implicit hints. Their nature assists players in identifying the emotional context of the level:

"Mariana was overjoyed. After weeks of waiting, she got the tickets for the concert of her dreams. The number 48 was marked on the ticket, indicating her place in the front row!"

"Today was a special day for Joana. She studied hard and finally got a 95 in her math test. She was overjoyed when she saw her grade!"



Figure 5.33: Positioning of a prominent clue.

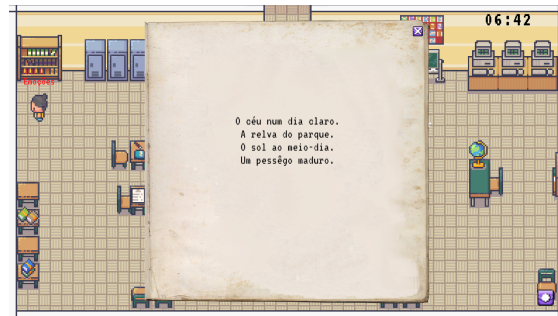


Figure 5.34: Cryptic Phrases as Textual Clues.

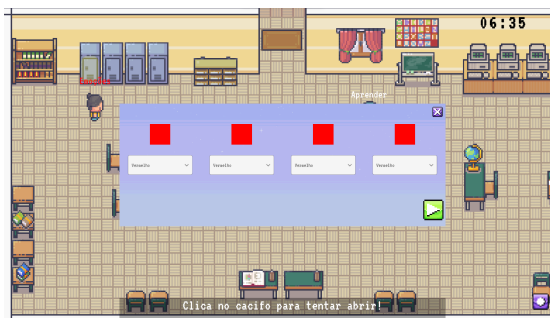


Figure 5.35: Color ordering puzzle.

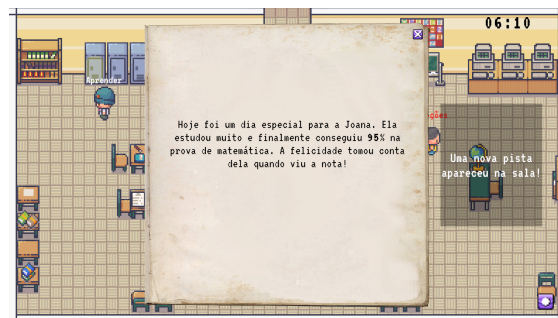


Figure 5.36: Joyful narrative-based clue.



Figure 5.37: Collaborative task to unlock the drawer.

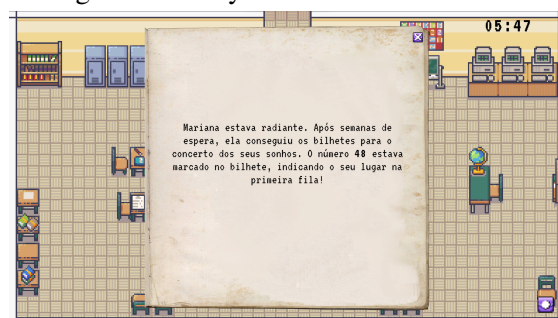


Figure 5.38: Another joyful narrative-based clue.

After completing the initial level phase, players must continue exploring the room to determine where to apply their gathered textual clues. There is only one location in the room where this can be done—a drawer in the teacher's desk. Interacting with this drawer triggers a new number code puzzle (see Figure 5.39). Players must link the two highlighted numbers found in the clues to solve the puzzle. Upon solving it, a new clue is revealed: a book appears in the room that players can interact with (see Figure 5.40).

Engaging with the book quizzes players on the characteristics of an emotion not yet encountered in the game (see Figure 5.41):

Which of these emotions is often associated with a sense of danger

Answer: Fear

This serves as a preparatory step for the final level of the first phase of the game (the emotion recognition rooms), where fear is the emotion being represented. Suppose players correctly identify fear as the emotion related to the characteristics described in the quiz. In that case, a final clue is revealed, unlocking the door and allowing players to proceed to the next challenge.



Figure 5.39: Numeric keypad for accessing the table's drawer.



Figure 5.40: A new clue materialized in the form of a book.

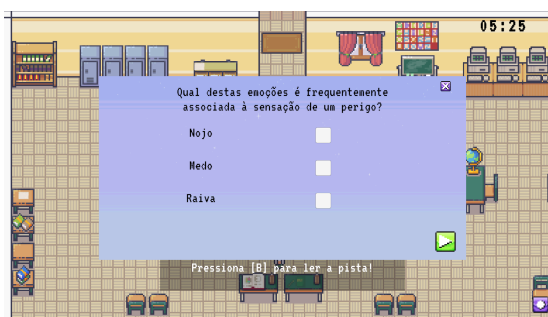


Figure 5.41: Match the characteristics with the corresponding emotion quiz.



Figure 5.42: Final clue revealed and door unlock notification.

In this phase, players are tasked with discovering the final clue within the room. This clue materializes on a nearby table (see Figure 5.43) and, upon interaction, reveals a narrative aligned with the emotional theme of the room, specifically happiness (see Figure 5.44):

"Joana's parents couldn't believe it. After months of waiting, they finally came home to a surprise that filled everyone's heart with joy. Joana looked into her mother's arms and realized the family had grown. The emotion was indescribable, and the smiles on Joana's parents' faces said it all."

Additionally, the clue presents the players with a final puzzle to solve collaboratively. To successfully "escape" the room, players must take into account two key pieces of information: the emotion represented by the narrative and a mathematical challenge involving the word "alegria"

(which translates to "joy" in Portuguese). In this puzzle, players must assign values to the word's letters, with consonants valued at 300 units each and vowels at 500 units each. The players must engage in discussion to correctly identify the emotion associated with the narrative they encountered and apply the puzzle's numerical instructions to achieve the solution and progress.



Figure 5.43: Location of the final clue of the room.

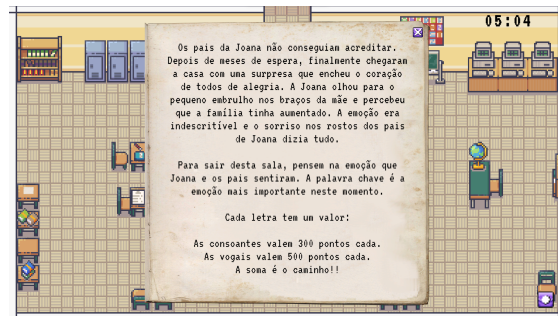


Figure 5.44: Final clue content.

Players' final challenge before "escaping" the room involves solving a numeric code (see Figure 5.45). Players must refer to the last clue provided to decipher this code and calculate the sum of the letters in the word "alegria," based on the numerical values assigned to each letter in the preceding clue. Once this sum is determined, it is entered into the numeric puzzle, allowing players to complete the level.

The complexity of this level stems from the players' ability to interpret contextual clues, demanding attention to detail and logical reasoning. Effective collaboration is essential to accelerate problem-solving and manage the room's time limit of 8 minutes and 20 seconds.



Figure 5.45: Final numeric code panel associated with the emotion represented in the room.

5.2.7.7 Fear room

Game World

The sixth emotion recognition escape room is set within a supermarket environment. Although a supermarket may not traditionally be associated with the emotion of fear, its selection is closely tied to insights derived from the co-design process, which will be discussed in subsequent sections. This room features typical supermarket elements, including checkout counters, food items, shopping carts, and security alarms at the exits. Additionally, certain elements not typically found in supermarkets, such as mirrors, are incorporated to enhance the narrative and evoke the intended emotional response.



Figure 5.46: Fear Room

Level Design

This is the final level in the phase of emotion recognition rooms, culminating with the emotion of fear, thereby completing the six core emotions featured in the game. This level is designed to be the most challenging, incorporating unexpected obstacles and time-sensitive tasks that heighten tension and difficulty.

Upon entering the room, the priority for players is to identify the primary objective. A textual clue (see Figure 5.47) reveals that they must locate four specific items within the room. However, the level introduces several intricate challenges to complicate the players' progress and add layers of complexity.

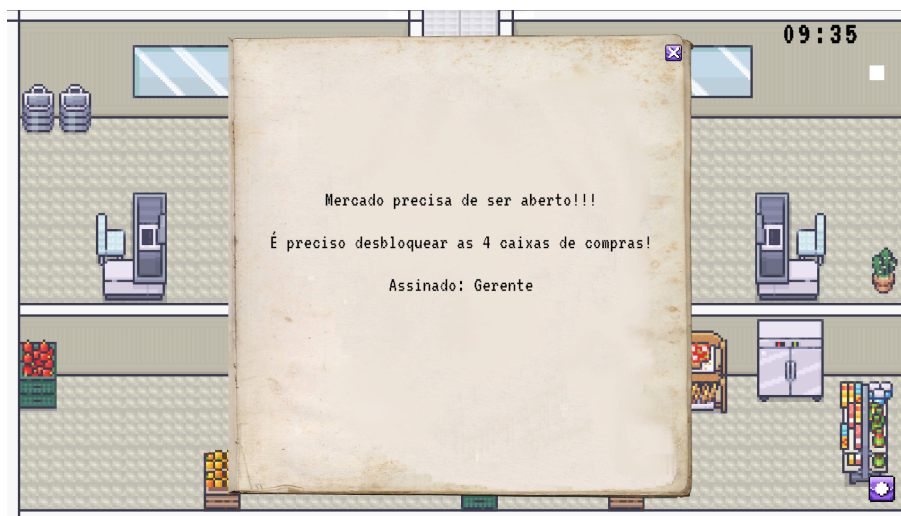


Figure 5.47: Described objective for the level.

One such challenge involves a seemingly harmless button (see Figure 5.48) that, when pressed, triggers a loud and unsettling alarm. This event initiates a countdown timer, further escalating the urgency and stress within the room. Players are now under pressure to find a way to deactivate the alarm before time runs out. The solution lies in a nearby panel close to the door, which requires a specific numeric code to disable the alarm (see Figure 5.49). The players must collaborate under these high-pressure conditions to search for the code hidden in the room. Failure to deactivate the alarm before the timer expires results in the players losing the level, emphasizing the importance of effective teamwork and quick thinking.



Figure 5.48: Alarm button interaction.



Figure 5.49: Numeric code panel to deactivate room alarm.

The sequence in which players tackle these room challenges can vary, as this level does not require a linear progression. One particularly creative and challenging task involves a collaborative puzzle centered on the relocation of items. In this scenario, players encounter a cryptic textual clue within the room (see Figure 5.50), which instructs them to move a specified number of items from one location to another while also relocating a different set of items elsewhere. To succeed, players must engage in discussion to interpret the clue accurately and formulate a strategy. A significant twist to this challenge is introduced when the players initiate the task by correctly

placing the first item (see Figure 5.51). At this point, a countdown timer begins, adding a time constraint to the challenge. If the players complete the relocation according to the instructions within the allotted time, they are rewarded with a crucial item needed to progress in the central objective. Failure to meet the time limit, however, results in a loss, forcing the players to restart the level. This puzzle not only tests the players' problem-solving abilities but also emphasizes the importance of teamwork and efficient time management.

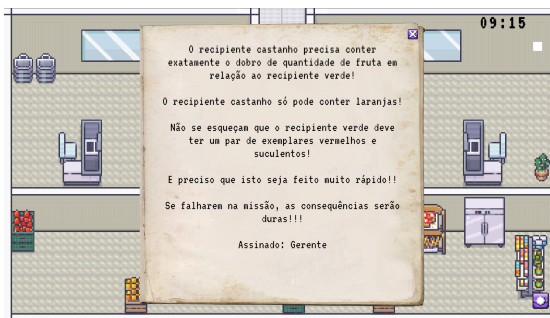


Figure 5.50: Instructions for the relocation of items challenge.



Figure 5.51: Notification of successful product relocation and countdown time started.

To complete the central objective of the level, the remaining items must be collected through various challenges within the room. Two of these items can be obtained by solving two mirror puzzles (see Figure 5.52). The level requires players to collaborate by lifting a mirror together—one player on each side. This mechanic, which involves synchronized interaction, is a recurring feature throughout the game and should be well-understood by players at this stage.

The fourth item can be obtained by interacting with a container in the room (see Figure 5.53), which triggers a familiar word-forming puzzle (see Figure 5.54). This time, the word that players need to discover is thematically linked to the emotion of fear:

Unintentional physical response. It often occurs when the person feels threatened or terrified.

Answer: "Tremor," which means tremble in Portuguese.

Upon solving this puzzle, players will have gathered all four necessary items to complete the initial objective. As a result, a final clue appears in the room (see Figure 5.55), allowing the players to unlock the door and proceed to the next stage of the game.



Figure 5.52: Mirror interaction challenge.



Figure 5.53: Container clue interaction.

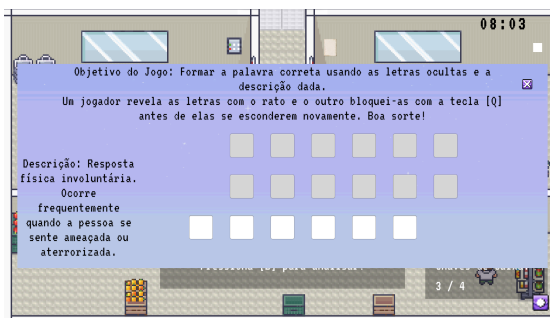


Figure 5.54: Word-forming puzzle.



Figure 5.55: Final clue spawn notification.

Upon discovering the final clue hidden within the room, players are presented with a crucial textual hint for identifying the emotion that this level is designed to transmit—fear (see Figure 5.56):

"You're in the supermarket and, as you explore the aisles, you suddenly realize that your parents have disappeared. You look around, but all you see are strangers. Your heart beats faster, and you feel a lump in your throat. Every corridor looks the same, and you don't know how to return to where you started. You're lost, you're shaking, and panic is starting to take over."

Once players have deciphered the clue, they can proceed to the room's exit to confront the final challenge: a word-forming puzzle similar to a previous puzzle encountered in this level. However, this time, the word to be constructed is 'medo,' which translates to 'fear' in Portuguese. The following description was given:

It arises in response to a threat, real or imagined, causing anxiety and tension

Completing this puzzle not only marks the conclusion of this particular room but also signifies the end of the first phase of the game—emotion recognition. Players can now advance to the second phase and enter the final escape room, progressing toward the game's completion.

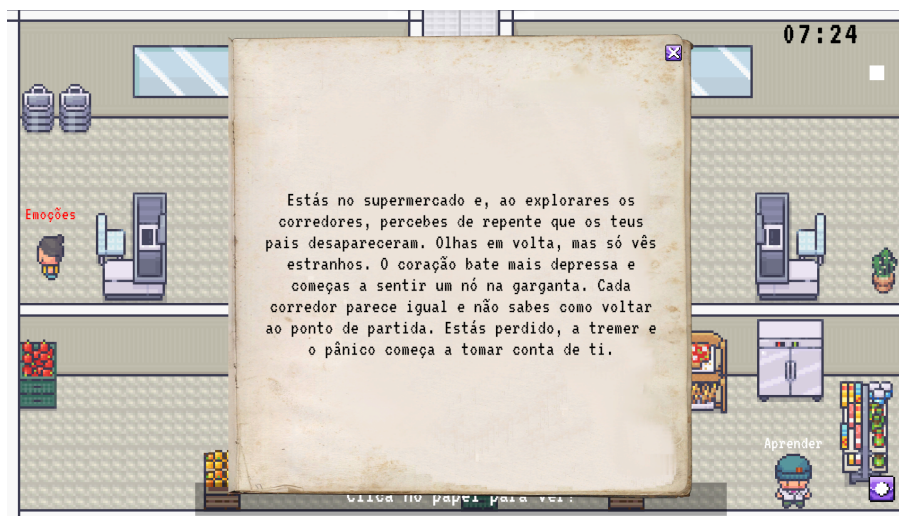


Figure 5.56: Final clue object.

5.2.7.8 ER strategies training room

Game World

In the final escape room, intended for training ER strategies, the environment is purposefully underdeveloped in its early stage. This design choice reflects the room's role in accommodating multiple narrative lines, each corresponding to distinct areas within the room. As depicted in Figure 5.57, players initially encounter a largely obstructed space, with only a central area accessible. This area lacks specific thematic elements, serving as a neutral zone. The first accessible section, however, introduces an arcade-themed environment, featuring interactive elements such as an arcade machine and a ping pong table, setting the stage for the players' journey through the ER strategies training.

Figure 5.58 provides a detailed view of the game's spatial layout. The environment is segmented into distinct areas, each with thematic elements. Players navigate through spaces such as a kitchen with typical items like a fridge and tables, a spacious living room featuring a TV and a musical element (e.g., a guitar), and a pool table area. Additionally, there is a smaller living room containing general household elements.

These areas are strategically arranged to form a sequential path players must follow. The design of each space is closely tied to a dedicated narrative, reinforcing the educational objectives associated with the ER strategies.



Figure 5.57: Early Stage ER Training Room



Figure 5.58: Late Stage ER Training Room

Level Design

This final level includes the largest environment within the game, with the dimensions of this room exceeding those of the previous levels. The expanded space is essential to accommodate five distinct sub-rooms, each corresponding to a unique ER strategy that will be introduced at this stage. Notably, this level presents the highest complexity, both in terms of the challenges posed and the puzzles players must solve.

Upon entering the level, players initially have access only to a central area with minimal content to explore, along with an unoccupied space located at the bottom right of the room. This design intuitively guides players to begin their exploration in that direction, as all other pathways are obstructed (see Figure 5.59).

As in previous levels, a textual clue (see Figure 5.60) is provided within the central area, which outlines the primary objective of this stage. Specifically, players are tasked with gathering five items, called ER tokens, each linked to one of the ER strategies being taught at this level.

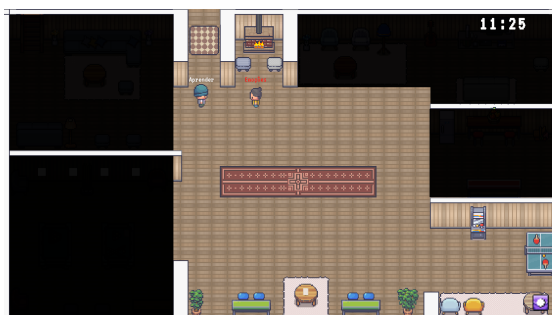


Figure 5.59: Initial state of the room.

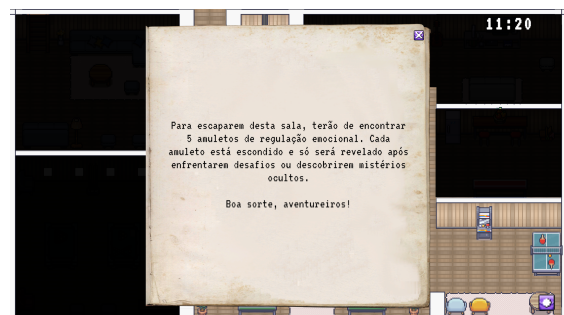


Figure 5.60: Objective contextual clue

Upon entering the first sub-space, players encounter an arcade machine that initiates a new mini-game (see Figure 5.61) not previously encountered within the game. This mini-game is a cooperative shooting challenge where players must work together to maximize their score. One player is responsible for aiming at the target, while the other executes the shot. The goal is to accumulate 15 points within a 20-second time limit. If players fail to meet this objective, they have

the option to restart the mini-game and attempt the challenge again. Upon successful completion, the first explanation of an ER strategy (see Figure 5.62) is revealed:

Cognitive reappraisal is when we change the way we think about a situation in order to alter our emotional response.

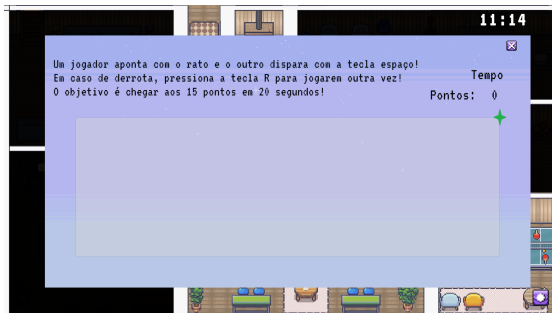


Figure 5.61: Shooting mini-game.

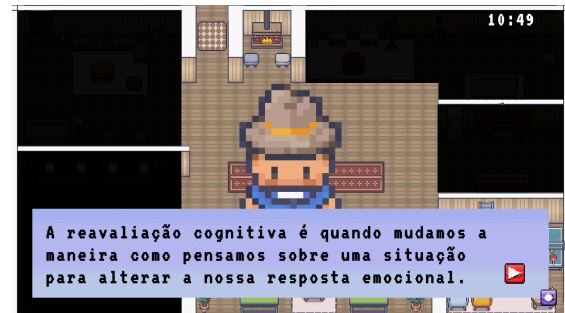


Figure 5.62: Cognitive reappraisal strategy explanation.

Following this explanation, participants are required to complete a multiple-choice quiz (see Figure 5.63) designed to assess their comprehension and validate their understanding by applying the **Cognitive Reappraisal** strategy to a practical scenario.

Jorge's friends all want him to go to the arcade in the evening, but his parents won't let him go out at night and he gets very upset with them. What is the best way for Jorge to apply the strategy - cognitive reappraisal - in this context?

Answer: Jorge may think that his parents are just worried about him, and that this concern shows how much they care about him.

Correctly answering the quiz awards players their initial ER token.

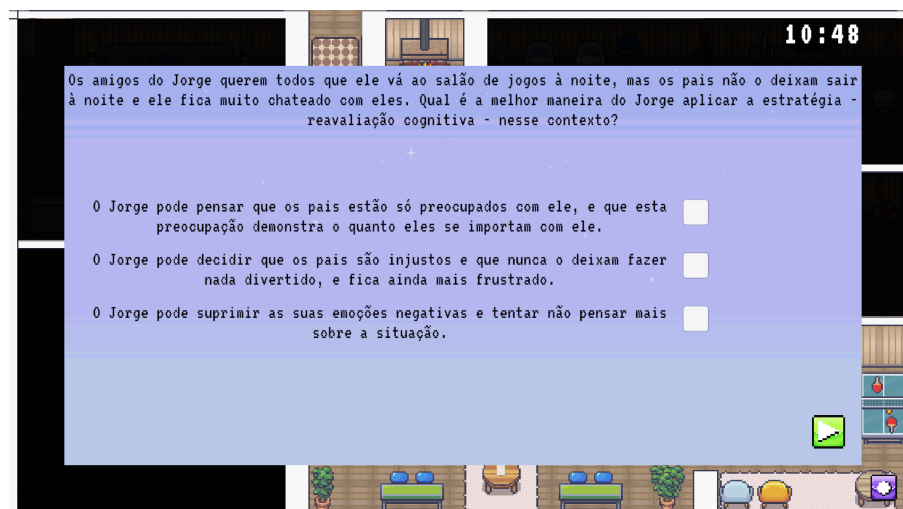


Figure 5.63: Validation quiz on cognitive reappraisal practical application.

Upon acquiring the initial ER token within the first sub-space, a subsequent sub-space becomes accessible for further exploration. This second sub-space, resembling a kitchen or a typical dining

area, presents players with a textual clue (see Figure 5.64) hidden within a basket. The clue contains a cryptic message and three critical numbers totaling four digits. These digits are essential for deciphering a code puzzle (see Figure 5.65) that is activated when players engage with the refrigerator in the space. Successful resolution of the puzzle unveils the second ER strategy (see Figure 5.66):

Situation selection involves choosing or modifying aspects of the situation to influence our emotional experience

The validation quiz (see Figure 5.67), in which participants are required to practically implement the ER strategy of **Situation Selection**, is as follows:

While she was home alone and making a snack, Joana broke her mother's favorite dish. She is afraid to tell her mother. What is the best way for Joana to apply the strategy - situation selection - in this context?

Answer: Choose a quiet moment, like after dinner, to tell mom about the broken plate.

Correctly answering the quiz grants players their second ER token and opens up the third sub-space.

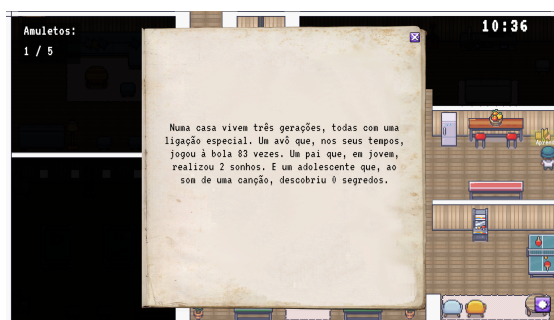


Figure 5.64: Textual clue.



Figure 5.65: Code puzzle.

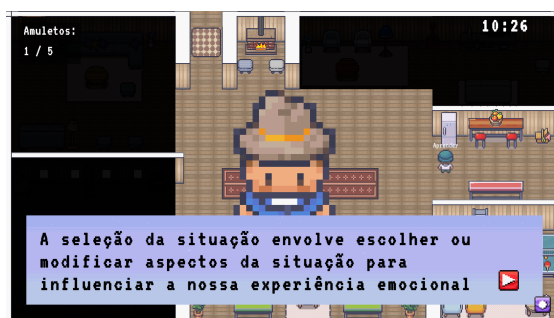


Figure 5.66: Situation selection strategy explanation.

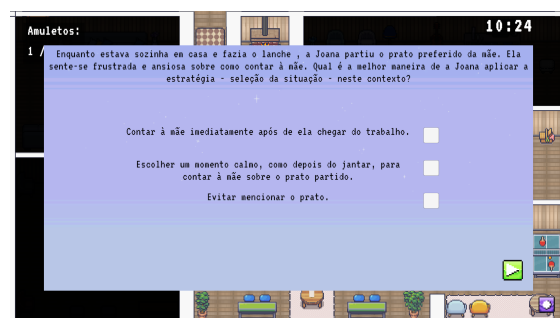


Figure 5.67: Validation quiz on situation selection practical application.

In the third sub-space, there is a cryptic textual clue (see Figure 5.68) indicating the required player actions concerning a set of switches within this environment. Specifically, players must collaborate to simultaneously engage two particular switches out of the total four available, a mechanism that is familiar to players at this advanced stage of the game.

Upon the simultaneous activation of these two switches, the ambient lighting within the space is

illuminated, revealing a new object. Interaction with this newly revealed object elucidates the third ER strategy (see Figure 5.70) in a similar manner to the preceding strategies:

Situation modification is when we try to change the situation itself or an aspect of that situation in order to change our emotional response.

Following the presentation of the educative content, players proceed to engage with the quiz (see Figure 5.71), designed to facilitate the practical application of **Situation Modification** and to enable the acquisition of their third ER token:

João is playing pool with friends, but he's not playing very well and is frustrated at losing. He's starting to feel anxious about his friends' comments on his performance. What is the best way for João to apply the strategy - situation modification - in this context?

Answer: Propose playing in teams rather than individually.

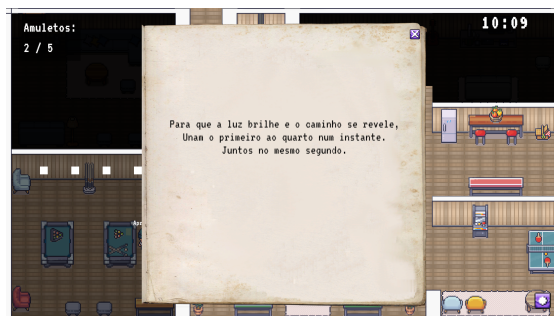


Figure 5.68: Textual clue on how to operate the switches.



Figure 5.69: Switches enable collaborative task execution.

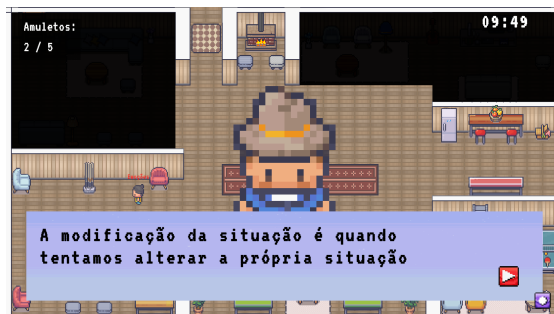


Figure 5.70: Situation modification strategy explanation.

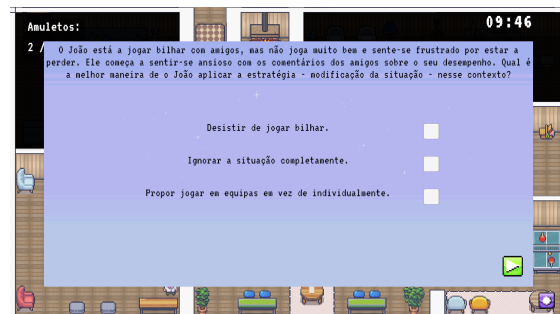


Figure 5.71: Validation quiz on situation modification practical application.

In the fourth space, participants are presented with a recurring puzzle, specifically the color ordering puzzle (see Figure 5.72). In this context, players must investigate the environment within this space and discern the color sequence of the pillows on the sofa to resolve the puzzle. Upon completing this task, the fourth ER strategy (see Figure 5.73) is presented to the parent and the adolescent, followed by a subsequent assessment quiz (see Figure 5.74) designed to validate their comprehension of the **Attentional Deployment** strategy:

Attentional deployment strategy is redirecting our attention to reduce the negative emotional response.

Joana's mother had a difficult day at work. However, when she got home, she saw that Joana had left her books scattered around the living room, and she became even more irritated. How can Jane's mother apply the strategy - attentional deployment - in this situation?

Answer: Instead of acting on her anger, Joana's mother could go and read for a while, something she likes to do, to calm down.



Figure 5.72: Color ordering puzzle.

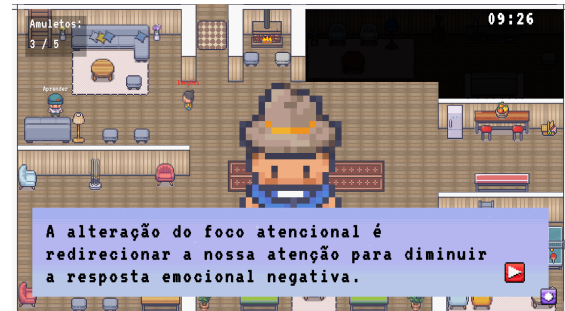


Figure 5.73: Attentional deployment strategy explanation.

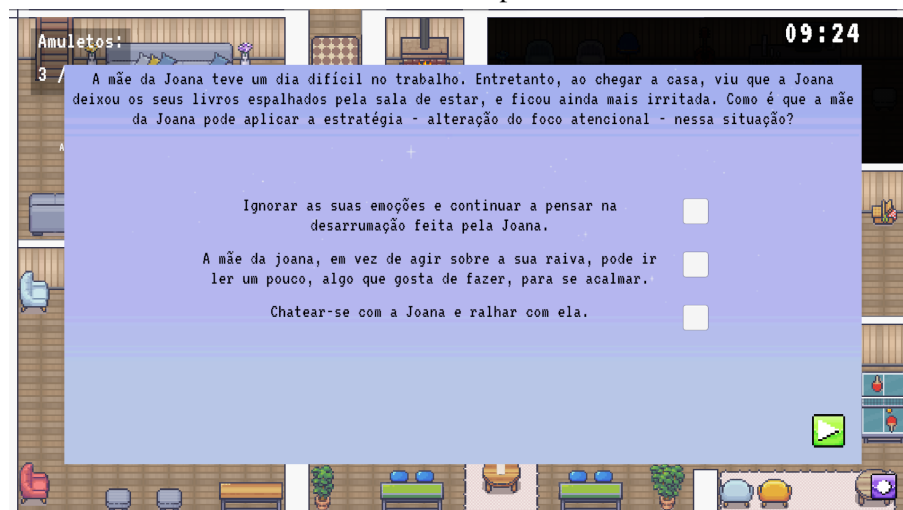


Figure 5.74: Validation quiz on attentional deployment practical application.

This final section of the room introduces arguably the most complex puzzle in the game—a musical challenge that incorporates an additional layer of complexity compared to previous levels. Upon interacting with the guitar, the musical puzzle is activated (see Figure 5.76). Following the successful completion of the puzzle, the **Emotional Suppression** ER strategy is presented to the players (see Figure 5.77). Subsequently, they are questioned (see Figure 5.78) on the key characteristics of this strategy, with an emphasis on its practical application in a real-world scenario:

Emotional suppression is not showing what you're feeling, for example in your facial expressions.

Jorge's father recently learned that he had been made redundant and was very saddened by the news. When he got home, he went to see Jorge and his mother, who were in the living room

talking. What is the best way for Jorge's father to apply the strategy - emotional suppression - in this situation?

Answer: Suppress the sadness and fear and keep a relaxed expression during the moment so as not to worry the family.



Figure 5.75: Final section of the room.

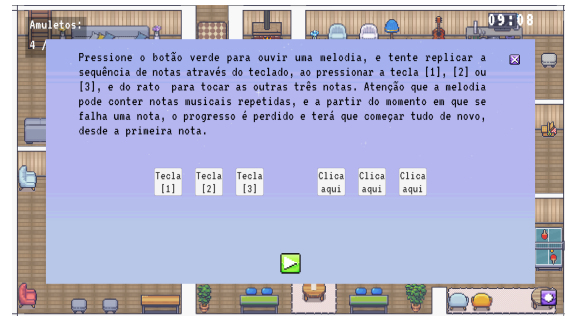


Figure 5.76: Musical puzzle with added complexity.

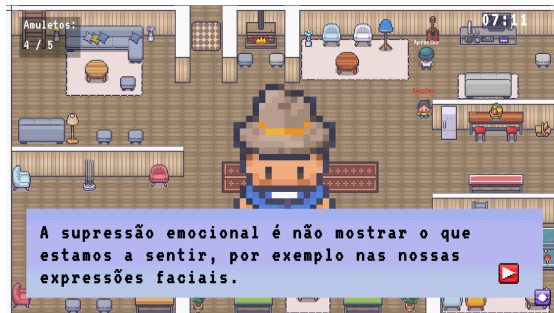


Figure 5.77: Emotional suppression strategy explanation.

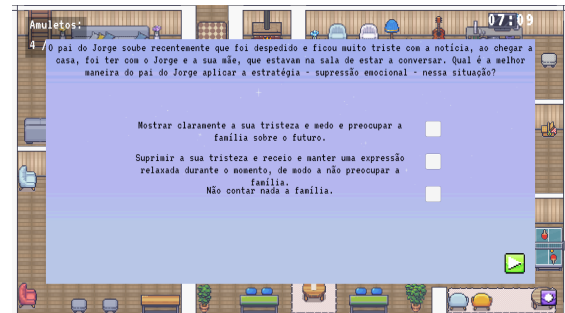


Figure 5.78: Validation quiz on emotional suppression practical application.

Upon completing all challenges within the room and mastering the five ER strategies through their application in practical scenarios, the participants have acquired all five ER tokens, thereby unlocking the door to attempt the final "escape."

The concluding puzzle involves solving an anagram (see Figure 5.80), requiring the participants to recall the core educational objective of this final level—learning and practicing ER strategies. The solution to the anagram is "regular," which translates to "regulate" in Portuguese, encapsulating the essence of emotion regulation.

By deciphering this final puzzle, participants effectively conclude their journey through *Emotion Odyssey*.



Figure 5.79: Final ER token achieved and door unlocked.



Figure 5.80: Final anagram.

5.2.8 User Interface

Heads-up Display

The Heads-Up Display (HUD) is a crucial interface element in *Emotion Odyssey*, designed to provide players with real-time information and controls necessary for navigating and interacting with the game environment.

This section explores the various components of the HUD, detailing their functions and how they contribute to the overall player experience. From action prompts and notifications to timers and help system icons, each element has been designed to enhance the player's immersion and practicality.

In certain levels of *Emotion Odyssey*, the HUD incorporates specific panels, such as the area labeled (1) in Figure 5.81. These panels enable players to track the collection of items or objects within the level, providing detailed information on which items have been acquired by which player. These panels are designed to be context-specific, appearing only during particular challenges, such as those involving the relocation of items.

In certain challenges, mini-games, or events throughout the game, the HUD may incorporate a timer, such as the one labeled (2) in Figure 5.81, to impose time constraints on these tasks. This timer serves to limit the duration available to players, adding a layer of urgency and requiring efficient task completion within the allocated time frame.

In each level of *Emotion Odyssey*, a distinct countdown timer is consistently present in each level. This primary countdown timer serves as a crucial mechanism, enabling players to monitor the remaining time available to successfully "escape" the room and complete the level. An example of this timer is illustrated as item (3) in the accompanying Figure 5.81.

Item (4) in the figure illustrates an example of an in-game notification that players may receive. Throughout the game, various types of notifications are employed, including alerts for new clues, door unlocks, item collection, successful interactions with objects, and unsuccessful attempts. These notifications play a critical role in guiding players through level progression and providing immediate feedback on their actions, thereby enhancing the overall gaming experience.

Action prompts play a crucial role in guiding players on when and how to interact with proximity-based interactive objects. These prompts are consistently positioned at the lower center of the screen, ensuring accessibility and visibility. Distinct action prompts are provided for Player 1 and Player 2, tailored to their respective roles and interactions. An example of an action prompt specific to Player 1 is depicted in Figure 5.81 labeled as item (5).

Finally, across all levels of the game, two icons located at the bottom-right corner of the screen serve crucial functions. The red icon is displayed only when players acquire additional clues. It functions as a button that provides access to these supplementary hints, aiding players in advancing through the level. Conversely, the purple icon is consistently present at every level and provides access to the help system. These icons are illustrated in item 6 of the accompanying figure.

Certain elements of the HUD may undergo modifications in color, location, and size to enhance visibility and optimize the user experience. These adjustments are designed to be subtle and within the bounds illustrated in the accompanying figure, ensuring that they contribute to improved player interaction without causing significant disruption.



Figure 5.81: *Emotion Odyssey* HUD.

Menus

Menus in *Emotion Odyssey* serve as the primary interface through which players navigate the game's various features and content. Well-designed menus are crucial for ensuring an efficient user experience.

This section will examine the design and functionality of *Emotion Odyssey* menus, exploring their layout, purpose, and how they contribute to an intuitive and engaging player experience.

The first menu encountered by players in the game is the initial menu (see Figure 5.86), which introduces them to the game's title and establishes the color palette. This menu evolves through distinct phases as the player progresses.

In the first phase, presented during the player's initial interaction with the game, the menu features

only two options: to exit the game or to begin a new adventure. This minimalist design reflects the player's first exposure to the game environment.

The second phase is activated once the player has successfully completed at least one level, with progress saved at the last completed level. At this stage, an additional option appears, allowing the player to continue from where they last left off.

The final phase of the initial menu becomes available upon the game's completion. In this phase, a new button is added, granting access to a comprehensive guide that delves deeper into the ER strategies learned throughout the game, extending beyond what was covered during gameplay.

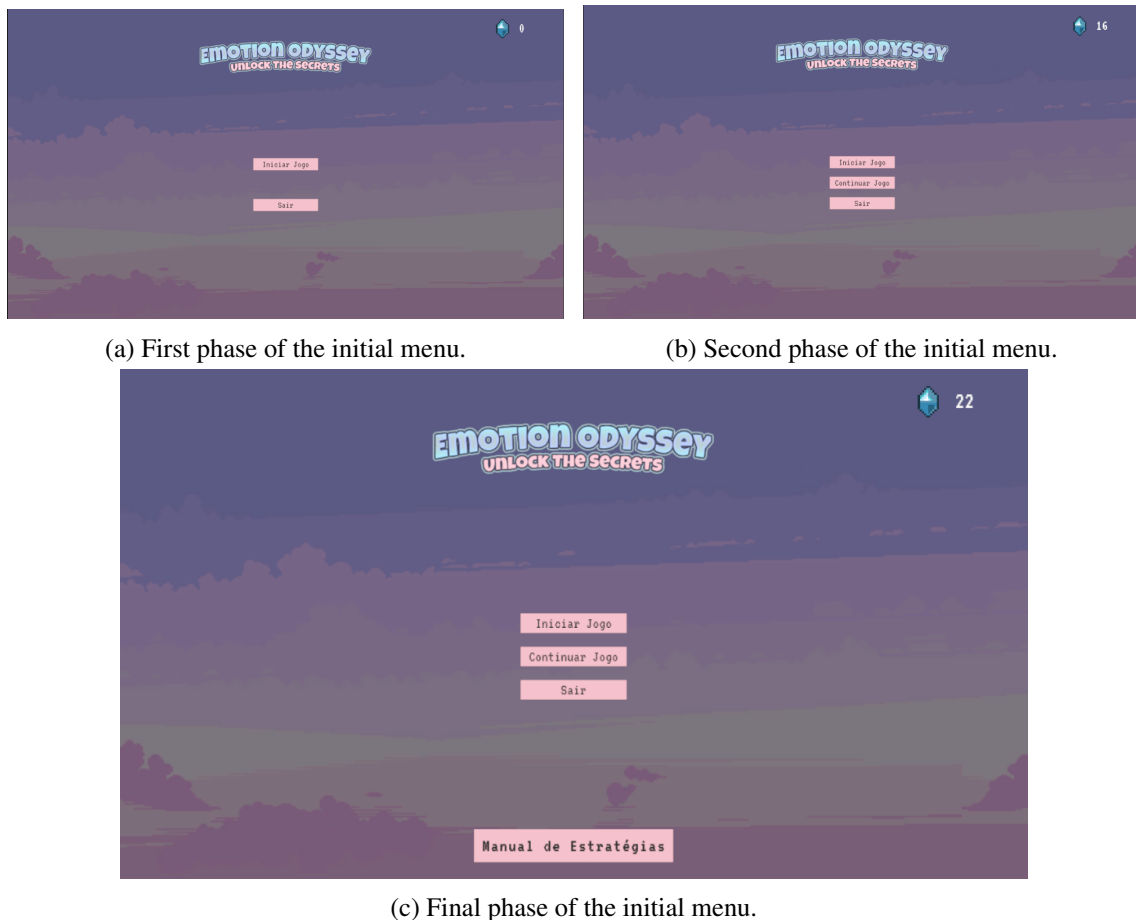


Figure 5.82: Overview of all phases of the initial menu of *Emotion Odyssey*.

Emotion Odyssey features a save progress system that enables players to advance to the next unbeaten level while marking all previously completed levels as conquered. When players select the **Continue Game** option from the initial menu or during the transition between levels, they are directed to the level selection menu.

In this level selection menu (see Figure 5.83), players can view a comprehensive list of levels, distinguishing between those that have been completed and those that are still pending. The menu also indicates the next available level for the player to attempt. Additionally, players have the option to return to the initial menu by pressing the button located in the bottom left corner or to

access the character models shop (see Figure 5.3) by pressing the button in the bottom right corner, where they can purchase and switch between character models.



Figure 5.83: Level selection menu.

The final menu discussed in this section is the pause menu (see Figure 5.84). This menu can be activated at any point during gameplay, providing players with the ability to temporarily halt the game. The pause menu offers various options, including the ability to restart the level, exit the game, return to the initial menu, or revisit the controls page.



Figure 5.84: Pause menu.

Help System

The help system (see Figure 5.85) in *Emotion Odyssey* is designed to assist players at any point throughout the game. It provides two primary support options: the ability to purchase an additional page of context-specific clues or to extend the level's time by two minutes. Both options require

spending in-game currency, with costs increasing progressively as players advance through the levels. This system necessitates strategic resource management, captivating players to carefully consider their expenditures and weigh the potential benefits of these purchases against the rewards gained from successfully completing each level.



Figure 5.85: Pause menu.

5.2.9 Feedback

Feedback in *Emotion Odyssey* plays a pivotal role in enhancing the player experience by providing meaningful responses to in-game events, such as successfully completing a level, facing defeat, or assessing player performance in levels.

This section examines the various feedback mechanisms incorporated into the game, emphasizing how these elements reinforce player engagement, validate their efforts, and sustain a sense of progression.

A diverse range of feedback types is employed to inform players of their performance, with one of the most prevalent being context-sensitive notifications that signal positive or negative outcomes based on player actions within a level. For instance, successfully gathering all required items to achieve an objective triggers a specific positive feedback. This recurrent feedback mechanism is integral to the gameplay experience, and numerous examples are detailed in the levels section.

Another form of feedback provided to players occurs after the completion of each level, whether successfully or unsuccessfully. To maintain sustained player engagement, it is crucial that the feedback following a failure is framed positively to enhance motivation. In the game, players encounter two distinct feedback scenes: one delivers a congratulatory message upon victory, while the other offers a motivational prompt encouraging players to retry a level after failure.



(a) Congratulatory message on successful completion of a level.

(b) Motivating message on unsuccessful completion of a level.

Figure 5.86: End-of-Level Feedback Messages in *Emotion Odyssey*.

An additional crucial feedback mechanism within the game is the evaluation of player performance across each level, which is facilitated through the rating system of *Emotion Odyssey*.

The rating system measures how well players complete levels based on the time they take and their use of help. It calculates the total time available, including any help time, and compares it to the actual time spent. If players use help, their score is adjusted to reflect this. Players earn between 0 to 3 stars depending on how efficiently they complete the level, with fewer stars indicating better performance. The system encourages players to finish levels quickly and with less reliance on help.

This rating system not only provides players with continuous motivation to improve their performance across levels but also enables them to assess their navigation efficiency. It facilitates discussions among players about strategies and approaches for enhancing performance in subsequent levels, thus promoting more effective gameplay strategies.



Figure 5.87: Assessment of players performance in *Emotion Odyssey*.

5.2.10 Auxiliary Learning Resources

Upon completing *Emotion Odyssey*, players gain access to supplementary resources through the initial menu. These resources are associated to the five ER strategies from Gross's model that were introduced and explored during the game. Auxiliary learning resources play a crucial role in enhancing the educational experience of this SG by providing supplementary materials that complement the primary content of the game. These resources are designed to reinforce key concepts, and facilitate deeper understanding through informational means.

In this section, the auxiliary learning resources available are detailed exactly as they are in-game:

Situation Selection

Situation Selection involves choosing to be in situations that are likely to lead to the experience of positive emotions or avoiding situations that could generate negative emotions. In this way, we can control the environment or context in which we find ourselves, which can include choosing certain people we want to interact with or what activities we want to do in order to feel more positive emotions or avoid negative emotions. This strategy requires the ability to anticipate how different situations might affect our emotions and to make the best decisions based on what we anticipate will happen and how we will feel. It is an adaptive strategy and promotes emotional well-being by helping to deal with emotions in an effective and positive way.

Situation Modification

Situation Modification involves changing something in the environment or context in which we find ourselves in order to alter the impact that situation has on us and therefore improve our emotional state. It requires conflict resolution skills and creativity to find effective ways of changing the situation. It helps to reduce the impact of negative emotions and increase the experience of positive emotions.

Attentional Deployment

This strategy consists of focusing attention on non-emotional aspects of a situation, shifting our focus to another activity or thought in order to reduce the emotional impact of that situation. The aim is to reduce exposure to aspects of the situation that cause negative emotions, thus reducing the emotional impact. It allows a person to maintain control over their reactions and continue to function effectively in a situation by keeping the focus on non-emotional tasks or aspects.

Cognitive Reappraisal

This strategy involves changing the way a person thinks about a situation in order to alter its emotional impact. Cognitive reappraisal involves recognizing the emotional situation, analysing the thoughts that arise in response to the situation, generating more balanced and less disturbing ways of thinking about the situation and implementing these new perspectives to feel better. It is a process that seeks to implement a healthier and more balanced approach to negative situations by helping to cultivate a more positive mindset. It is considered an adaptive strategy since reinterpreting situations can change the negative impact we feel. However, sometimes it may not be the most appropriate strategy. For example, let's imagine that a person is upset because a friend cancels plans to go out together too often. The person may always think that "he probably has a good reason", in order to feel better about this absence. However, this reassessment can prevent the person from confronting the friend with the situation and clarifying the reasons for the lack of commitment.

Emotional Suppression

This strategy involves controlling physical reactions, avoiding expressing emotions or sharing the emotional experience with other people. This strategy is suitable for certain situations in which it is more appropriate not to express emotions, however, if used excessively or as the main strategy for dealing with emotions, it can be harmful, particularly in terms of getting support from other people (if you don't express your emotions, for example, sadness, other people won't identify this emotion in order to provide support).

These detailed insights into each ER strategy can be accessed through the 'Emotion Regulation Manual' button in the initial menu of *Emotion Odyssey* after players complete all levels successfully. Players have the flexibility to explore each strategy individually.

5.2.11 Reflection on the Importance of the First Co-Design Phase in the Game Development

This section will detail more profoundly design choices made in the development of *Emotion Odyssey* highly associated with the ideas discussed during the interviews done in the first phase of the co-design process (see section 5.1).

The game environments were designed to reflect the insights gathered from interviews with psychologists and participants of the target population. As discussed, the game features both realistic and fantastical scenarios. For instance, the 'Enjoyment' room is modeled after a classroom, and the 'Sadness' room replicates a typical adolescent bedroom, both of which are grounded in reality. Conversely, the 'Disgust' room incorporates elements that are more abstract, such as a witch's cauldron filled with green liquid and various potions that the players can collect, which do not correspond to real-world objects.

Moreover, most of these environments were selected for their relevance to the target population, either because they were inherently familiar to the participants or were specifically highlighted

during interviews. For instance, the inclusion of the supermarket environment was directly influenced by discussions in which it was identified as a setting associated with fear.

Themes such as family dynamics, school experiences, and peer pressure, which emerged during the interviews, were integrated into the game's narrative. *Emotion Odyssey* incorporates one or more narrative moments throughout the game that specifically address these themes.

An essential recommendation from the psychologists involved in the development of this game was the intentional integration of parental participation. The game is designed to foster collaboration between parents and their children, allowing them to play together, improve their ER skills, and reflect on various parenting scenarios. This collaborative aspect was a central objective during the game's development, leading to the inclusion of numerous opportunities for parents and children to engage in discussions, cooperate on challenges, and thrive together.

Moreover, *Emotion Odyssey* is structured to provide emotional education and ER strategies to parents as well. The game incorporates detailed parenting situations, and within the ER strategies room, the instruction and application of some of these strategies are often grounded in practical scenarios involving parents. This approach ensures that both children and parents benefit from the educational experience, promoting a shared journey of emotional development.

An essential concept highlighted during the interviews with psychologists was the inclusion of supplementary materials to allow players a better understanding of the characteristics and contexts of emotions, as well as the features of ER strategies. To address this need, *Emotion Odyssey* incorporates content, primarily in the form of quizzes, that emphasizes the practical contexts and defining characteristics of various emotions. Furthermore, as outlined in previous sections, upon completing the game, players gain access to additional information that elaborates on the ER strategies taught, providing comprehensive insights into their application and underlying principles.

The reward system and its implementation were prominent topics of discussion during the interviews, particularly among participants from the target population. The consensus was that a well-developed reward system is essential for fostering player engagement. Participants emphasized the importance of using rewards to purchase items such as character personalization options or adjustments to difficulty levels.

As detailed in previous sections, *Emotion Odyssey* allows players to use in-game currency—earned as rewards—to purchase additional character models and unlock gameplay assistance options. The game offers a total of 11 distinct character models, as well as the ability to personalize elements such as the player's in-game name. These features contribute to a sense of relatability and customization, addressing the variety and personalization that participants expressed a desire for during the interviews.

5.3 Second Phase of Co-Design

5.3.1 Procedure

The second phase of co-design, conducted asynchronously, occurred when the game reached an advanced stage of development. Based on their availability, a small sample of participants from the first phase were given access to the current version of the game and could provide feedback in a written format at their convenience.

The objective was to collect specific feedback from each type of participant through structured questionnaires (annex C) following their testing of the game.

For health professionals, the questionnaire focused on the following aspects:

- Clarity of the game's objectives
- Perceived challenge and motivation for the target population
- Completeness of the educational content and alignment with discussions from the first phase
- Additional suggestions for improvement

For the parent and adolescent, the questionnaire addressed:

- Perceived challenge and motivation of the game
- Whether the participants felt they learned about ER and if the learning process was easy and clear
- Opinions on the game's rewards
- Suggestions for further improvements

Detailed descriptions of these questionnaires are provided in the annex section.

As with the procedure outlined in 5.1.1 from the first phase of co-design, this procedure was included under the same approval from the ethics committee and adhered to the same principles.

5.3.2 Participants

In the second phase of the co-design process, a subset of participants from the first phase was involved. The reference codes assigned to these participants are consistent with those given in the first phase (see section 5.1). This sample included a 14-year-old adolescent (A1), her 45-year-old mother (PA1), and a psychologist (P1).

5.3.3 Data Analysis

In the second phase, an inductive thematic analysis [64] was conducted on the feedback obtained from the structured questionnaires completed by the participants after testing the near-final version of *Emotion Odyssey*. This phase focused on understanding participants' perspectives on the

game's design, functionality, and educational effectiveness.

The thematic analysis [64] involved categorizing participants' responses to identify recurring themes and feedback.

5.3.4 Results

To provide comprehensive understanding on key insights, verbatim quotations from participants' written responses are included through the results description.

Theme 1: Clarity of Game Objectives

Participants expressed varied perspectives on the clarity of the game objectives. A1 revealed confusion during a specific challenge within a level of the game, indicating a need for clearer instructions: *"no, the oranges and strawberries challenge is confusing"* (Quote 20, A1). Similarly, PA1 shared this sentiment, highlighting the necessity for improvements in transmitting the game's objectives effectively: *"Most of them are quite clear, but there are a few tips that aren't quite right"* (Quote 21, PA1).

These responses suggest that some aspects of the game require refinement to enhance player comprehension.

Theme 2: Difficulty and Motivation

This theme explores if the challenges in *Emotion Odyssey* promote motivation in players or cause frustration and disengagement.

While the game objectives are generally clear, P1 emphasized that players should be allowed more time to familiarize themselves with the tasks at their own pace: *"I think there should be more time in the first rooms so that players can explore the rooms better and understand how each mini-game works and its objectives."* (Quote 22, P1).

Furthermore, PA1 and A1 agreed that the game presented an adequate level of challenge without inducing frustration, even during more difficult segments: *"Yes, I find the game very challenging and it doesn't frustrate me at all"* (Quote 23, PA1).

Finally, P1 emphasized the importance of the game's progressive difficulty, noting that this incremental increase in challenge enhances player motivation and sustains engagement throughout the gameplay experience: *"In addition to the game being very fun and challenging, it is possible to notice that the difficulty and complexity of the tasks is increasing, also leading to a greater desire to continue the game."* (Quote 24, P1).

Theme 3: Educational Value

Concerning the educational component of the game, feedback from both the psychologist and the family offered distinct evaluations of its content quality. P1 highlighted the significant advantage of the game's multiplayer format, emphasizing its value in facilitating collaborative learning among players. Additionally, P1 commended the frequent opportunities for emotion recognition inserted throughout the game, allowing players to discuss specific emotional situations. Another positive aspect noted by P1 was the use of relevant and appropriate scenarios tailored to the target population: *"I think that the stories and situations described are appropriate for the target age group and also lead to greater identification"* (Quote 25, P1).

The family was asked to elaborate on the effectiveness of the educational content and whether it was clear and easy to understand. PA1 stated: *"Yes, you can understand the message and learn from the game, and you learn to deal with the various emotions"* (Quote 26, PA1).

This response indicates that the educational content successfully communicates its intended messages and facilitates learning emotional regulation strategies. Additionally, A1 shared the same opinion as PA1: *"the content is clear and easy to understand, I feel I've learned to work with my emotions"* (Quote 27, A1).

The positive feedback from PA1 and A1 suggests that the game can effectively achieve its educational objectives, providing players with practical insights into managing emotions. These findings highlight the game's potential as a valuable tool for developing ER skills and support its continued development and adjustment.

Theme 4: Rewards

Participants generally found the rewards valuable and motivating, mostly due to their role in facilitating player progression through the game: *"I think the rewards system is well done. It's nice to be able to use the game's "money" to help out"* (Quote 28, P1), *"the rewards help you to have more time for more difficult clues"* (Quote 29, PA1).

Theme 5: Recommendations for Improving the Game

Regarding improvement suggestions in *Emotion Odyssey*, the psychologist proposed extending the time available in each escape room level. This additional time would allow players to explore solutions better, uncover clues, and engage in reflection together on the educational content rather than focusing solely on completing the level:

The time people have to solve the rooms should be longer, not only because I think it's too short to complete the tasks, but also to leave some time for players to reflect on the situations represented in the game (Quote 30, P1).

Additionally, she also identified several technical issues related to fundamental in-game mechanisms, offering valuable insights for necessary improvements in the game's final version. The mother and the adolescents acknowledged that *Emotion Odyssey* is a well-designed game

that effectively communicates its educational message. However, the adolescent recommended increasing the cost of in-game assistance options to enhance the game's challenge and encourage players to develop better currency management skills.

5.3.5 Conclusions

This second phase of co-design during the mid-development of *Emotion Odyssey* was crucial in assessing whether the development was aligning with the initial concepts established in the first phase of co-design with psychologists and the target audience.

Analyzing the results obtained through structured questionnaires in this phase yielded significant insights into the current state of the game. These findings informed necessary adjustments to enhance both the gameplay and the educational experience offered by *Emotion Odyssey*.

One of the key findings was related to the clarity of game objectives. In certain sections of the game, objectives were not sufficiently clear, and players often lacked adequate time to fully comprehend them. This feedback led to an extension of the time limit for completing each level across all rooms. Additionally, a comprehensive review of all clues and instructions for mini-games and challenges was conducted. The ambiguous or confusing text was revised, and missing information was incorporated to enhance overall clarity.

Overall, participants argued that the game's difficulty level was appropriate, with one notable suggestion for improvement. They recommended that the cost of accessing the help system should gradually increase as the game progresses rather than remaining consistently low throughout. This adjustment would enhance the challenge by requiring players to more carefully manage their in-game currency, thereby increasing the complexity and engagement of gameplay. Participants viewed this change positively, as it would prevent the game from becoming too easy by allowing unlimited access to assistance. This suggestion was straight away implemented.

Finally, regarding other aspects such as the educational content and rewards, participants indicated that these elements were well-developed within the game and demonstrated practical utility. This feedback suggests that the development in these areas was consistent with the objectives established during the initial phase of co-design and was progressing effectively.

Chapter 6

Game Development: Toolkit, Assets and Practical Implementation

6.1 Engine and Auxiliary Software

6.1.1 Unity

A game engine is a software framework designed to streamline and optimize video game development. It provides essential components such as 2D and 3D graphics rendering, physics simulation, and animation. It can also integrate tools like level, script, material, and sound editors, facilitating the development of game environments, behaviors, visuals, and audio. These tools enhance game development by offering specialized functionalities within a unified interface. Game engines are crucial because they allow developers to build games more efficiently without creating each component from scratch [69].

Examples of game engines include Unity, Unreal, Torque, Ogre, and XNA. Unity has consistently emerged as the preferred development platform among serious game developers, as highlighted in the literature review detailed in chapter 4, offering a comprehensive array of features such as those previously mentioned. This contrasts with other game engines that may lack such extensive functionality [70].

The Unity game engine was selected for this project, specifically utilizing Unity2D for its 2D graphics rendering capabilities. This choice was influenced by prior experience with Unity, including smaller projects completed using this engine. Despite the increased complexity of this project, the extensive community support, the variety of assets available in the Unity Asset Store, the engine's user-friendly nature, and the abundance of online tutorials were critical factors in deciding to use Unity to develop *Emotion Odyssey*.

6.1.2 Photopea

Photopea [71] is a web-based image editing application. It supports various file formats, including PSD, AI, and SVG, allowing for versatile editing and compatibility with various design tools.

Photopea offers layer management, advanced selection tools, filters, and adjustment layers. Photopea was employed to design the logo and icon for *Emotion Odyssey*.



Figure 6.1: Logo of *Emotion Odyssey* designed using Photopea.

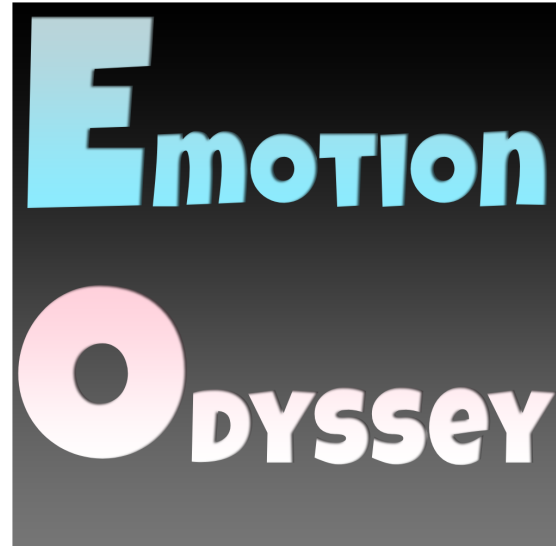


Figure 6.2: Icon of *Emotion Odyssey* designed using Photopea.

6.2 Assets

The development of *Emotion Odyssey* incorporated a diverse array of assets, including 2D models, user interface (UI) elements, audio files, and fonts. All these assets were sourced from various web-based platforms. This approach facilitated the integration of high-quality, pre-existing resources, enabling concentration on refining gameplay mechanics and enhancing the overall user experience. By leveraging these ready-made assets, the development process was streamlined, and the focus was on key aspects of game design and functionality.

6.2.1 Characters and Environment models

Emotion Odyssey employs a 2D digital format, necessitating the careful selection of appropriate 2D character and environment models. This subsection clarifies the rationale behind the selection and utilization of these models, highlighting their aesthetic contributions.

The 2D models were systematically integrated into various aspects of the game, including the two primary characters and the diverse environments, in this case, all of the escape room environments encountered across the game. The selection criteria for these models were based on achieving the 2D-pixel art aesthetic and ensuring an engaging user experience.

In developing a serious game, multiple avenues exist for sourcing appropriate models. One option involves searching for free assets available on the internet, such as those found on the Unity Asset Store, and websites such as itch.io, where individuals can host, sell, or download game assets. Numerous paid options exist, as high-quality game assets can represent significant value, reflecting

the substantial effort and expertise involved in their creation.

For the development of *Emotion Odyssey*, an extensive search for 2D models was undertaken across multiple online platforms. This investigation led to the identification of a comprehensive asset pack titled *Modern Interiors* available on itch.io. This asset pack, created by LimeZu (limezu.itch.io) and accessible at limezu.itch.io/moderninteriors, provided all the essential models required for designing various character model variations as well as the interior layouts for all rooms and levels within the game. All models utilized in this project adhere to a resolution of 16 pixels by 16 pixels. This resolution is standard for assets designed to achieve a low-resolution pixel art aesthetic.

6.2.1.1 Character Models and Animations

All character models in the game were obtained through two primary methods: (1) utilizing pre-existing sprite sheets, which are single image files containing multiple frames of animation for each character sprite, and (2) employing a character generator application (see Figure 6.4), which is included in the asset pack to create custom sprite sheets. Figure 6.3 illustrates one such sprite sheet used in the game development process. This figure demonstrates the arrangement of multiple animation frames within a single image, thereby facilitating efficient sprite-based animations for the character models. The character generator enables the customization of sprites according to predefined parameters, such as hair, clothing, and skin color, allowing for a diverse range of character variations.



Figure 6.3: Sprite sheet for character animations.



Figure 6.4: Character Generator Application.

6.2.1.2 Environment Models

For the environment models, the asset pack provided comprehensive interior designs for all rooms encountered in the game. These designs are presented as a single image containing elements organized according to specific thematic themes. Each design comprises 16x16 pixel tiles, which are intended to be utilized as tilesets within Unity to construct detailed interior environments. The

tileset format allows for efficient placement and manipulation of individual design elements, facilitating the creation of diverse and cohesive room layouts.

As illustrated in Figure 6.5, the asset pack includes a birthday party-themed tileset. This image encompasses all the necessary elements to design a birthday party escape room scenario, exemplified in Figure 6.6, such as decorations and furniture, enabling the creation of a visually consistent and engaging themed environment.

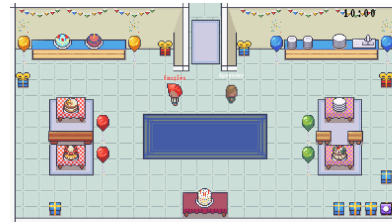


Figure 6.5: Image containing birthday party elements. Figure 6.6: Birthday party-themed escape room.

6.2.2 Graphic Assets

The UI is a critical aspect of game design, as it facilitates player interaction with the game. Effective UI design improves user experience through intuitive navigation and visually engaging elements.

All UI images used in *Emotion Odyssey* were sourced from licensed-free web platforms.

Background images

Background images establish the visual context and impression of the many screens *Emotion Odyssey* has, ensuring a consistent aesthetic throughout the game.

Three distinct background images, available at free-game-assets.itch.io, were utilized. Examples and illustrations of these background images are provided below.



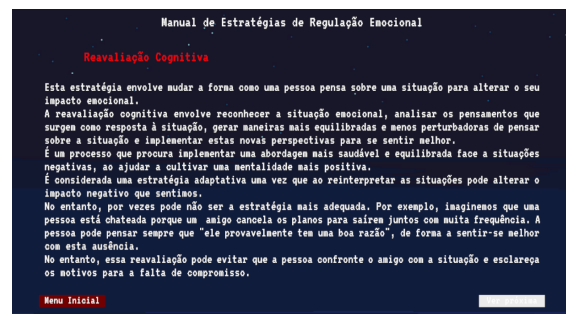
(a) First background image.



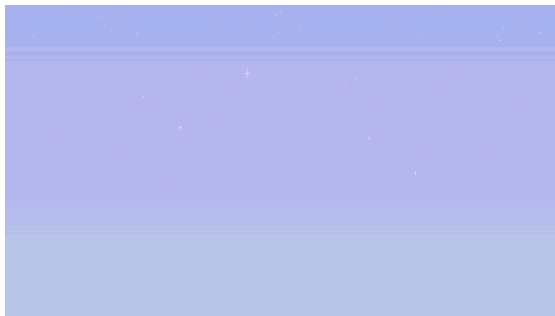
(b) First background image utilized in the initial Menu.



(c) Second background image.



(d) Second background image utilized in the ER strategy explanation screen.



(e) Third background image



(f) Third background image used in the game's puzzle interface

Figure 6.7: Illustrations and examples of background image usage in the game

Player Controls

Images of keyboard keys and mouse buttons were utilized to explain the essential game controls clearly and visually. This comprehensive graphical asset is available on itch.io, developed by BlatFan. This asset offers a variety of practical button representations and can be accessed at blatfan.itch.io/blatkey. Figure 6.8 illustrates the graphical asset employed.

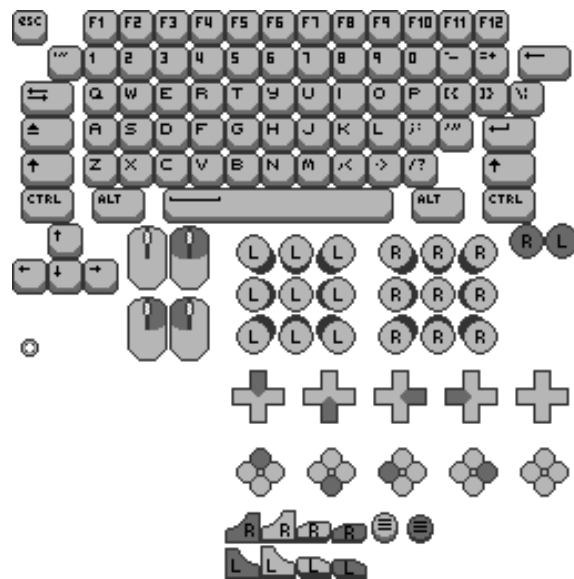


Figure 6.8: Graphical asset depicting keyboard keys and mouse buttons explaining game controls.

UI buttons

The UI buttons used in *Emotion Odyssey* were sourced from a comprehensive pack of UI button images available on itch.io. This pack provides various functional and visually cohesive designs, accessible at kicked-in-teeth.itch.io/button-ui. These buttons were predominantly used in-game to enhance the user interface. Figure 6.9 illustrates the graphical asset from which UI buttons were extracted.



Figure 6.9: Graphical asset depicting the UI buttons used.

Clues

Given that *Emotion Odyssey* is an escape room game, one primary image is associated with in-game clues. Figure 6.10 illustrates a page, sourced from opengameart.org/content/old-pagesflip-with-sound, where emotional-thematic narrative or level-progressing clue elements are displayed in-game.



Figure 6.10: Page image where clues are displayed.

In-game currency

A symbol representing in-game currency is crucial for delivering players a clear and immediate visual cue of the available currency. This facilitates easy recognition and differentiation from other game elements. The currency symbol (see Figure 6.11), sourced from laredgames.itch.io, resembles a diamond or valuable gem and transmits its significance as a valuable asset within the game. Adolescent participants' feedback informed this design decision during the initial co-design phase, which specified a preference for rewards in the form of diamonds with currency functionality (see section 5.1).

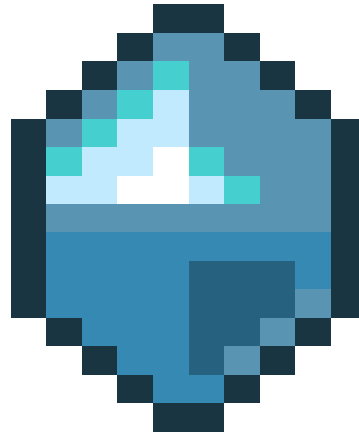


Figure 6.11: In-game currency symbol.

Star rating system

The level performance assessment system is essential for providing parents and adolescents with immediate feedback on their completed-level performance. This system also functions as a reward, recognizing players' achievements and enhancing motivation to continue progressing. In alignment with serious games discussed in the literature review (see chapter 4), which utilize reward mechanisms such as points or badges, this system includes a star-based rating, where the quantity of stars attributed to players represents different performance levels. The star symbol utilized is sourced from soulofkiran.itch.io.



Figure 6.12: Star image used in the level performance rating system of *Emotion Odyssey*.

6.2.3 Audio Assets

In the development of *Emotion Odyssey*, audio plays a crucial role in enhancing the immersive experience and providing auditory cues on some levels. An extensive search for free sounds was conducted across various online platforms to source appropriate audio assets. Among these,

Freesound (freesound.org) emerged as a primary resource due to its extensive library of user-uploaded sound effects.

Various audio assets were integrated for different game components, including musical puzzle notes, auditory cues, and thematic sound effects, for example, in the form of scary sounds when interacting with game objects in the **fear** escape room level.

The selection and integration of these audio assets were carried out with consideration of their quality and relevance to the game's objectives.

6.2.4 Fonts

The selection of fonts in *Emotion Odyssey* is pivotal in enhancing the game's aesthetic appeal, ensuring readability, and maintaining cohesion between the overall game aesthetic and the typographic elements. The primary font used for all text elements in the game is VT323, designed by Peter Hull (available at fonts.google.com/specimen/VT323). This font effectively complements the game's pixel art style. Figure 6.13 provides a representative example of the font's usage in the game.

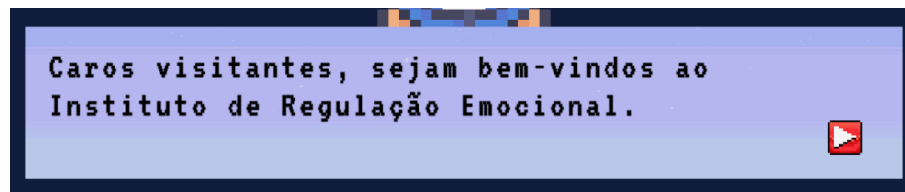


Figure 6.13: Example representation of the VT323 font used in *Emotion Odyssey*.

6.3 Technical Details

6.3.1 Overview of Game Components

Player Input System

The development of the *Emotion Odyssey* relied heavily on Unity's **Input System package** [72], a versatile framework designed for managing input. This package was a critical component, as the game requires input from two players, each using distinct control schemes. The Input System's modular and scalable design was essential for efficiently handling input from multiple devices, such as keyboards and mice.

An **Action Map** named *PlayerControls* was created to organize all input actions for both players, as detailed in the following table:

Table 6.1: Input Actions, Bindings, and Purpose in *Emotion Odyssey*

Input Actions	Bindings	Purpose
Move	WASD / Arrow Keys	First Character movement
Click	Right Button [Mouse]	Second Character movement
InteractPlayer1	B [Keyboard]	First character interaction with scene objects
InteractPlayer2	Left Button [Mouse]	Second character interaction with scene objects by clicking on them.
GetMousePosition	Position [Mouse]	Auxiliary action to execute second character movement and interaction
Pause	Escape [Keyboard]	Open the pause menu in-game
Read	P [keyboard]	Read collected clues
BlockLetter	Q [Keyboard]	First player action to block letters in word-forming puzzles
Note1	1 [Keyboard]	Play first note in musical puzzles
Note2	2 [Keyboard]	Play first note in musical puzzles
Note3	3 [Keyboard]	Play first note in musical puzzles

Character Movement

Emotion Odyssey is designed for two players, each controlling a character with distinct input methods: the first player uses the keyboard, while the second player uses the mouse. To facilitate this, two separate movement scripts were developed. The script *PlayerMovement* manages the keyboard-controlled character, where movement is based on a two-dimensional input vector, a product of the *Move* input action (see Table 6.1), that is translated into position updates.

Regarding animations, the direction of movement informs the animation parameters, ensuring that the appropriate walking animations are displayed. The system prioritizes horizontal movement for

diagonal movement to simplify the animation state handling.

The mouse-controlled character in *EmotionOdyssey* uses an artificial intelligence (AI) driven navigation system named *NavMeshPlus*, available in github.com/h8man/NavMeshPlus, which extends Unity's *NavMesh* system with 2D pathfinding capabilities and additional features. Unity's *NavMesh* system [73] is a tool for creating and handling the paths that characters can use to move through the game world. It allows characters to automatically find their way through the environment by calculating the best routes around obstacles, such as scene objects.

While Unity's *NavMesh* is generally used in 3D environments, the 2D nature of *Emotion Odyssey* necessitated the use of *NavMeshPlus*. Using this AI system, the script *PlayerMouseMovement* allows the player to move by clicking on a point in the game world. The character will navigate towards the clicked point using a *NavMeshAgent*, which handles pathfinding and movement.

Regarding animation handling, the script calculates movement direction and updates the animator component to reflect the player's movement in the game world.

The Unity method *FixedUpdate* is used in both scripts to ensure reliable updates for character movement. *FixedUpdate* executes on a fixed time step, meaning that regardless of frame rate variations or hardware performance, the calculations for character movement are performed at regular intervals. This consistency helps maintain smooth gameplay, preventing inconsistencies arising from different device frame rates.

Player Interaction

Interaction with scene objects is the primary method of progression through levels in *Emotion Odyssey*. The *ClueInteraction* component is associated with each clue object within the game environment. This component is responsible for detecting player proximity, specifically distinguishing between the keyboard player and the mouse player using tags and colliders.

When a player is within proximity, *ClueInteraction* manages the visual highlighting of the clue object and instantiates action prompts specific to each player. It detects the input actions *InteractPlayer1* and *InteractPlayer2* (see Table 6.1) and, upon detecting these actions, calls the appropriate methods to handle interactions with the clue.

To manage interactions with clue objects, the component *ClueCollectorController* governs the events triggered when a player engages with a clue. This component is divided into two sub-components: *NormalClueCollectorController* and *PuzzleClueCollectorController*.

The *NormalClueCollectorController* is associated with clues that do not trigger puzzles but can be collected through direct interaction. The outcomes of collecting these clues are determined by *NormalClueCollectorController*, based on the current level of the game.

In contrast, *PuzzleClueCollectorController* is linked to clues that activate puzzles upon interaction. A clue can only be collected after the associated puzzle is solved. The subsequent actions are then determined by *PuzzleClueCollectorController*, also in accordance with the game level.

Room Environment Manager

In *Emotion Odyssey*, each level features a central component, *RoomEnv*, designed specifically for that level. The *RoomEnv* component is responsible for updating the game state and UI in response to player actions, particularly interactions with clue objects in the scene. These clue objects are managed by a *ClueCollectorController*, which executes functions within *RoomEnv* to handle the collection of these objects.

Each level or room has its own handling functions within *RoomEnv*. For example, when a player collects a clue, the *ClueCollectorController* invokes methods on *RoomEnv* to update the UI panel with the newly collected items or to activate additional clues within the room.

Puzzles System

In each level, clue objects can be linked to puzzles that must be solved before the player can collect them. Puzzles vary significantly in their characteristics and complexity. The component *PuzzleController* provides the fundamental logic for managing puzzles, encapsulating methods such as *CheckWin*, *SetSuccess*, *GetSuccess*, *Close*, and *Open*.

Each specific puzzle in the game inherits from *PuzzleController*, with a specialized version of the puzzle's unique mechanics. For instance, musical puzzles are managed by a component named *NotePuzzleController*. These specialized components implement the detailed logic for their puzzles, including evaluating win conditions and updating their success status. After solving the puzzle, they communicate this outcome to the *PuzzleCollectorController*, allowing players to collect the associated clue.

Save/Load System

In *Emotion Odyssey*, several components must be preserved across player sessions to ensure continuity and enhance user experience. These components include the current character models, player names, available in-game currency, and the status of each level. This mechanism allows players to resume their progress without having to restart from the beginning if they exit the game before completing it.

To manage this data persistence, *Emotion Odyssey* utilizes the *PlayerPrefs* system provided by Unity. *PlayerPrefs* offers a straightforward method for storing and retrieving these small data elements between sessions. Consequently, data continuity is maintained across player sessions.

Game Camera

An important consideration in game development is accommodating the varying screen sizes of different devices. The game was initially developed with a reference resolution of 1366x768 pixels, which is High Definition (HD) and has an aspect ratio of 16:9. However, the game must adapt to devices with different aspect ratios, such as the common 16:10.

Two script components were developed to address this: *CameraAspectAdjuster* and *CameraResolution*. Both scripts are associated with the main camera in each scene. The *CameraAspectAdjuster* script ensures that the camera's viewport maintains a consistent aspect ratio, such as 16:9, regardless of the actual screen size. Meanwhile, the *CameraResolution* script adjusts the camera's orthographic size to preserve the correct view when the screen's aspect ratio deviates from the target aspect ratio. These adjustments ensure that *Emotion Odyssey* effectively responds to various screen sizes, providing a consistent visual experience across different devices.

6.3.2 Game Architecture

This section presents the game architecture in *Emotion Odyssey*. The architecture is designed to support scalability and flexibility, enabling the integration of new features such as additional clue objects and puzzles. Common components, such as the player interaction system and clues system, can be leveraged to streamline and optimize the creation of new levels and expand the game content.

Figure 6.14 illustrates the core game components and their interactions. Detailed descriptions of each component and its behavior are provided in the previous section.

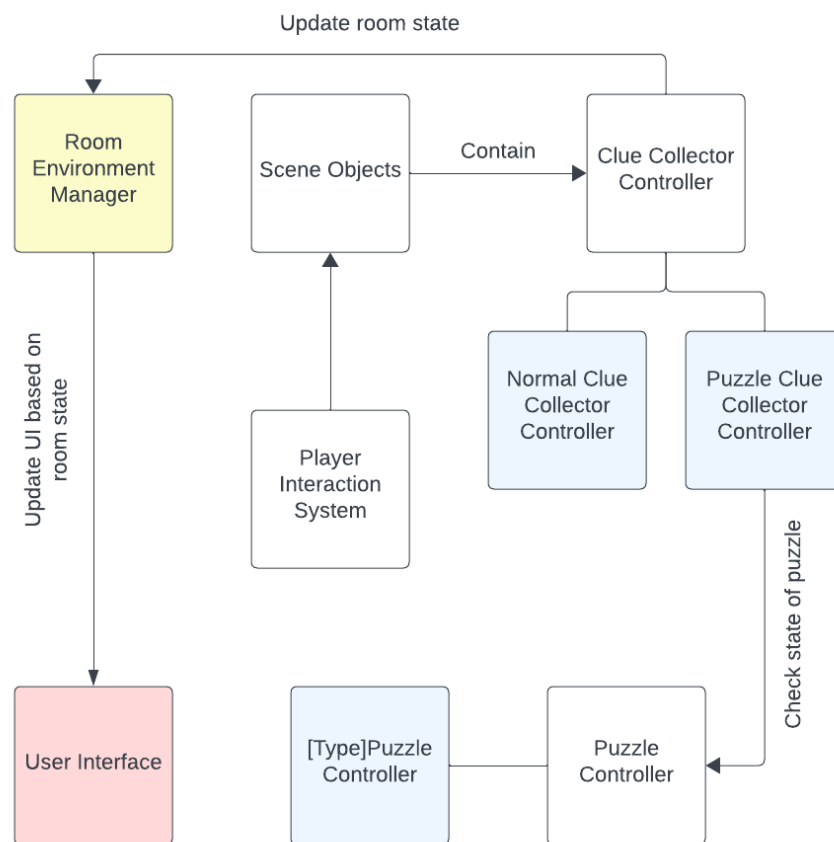


Figure 6.14: *Emotion Odyssey* game architecture.

6.3.3 Animations

In *Emotion Odyssey*, an efficient approach is used to animate the two characters, addressing the complexity of managing 11 available character models. Creating individual animations for each model would be resource-intensive and time-consuming. To optimize this process, the animation system takes advantage of Unity's *Animation Override Controller*, *Sprite Resolvers*, and *Sprite Libraries*.

Animation Override Controller

The *Animation Override Controller* enables the reuse of existing animation assets across different character models. A base animation state machine was created, which both characters in the game utilize since their animations follow the same underlying logic. Although this approach is particularly beneficial for games with numerous characters sharing similar behaviors, it remains an efficient solution even with just two characters. It ensures a consistent animation style across both characters, minimizes the need for redundant animations, and simplifies the process of adding new characters to the game if needed.

Sprite Resolver and Sprite Libraries

In *Emotion Odyssey*, the integration of *Sprite Resolvers* and *Sprite Libraries* is essential for customizing animations across the 11 distinct character models without creating separate animation clips for each model.

The *Sprite Resolver* dynamically changes the sprites used in animation clips based on the active character model. Meanwhile, *Sprite Libraries* function as organized collections of sprite assets for each character model, which the *Sprite Resolver* uses to switch between sprites in animation clips. This combination of components enables an efficient change of character appearances within the same animation structure, ensuring consistent animation customization across all character models.

6.3.4 Platform

The game was specifically developed for the Windows platform and Intel 64-bit architecture. This choice facilitated ease of testing, as the game was consistently play-tested on a machine with these configurations.

The game has not been tested on other operating systems, such as macOS, which means compatibility with these systems is not assured.

Future plans include expanding the game's availability to additional platforms.

Chapter 7

Usability Study

A comprehensive usability study of *Emotion Odyssey* was conducted with participants from the target population and psychologists to evaluate the user experience, identify potential usability issues in the final product, and collect feedback for consideration in future work.

This section explores the study’s methodology, including participants’ details, the measures included for data collection, and the procedures followed to obtain usability insights. Furthermore, the results of the study are thoroughly discussed.

7.1 Procedure

This study was conducted asynchronously, allowing participants to engage with *Emotion Odyssey* at their own pace. Initial instructions for all participants required them to complete the entire game.

At the initial contact, participants were provided with an instruction manual (annex **D**) containing key concepts related to the game and a video tutorial detailing the installation process and game-play instructions.

Health professionals were advised to play the game with a chosen partner, preferably an adolescent to align with the game’s objectives, or alternatively, another individual of their choice.

All participants were required to complete an extensive usability survey after playing the game (annex **E**), designed using the *Inqueritos@UP* platform (inqueritos.up.pt), to evaluate their overall game experience and provide feedback on the game’s final version.

As with the procedure outlined in 5.1.1 from the first phase of co-design, this usability study procedure is under the same approval from the ethics committee of the Faculty of Engineering of the University of Porto (Doc. N° 10 /CE FEUP/2024) and the methodologies adhered to the principles outlined in the Declaration of Helsinki.

7.2 Participants

In this usability study, participants were recruited from two distinct groups. The first group consisted of individuals who had previously participated in the initial co-design phase for the *Emotion Odyssey* project. Of the participants directly involved in the initial co-design process, whose sociodemographic details are provided in 5.1, two of the four psychologists and the parent-adolescent dyad consented to participate in this usability phase.

To broaden the sample and enhance the reliability of the findings, additional participants from the target population, specifically parents and adolescents, were recruited through convenience sampling. This second group did not participate in the initial co-design phase, allowing for a comparative analysis between the usability feedback from those involved in the co-design and those who were not. This approach was designed to contrast both groups' perspectives and usability experiences, thereby providing a more robust assessment of the game's usability.

The sample for this usability study comprised two female Portuguese psychologists aged 22 and 29. The younger participant has less than one year of professional experience, while the older participant has five years of professional experience. Additionally, the usability study incorporated contributions from a total of four adolescents and four parents. Of these, one parent-adolescent dyad participated throughout all phases of the co-creation process, while three additional parent-adolescent pairs contributed for the first time in this usability phase. The sociodemographic characteristics of the participating adolescents and parents are detailed in Tables 7.1 and 7.2.

Table 7.1: Adolescents sociodemographic details ($n = 4$)

Variable	n	%
Gender		
Male	2	50%
Female	2	50%
Other	0	0%
Total	4	100%
Age		
14	3	75%
11	1	25%
Total	4	100%
Nationality		
Portugal	4	100%
Other	0	0%
Total	4	100%
Current School Year		
9th	3	75%
6th	1	25%
Total	4	100%

Table 7.2: Parents sociodemographic details ($n = 4$)

Variable	n	%	Mean (Range)	SD
Gender				
Male	0	0%		
Female	4	100%		
Other	0	0%		
Total	4	100%		
Age				
Mean & Standard Deviation			45.75 (39-51)	4.44
Nationality				
Portugal	4	100%		
Other	0	0%		
Total	4	100%		
Marital status				
Married / Civil partnership	4	100%		
Total	4	100%		
Academic qualifications				
3rd Cycle (7th to 9th grade)	2	50%		
Bachelor's Degree	2	50%		
Total	4	100%		
Number of adolescent children				
1	4	25%		
Total	4	100%		
Ages of adolescent children				
Mean & Standard Deviation			13.25 (11-14)	1.30

Participants involved in the initial co-design phase of the game were not required to sign additional informed consent and assent forms. This decision was based on the fact that the original documentation, which they had already signed, comprehensively covered all phases of the game co-creation project, including the details of this usability study. However, new participants who joined the usability study had to provide informed consent and assent to ensure ethical compliance and full awareness of the study's objectives.

7.3 Measures

The measures included in this usability study assess both qualitative and quantitative aspects of the user experience. These measures were selected to provide comprehensive insights into the satisfaction of the *Emotion Odyssey*.

All surveys are presented in the annex.

7.3.1 Sociodemographic Information

At the start of the usability survey, all participants were required to complete a sociodemographic questionnaire. The information requested was specific to each target group—health professionals, adolescents, and parents—corresponding to the sociodemographic details outlined in the preceding Participants section.

The collection of sociodemographic data is important to the usability study, as it provides essential context for analyzing the results, as user experience can vary significantly across different demographic groups.

7.3.2 GEQ

The Game Experience Questionnaire (GEQ) [74] was used in this usability study to assess the player's experience and emotional response to *Emotion Odyssey*. This questionnaire systematically assesses different aspects of the gameplay experience through a structured approach consisting of three sequential modules. In each module, respondents are required to indicate their level of agreement with each item using a scale ranging from (0) 'Not at All' to (4) 'Extremely,' with intermediate options of (1) 'Slightly,' (2) 'Moderately,' and (3) 'Fairly.'

Although the GEQ has not yet been formally validated for the Portuguese language, it has been employed in Portuguese-speaking contexts in numerous studies [75] [76].

GEQ Core Module

The first module, the **Core Module**, is central to the GEQ and is dedicated to assessing user experience by examining players' emotions and reflections during gameplay. This module comprises a total of 33 items.

The GEQ Core Module includes seven components: **Competence**, **Sensory and Imaginative Immersion**, **Flow**, **Tension/Annoyance**, **Challenge**, **Negative affect**, and **Positive affect**.

GEQ Social Presence Module

The second module, the **Social Presence Module**, similarly focuses on players' emotional experiences during gameplay and evaluates their emotional and behavioral interactions with other players. This module specifically applies to games involving multiplayer interactions, such as *Emotion Odyssey*, a two-player game. This module consists of 17 items.

The GEQ Social Presence Module includes three components: **Psychological Involvement – Empathy**, **Psychological Involvement – Negative Feelings**, **Behavioural Involvement**.

GEQ Post-Game Module

The final module, the **Post-Game** Module, is designed to assess players' reflections after they have completed the game. This module includes 17 items and provides insights into players' post-play experiences and overall emotional impact. The GEQ Post-Game Module includes four components: **Positive Experience**, **Negative Experience**, **Tiredness**, **Returning to Reality**.

7.3.3 PSSUQ

The adapted Portuguese version of the Post-Study System Usability Questionnaire (PSSUQ) [77] [78] is a measure used to assess participants satisfaction with the *Emotion Odyssey* system.

The primary aim of the Post-Study System Usability Questionnaire (PSSUQ) is to gather user feedback on various facets of system usability, including satisfaction with system performance and interface design. The PSSUQ is structured into three distinct subscales: **System Utility**, **Information Quality**, and **Interface Quality** [79].

The questionnaire comprises a total of 19 items. Participants rated each item on a scale ranging from (1) 'Strongly Agree' to (7) 'Strongly Disagree.' Additionally, an "Not Applicable" (NA) option was provided for items irrelevant to the specific game system under evaluation. Each item also included a text field for optional comments, allowing participants to provide further insights or clarifications. Importantly, lower response values for each item reflect stronger agreement with positive statements. Lower average scores across the PSSUQ subscales suggest better usability. Responses can be assessed overall by calculating the average of all 19 items, with a lower average value indicating higher user satisfaction, or they can be analyzed based on the three specified subscales:

System Usefulness

This subscale assesses the system's effectiveness in performing its intended functions and evaluates how valuable users find it. The score for this subscale is obtained by calculating the average of items 1 through 8.

Information Quality

This subscale evaluates how clearly and accurately the system presents its information. The score for this subscale is obtained by calculating the average of items 9 through 15.

Interface Quality

This subscale assessed the user-friendliness and design of the system's interface, focusing on aspects such as layout and responsiveness. The score for this subscale is obtained by calculating the average of items 16 through 18.

7.3.4 IMIp

The adapted to Portuguese version of Intrinsic Motivation Inventory (IMIp) [80] [81] was used to evaluate participants' personal experience while playing *Emotion Odyssey*.

To evaluate various dimensions of intrinsic motivation, the IMIp incorporates four distinct subscales: **Interest/Enjoyment**, **Competence**, **Effort/Importance**, and **Tension/Pressure**. The inventory comprises 18 items distributed across these subscales. Participants rated their responses using a Likert scale ranging from (1) 'Strongly Disagree' to (5) 'Strongly Agree.'

The scores for each subscale of the IMIp were calculated by averaging the values of the items that make up each subscale. The responses to items 4, 8, 14, 15, 16, and 17 were inverted before calculation because of their semantic meaning.

In the three scales, **Interest/Enjoyment**, **Competence**, and **Effort/Importance**, higher scores indicate a greater presence of the respective dimension. Conversely, in the **Tension/Pressure** subscale, higher scores reflect lower levels of tension and pressure due to the inversion of item scoring.

Interest/Enjoyment

This subscale measures how enjoyable and interesting the individual finds playing the game. This subscale consists of items 1, 5, 9, and 13.

Competence

This subscale assesses the extent to which players felt capable and effective while playing the game. This subscale consists of items 3, 7, 11, 15 and 18.

Effort/Importance

This subscale measures the level of effort players invest in the game and how significant they consider it to be. This subscale consists of items 2, 6, 10, 14 and 17.

Pressure/Tension

This subscale assesses the level of pressure or tension experienced by individuals while playing the game. This subscale consists of items 4, 8, 12, and 16.

7.3.5 Open Questions

In the final section of the survey, participants were presented with three open-ended questions specific to the demographic groups surveyed to collect qualitative feedback on their experience with *Emotion Odyssey* and their expectations.

For adolescents and their parents, the open-ended questions aim to assess:

- The perceived relevance of the game's educational content to their personal experiences.
- The extent to which they anticipate applying the skills acquired through the game in their everyday lives.
- The aspects of the game that they found most engaging or enjoyable.

Conversely, for health professionals, the open-ended questions focus on:

- The appropriateness and relevance of the educational content for the target population.
- Whether the game effectively represents real-world challenges the target population encounters.
- The potential for the game to be utilized as a tool in professional settings.

Detailed versions of these open-ended questions are available in the annex section for further review.

7.4 Results

This section presents the findings from the usability study, which evaluated various components of *Emotion Odyssey*.

7.4.1 GEQ Core Module

The GEQ Core Module results revealed differing opinions between the two psychologists, particularly in Positive Affect, where P1 reported much higher positive emotions than P2. P1 also felt more competent and immersed in the game, showing greater ease in understanding the mechanics and connecting with the game world, compared to P2, who reported significantly lower levels across these dimensions. Both psychologists reported moderate to high levels of focus and engagement within the game experience, as reflected in their scores on the Flow component.

In the remaining three components, tension/annoyance, challenge, and negative affect, the opinions of the two psychologists were largely consistent, with both scoring low on each dimension. Notably, P1 and P2 recorded minimum values in the negative affect component, indicating that the game elicited virtually no negative emotions.

More detailed results, including the combined average scores from both psychologists, are illustrated in the chart in Figure 7.1.

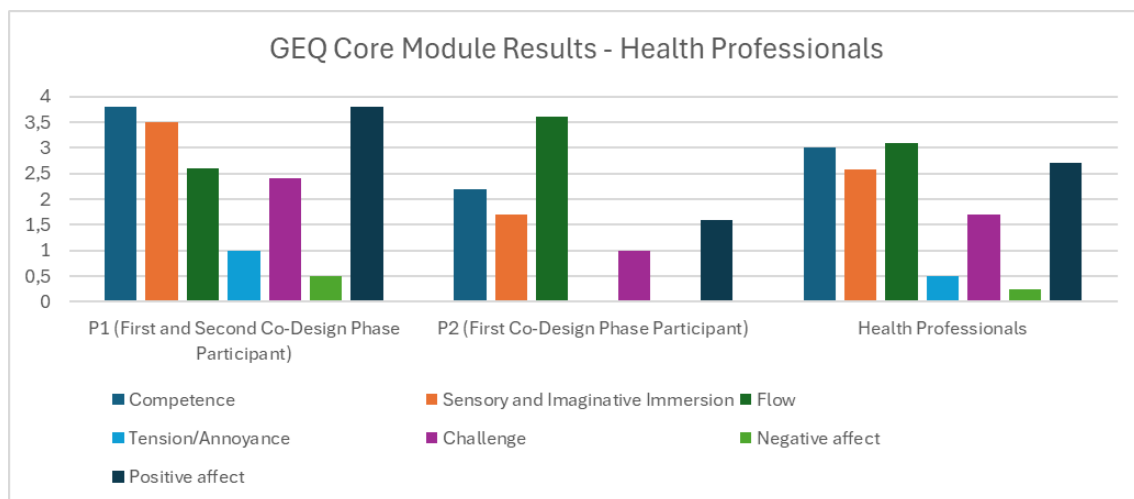


Figure 7.1: Results of the GEQ Core Module: Health Professionals.

In the results concerning the parents' participants, there was an overall consensus among all the parents. Each parent recorded minimum values on the Negative Affect component, indicating minimal negative emotions. Participant PA3 was an exception regarding the Tension/Annoyance component, reporting a value greater than zero, corresponding to a slight annoyance. The parents found the game somewhat challenging but reported feeling strongly connected with the game world and its narrative. They also felt competent and effective while performing game tasks and were highly engaged throughout their gameplay experience. Detailed results are presented in Figure 7.2.

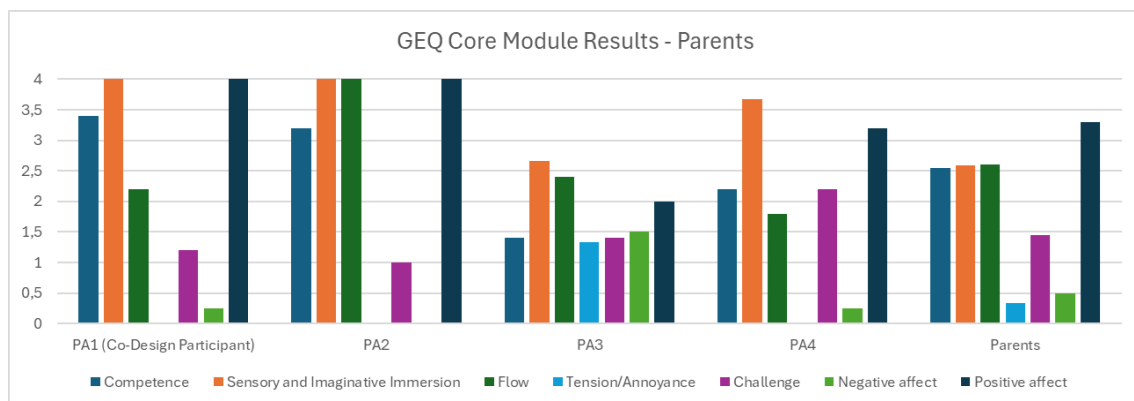


Figure 7.2: Results of the GEQ Core Module: Parents.

According to average values, adolescents reported feeling more capable and effective than parents, with an average score of 3.1 in the Competence dimension. They also exhibited higher levels of immersion in the game, reflecting a deeper absorption of the game's world and narratives. Notably, A3 emerged as an outlier for the Tension/Annoyance dimension, with a significantly higher score compared to the others, suggesting some frustration or annoyance during gameplay. In contrast, the other adolescents reported minimal tension, indicating a more positive experience in this

aspect.

Regarding focus, adolescents reported moderate levels of concentration and deep engagement throughout the game, with varying opinions on the game's challenge. The Positive Affect dimension was consistently high, with all adolescents expressing that the game elicited positive emotions and provided an enjoyable experience. For a more detailed breakdown of these results, please refer to the accompanying Figure 7.3.

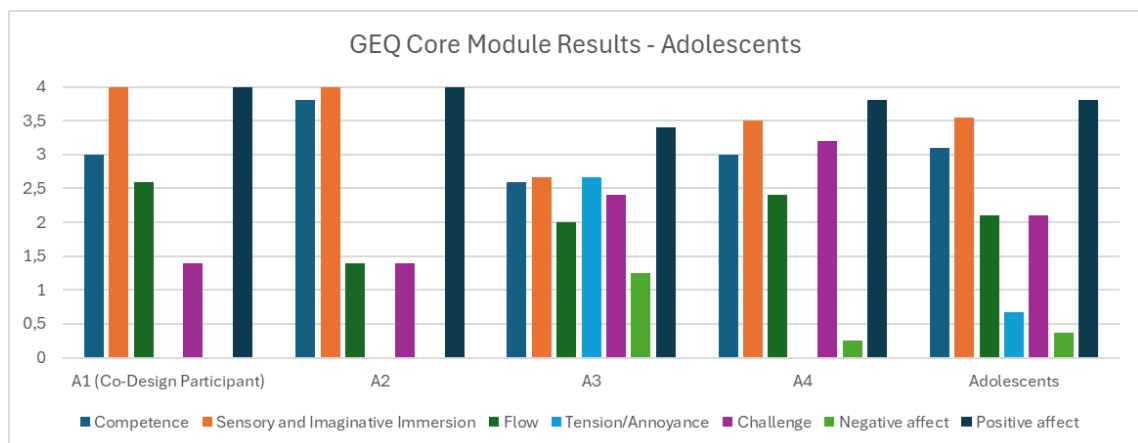


Figure 7.3: Results of the GEQ Core Module: Adolescents.

In the comparison of results across groups, parents reported the lowest sense of competence during gameplay. Adolescents exhibited the highest levels of imaginative immersion, while both health professionals and parents reported moderate immersion. All groups reported similarly low levels of annoyance, low to moderate levels of game challenge, and low levels of negative affect. Adolescents also reported the highest levels of positive affect, though health professionals and parents indicated high positive affect as well. Detailed comparison results are in Figure 7.4.

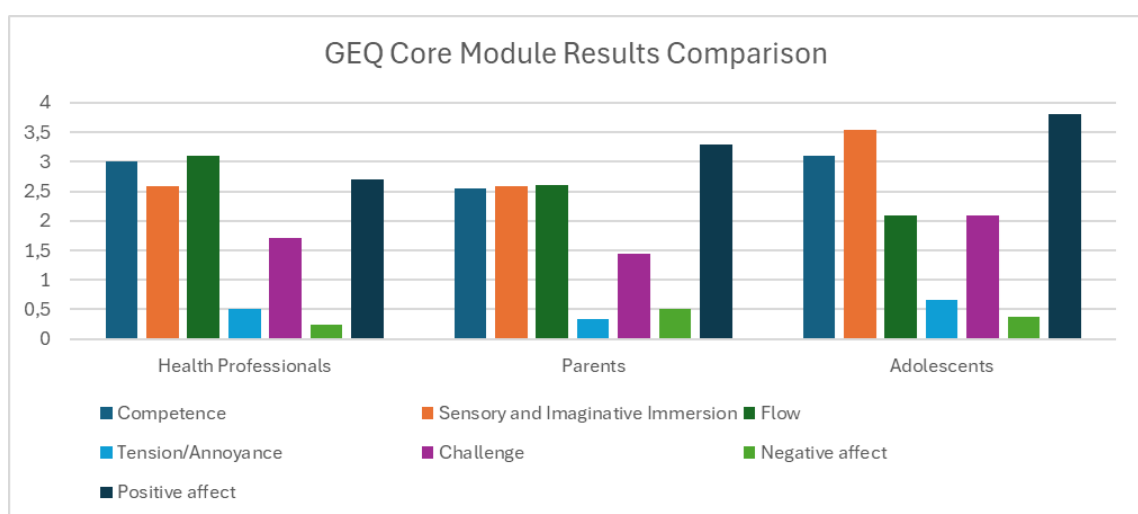


Figure 7.4: Comparison of the GEQ Core Module Results Across Participants.

7.4.2 GEQ Social Presence Module

Regarding the social multiplayer aspects of Emotion Odyssey, both P1 and P2 reported feeling strongly connected with the other player during gameplay. Additionally, both participants experienced minimal negative social feelings, indicating they did not encounter significant negative social interactions. Furthermore, both participants demonstrated high levels of active engagement in social interactions within the game. These findings are illustrated in the accompanying Figure 7.5.

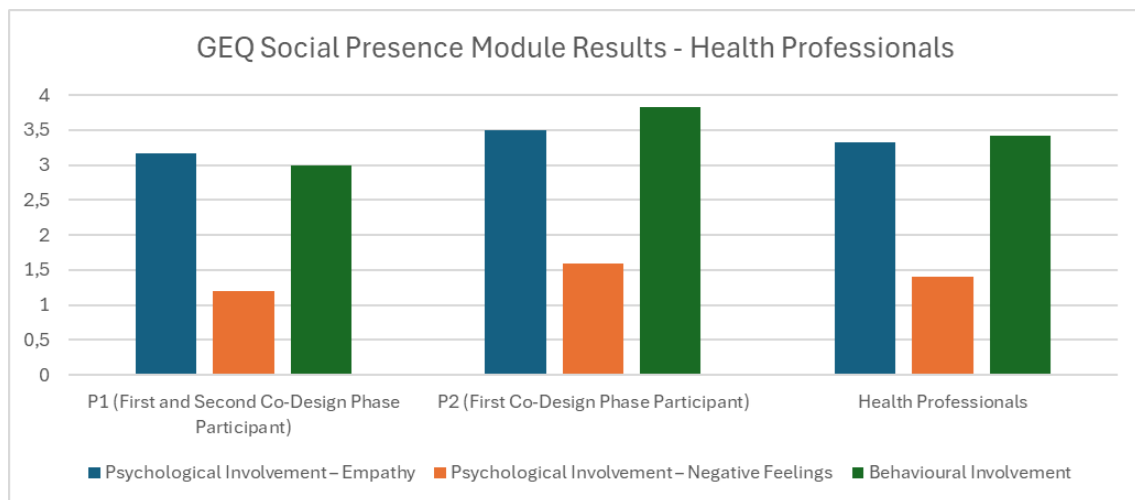


Figure 7.5: Results of the GEQ Social Presence Module: Health Professionals.

The results from parents and adolescents were generally consistent with those of the health professionals, showing a strong sense of connection during the game for most dyads, except for PA3 and P3. All parent-adolescent dyads reported very low negative social experiences within the game. Aside from the PA2-A2 and PA3-A3 dyads, which showed significant discrepancies between parent and adolescent scores on the behavioral involvement component, most parent-adolescent dyads reported moderate to high levels of active engagement in social interactions. Detailed results in each social component regarding parents and adolescents are depicted in Figures 7.6 and 7.7.

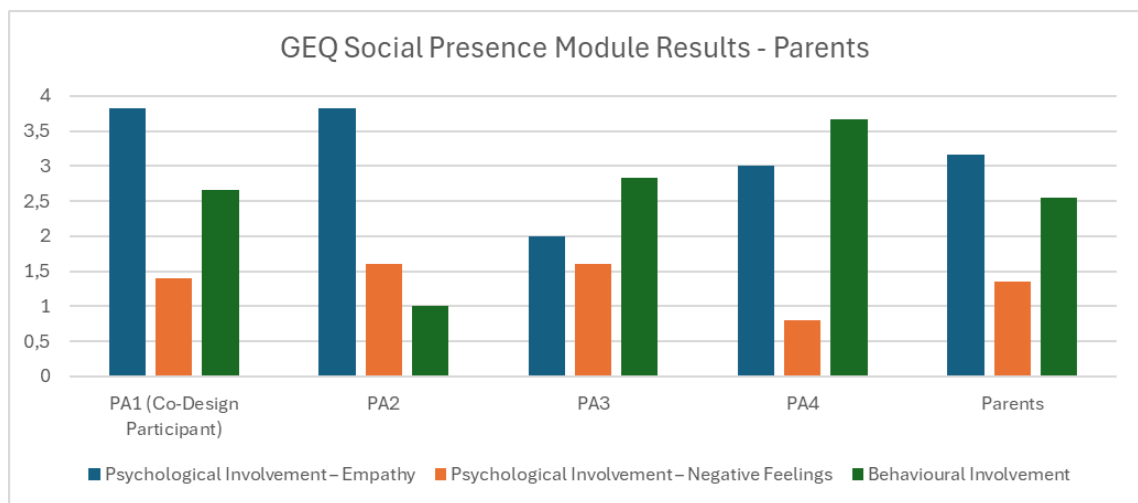


Figure 7.6: Results of the GEQ Social Presence Module: Parents.

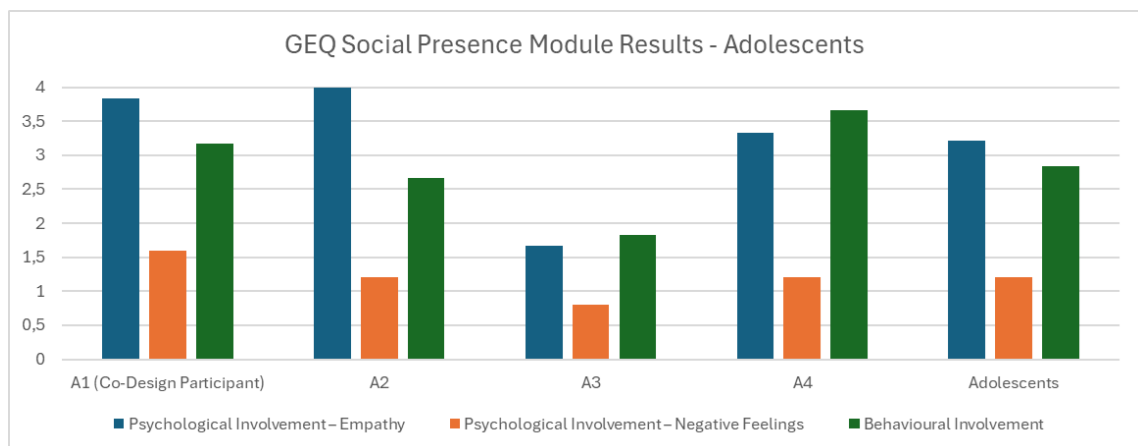


Figure 7.7: Results of the GEQ Social Presence Module: Adolescents.

Comparative analysis of the three participant groups revealed similar outcomes across all components of the **Social Presence** module. All groups reported moderate to high levels of active social engagement, strong feelings of interpersonal connection, and low levels of negative social emotions during gameplay. Detailed comparison results are in Figure 7.8.

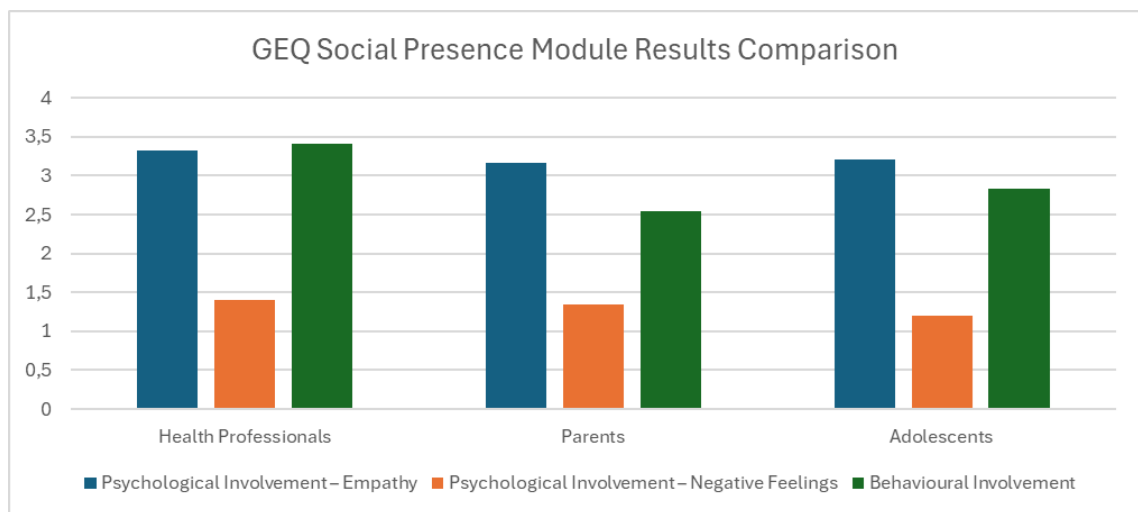


Figure 7.8: Comparison of the GEQ Social Presence Module Results Across Participants.

7.4.3 GEQ Post-Game Module

Psychologists reported moderate to low levels of positive emotions with the gaming experience, while parents and adolescents indicated moderate to high levels of positive experience. Additionally, all participants recorded low levels of negative emotions or disappointment, indicating they did not experience significant frustration or dissatisfaction with the game. Additionally, all participants noted that they felt no fatigue after playing and found the transition back to daily life seamless. Detailed results are depicted in Figures 7.9, 7.10 and 7.11.

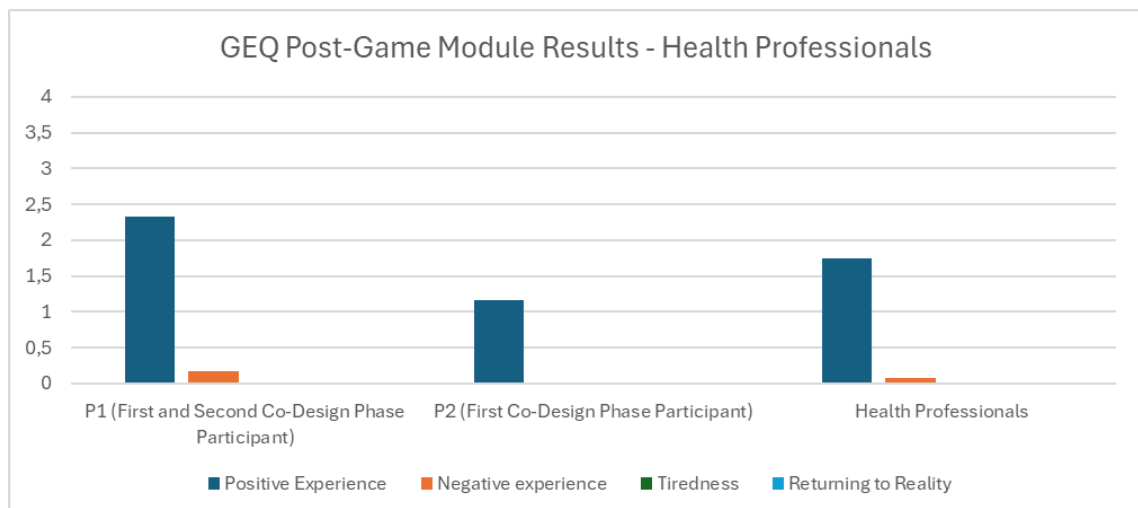


Figure 7.9: Results of the GEQ Post-Game Presence Module: Health Professionals.

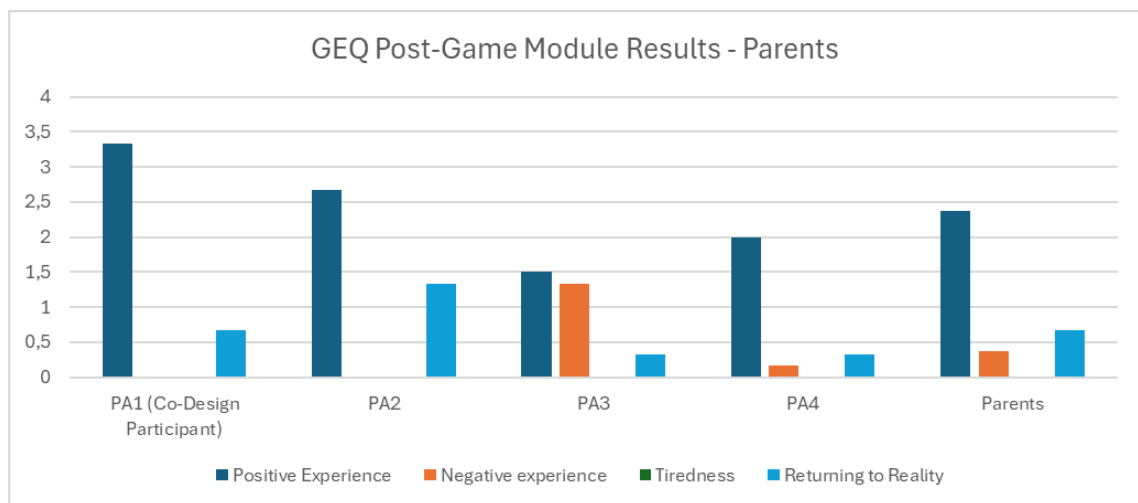


Figure 7.10: Results of the GEQ Post-Game Presence Module: Parents.

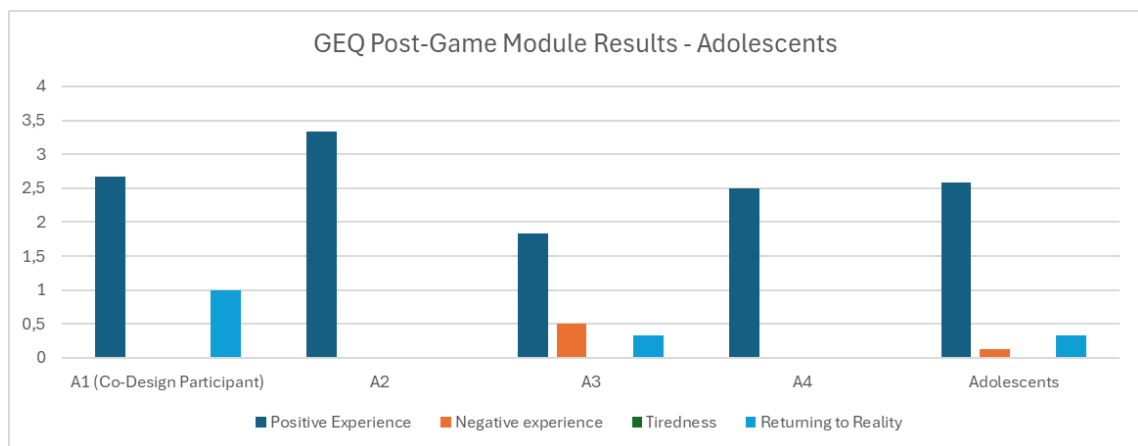


Figure 7.11: Results of the GEQ Post-Game Presence Module: Adolescents.

Post-game experience comparisons across participant groups reveal consistent trends. Adolescents reported the most positive and enjoyable gaming experience, followed by parents, while health professionals reported the lowest levels of enjoyment. All groups reported minimal to low negative gaming experiences, including fatigue and difficulty returning to daily activities. Detailed comparison results are in Figure 7.12.

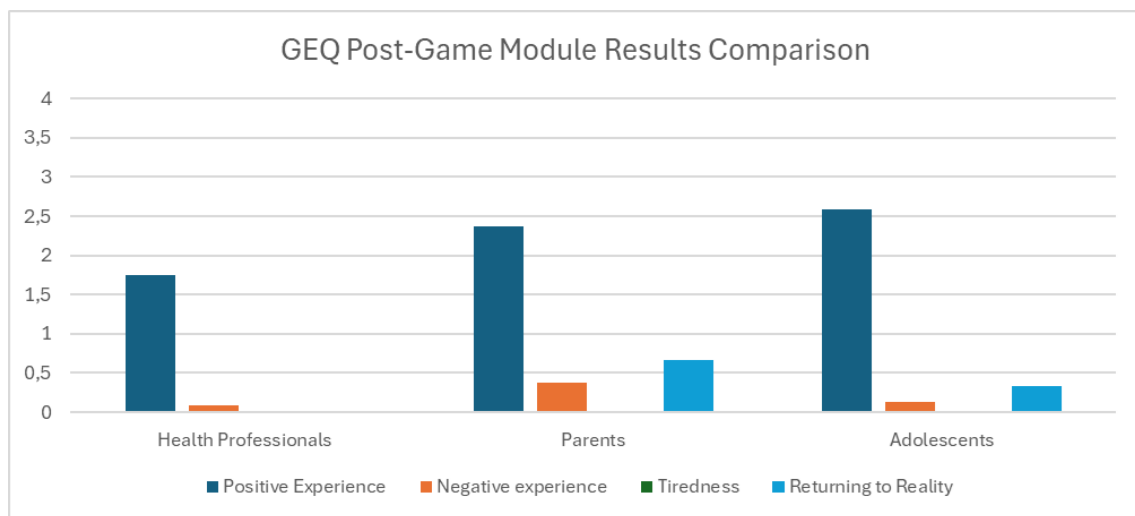


Figure 7.12: Comparison of the GEQ Post-Game Presence Module Results Across Participants.

7.4.4 PSSUQ

Regarding the usability of the *Emotion Odyssey* system functionalities, P2 reported higher average values in comparison with P1. P1 found that the game performed its intended functions effectively, providing accurate and clear information. P1 also recorded that the interface was user-friendly and pleasant. In contrast, P2 felt the system's usability, including the information and interface, could be improved (see Figure 7.13).

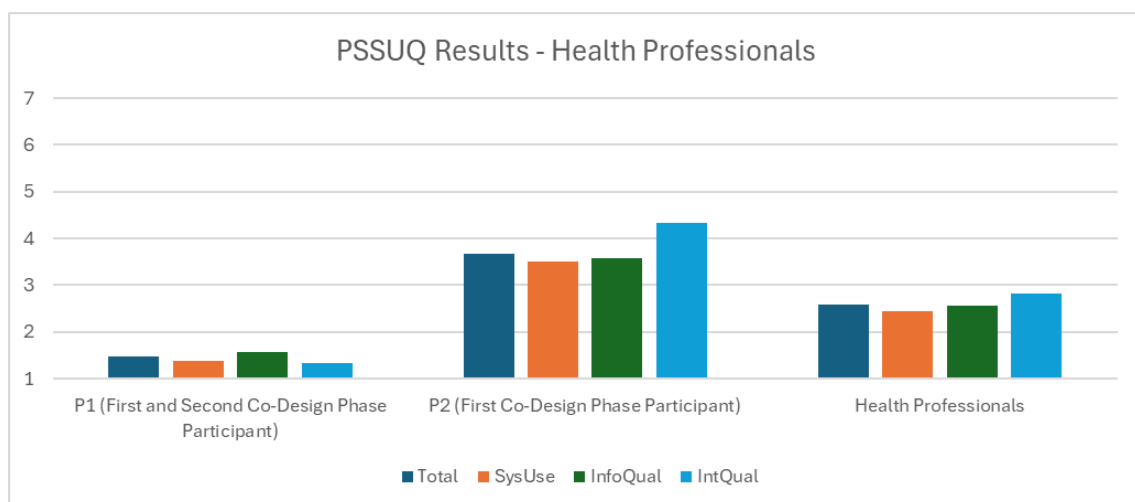


Figure 7.13: Results of the PSSUQ: Health Professionals.

The PSSUQ results for both parents and adolescents were quite similar, indicating that overall, both groups found the game to perform well. They generally liked using the interface and found the information provided clear. Participant PA4's experience differed slightly among the parents (see Figure 7.14). This aligns with the feedback PA4 provided in the commentary areas through

the questionnaire. PA4 mentioned difficulty adapting to the system, primarily due to a lack of familiarity with technology. Despite this initial challenge, PA4 expressed optimism, noting that they could become proficient and productive in using the game's functionalities with more practice. Additionally, PA4 highlighted that certain in-game tasks were time-consuming, often requiring multiple attempts.

Adolescent participant A4 also highlighted in the commentary sections that the game's controls occasionally did not function as expected, and certain aspects of the game were difficult to understand. Please refer to the accompanying Figures 7.14 and 7.15 for a more detailed breakdown of the PSSUQ questionnaire results for parents and adolescents.

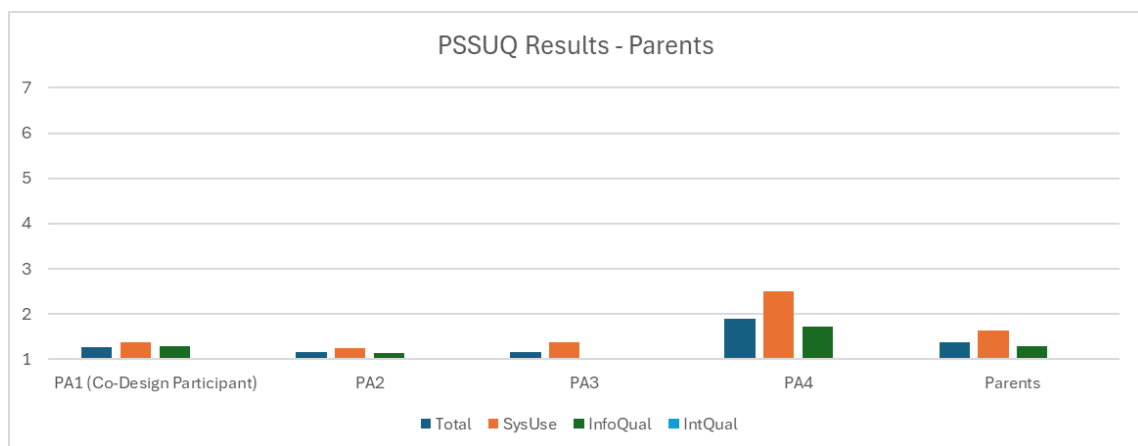


Figure 7.14: Results of the PSSUQ: Parents.

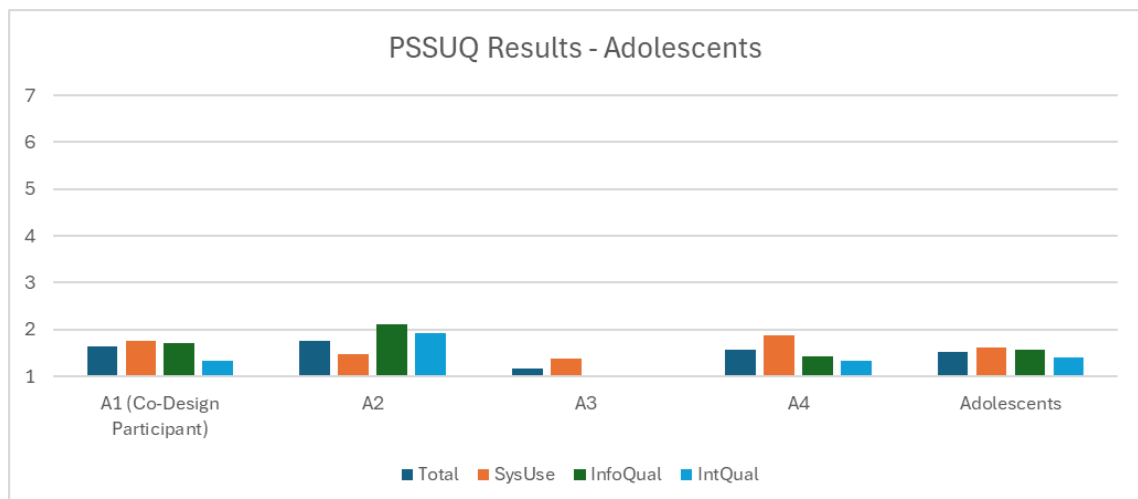


Figure 7.15: Results of the PSSUQ: Adolescents.

A comparison of PSSUQ results revealed that adolescents and parents reported similar positive evaluations of the game's system functionality, interface design, and clarity of information provided. Both groups indicated the system performed its functions well, and the information was accurate and clearly presented. Health professionals, although also reporting positive outcomes

across all subscales, identified more issues related to system functionality, interface usability, and information clarity. Detailed results are in Figure 7.16.

The overall usability score, calculated by averaging total scale values across all participant groups, was approximately 1.82, which indicates overall high participant satisfaction with *Emotion Odyssey*.

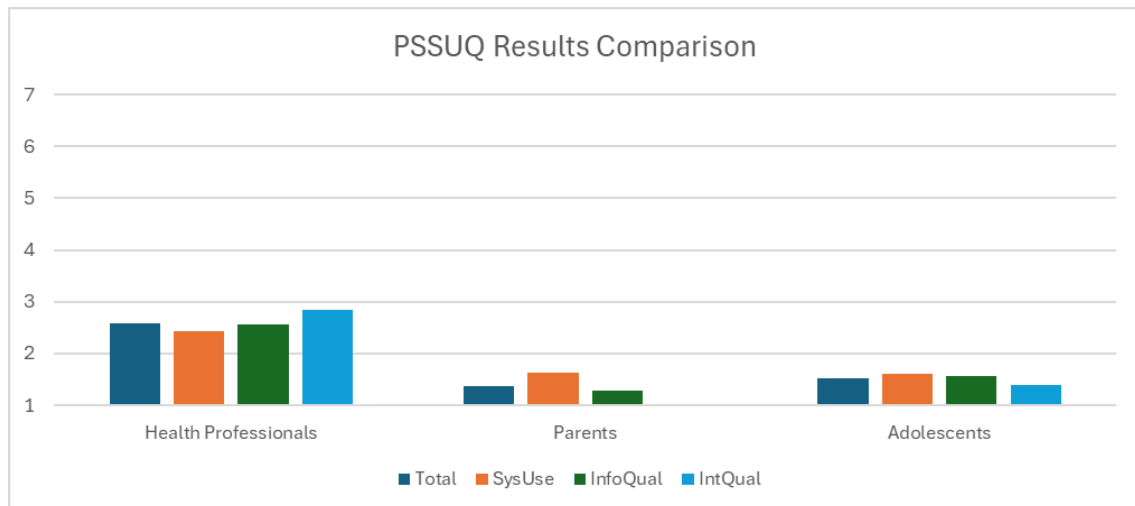


Figure 7.16: Comparison of PSSUQ Results Across Participants.

7.4.5 IMIp

Regarding the IMI results, most participants from the three groups in the analysis, including psychologists, parents, and adolescents, found playing the game enjoyable and engaging. The game successfully captured their interest. Most participants also felt confident in progressing through the game and completing the required tasks. Additionally, participants perceived the game as an important activity and invested considerable effort into it. The high Pressure/Tension dimension values, considering the inversion of most of the items included in this subscale to reflect a 'positive' analysis, suggest that participants generally did not feel nervous or pressured while playing. Detailed results for each group are depicted in the accompanying figures.

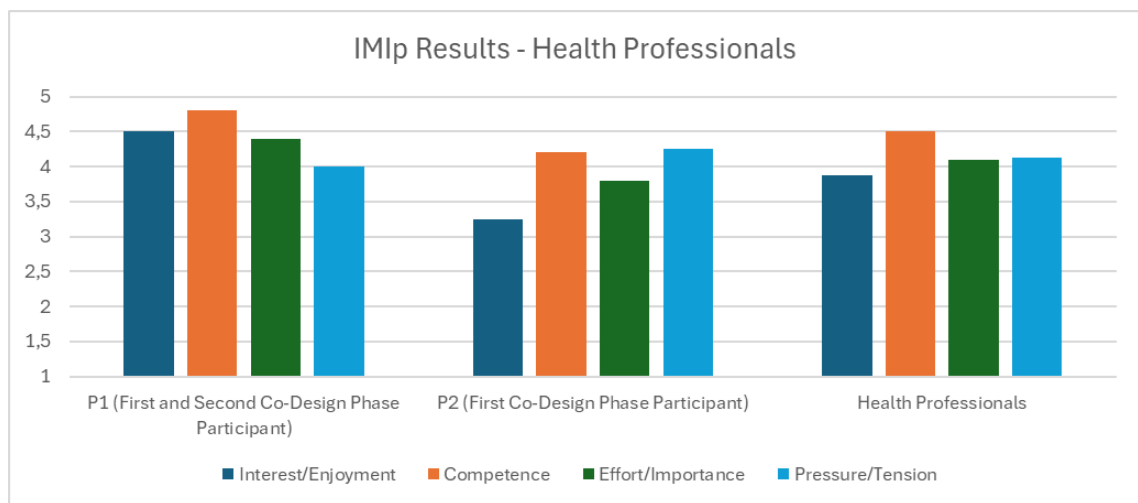


Figure 7.17: Results of the IMIp: Health Professionals.

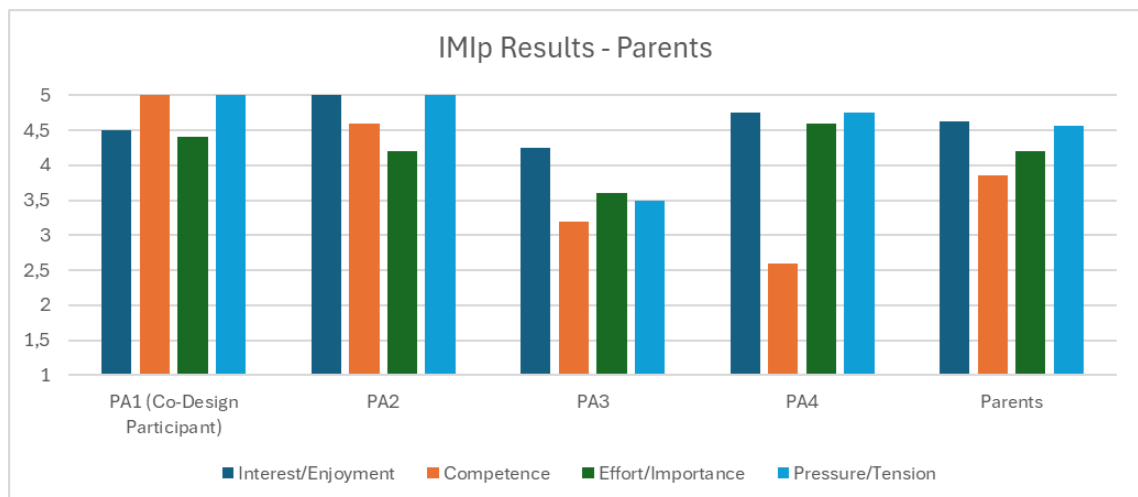


Figure 7.18: Results of the IMIp: Parents.

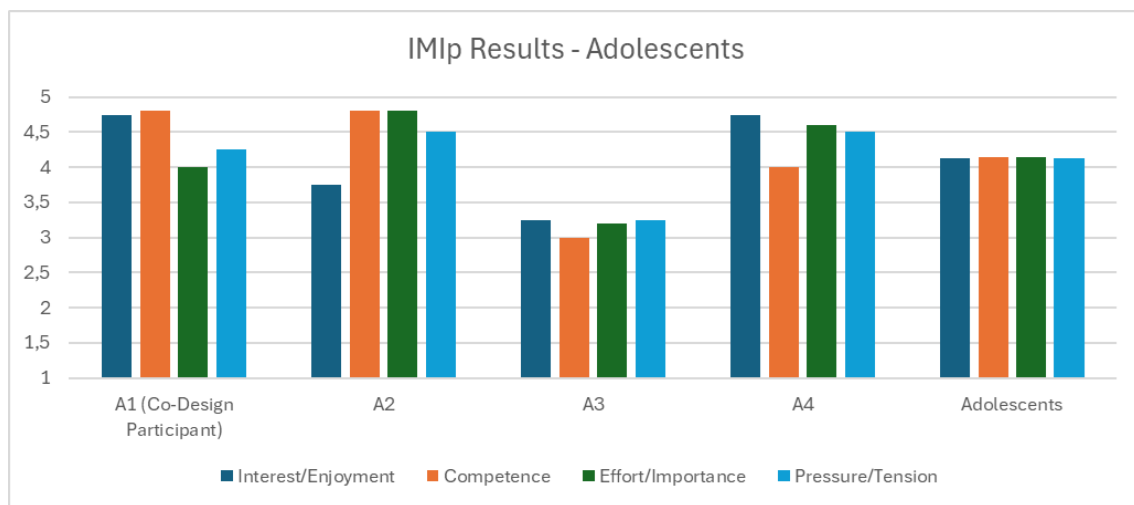


Figure 7.19: Results of the IMIp: Adolescents.

The overall IMIp results were consistent across all subscales and participant groups. Parents reported the highest levels of enjoyment, although the other two groups also found the game enjoyable. Health professionals expressed the greatest sense of competence while playing. All groups similarly reported exerting considerable effort and experiencing minimal pressure, as reflected by high scores on both effort and pressure subscales across all participant groups. Detailed results are in Figure 7.20.

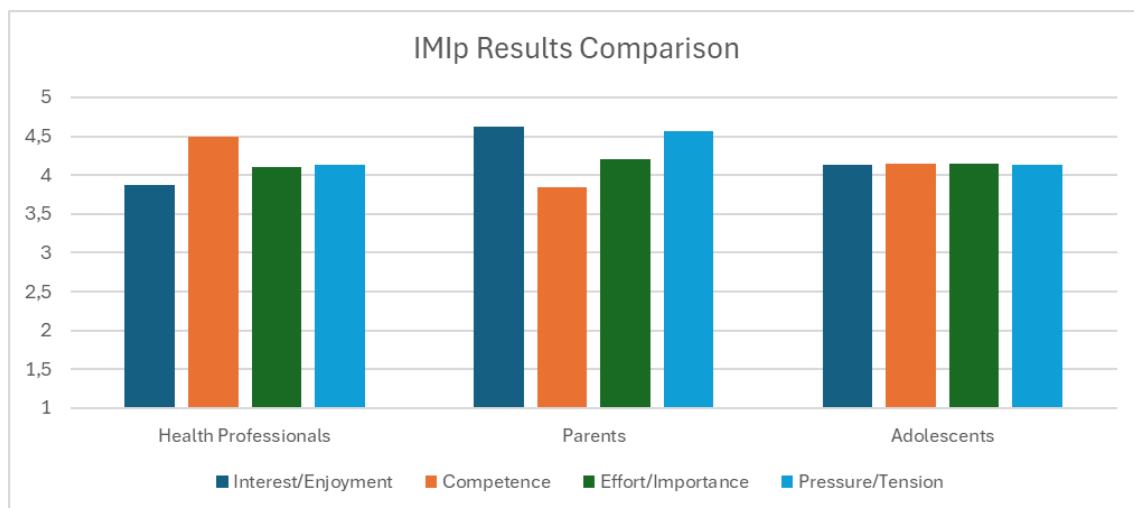


Figure 7.20: Comparison of IMIp Results Across Participants

7.4.6 Open Questions

In the open-ended questions, health professionals provided insightful feedback. P1 emphasized that the scenarios presented in the game closely mirror real-life situations that adolescents and their parents may encounter, making it easier for the target audience to connect with the content. P2 concurred with this observation but also highlighted a potential issue: the use of technical

language regarding the educational content on ER, which could be perceived as confusing or complex, potentially leading to a loss of interest among players. Drawing from previous experience, P2 further stressed the importance of having clearer and more precise instructions to reinforce the game's objectives and purpose effectively.

P2 also suggested that the game should place greater emphasis on themes such as social networks and intimate relationships with peers, given their significant relevance in today's world.

Both psychologists concurred that the game holds considerable potential for use in therapeutic settings. They highlighted the benefits of gamification in interventions, particularly the game's multiplayer aspect, which fosters interaction between players. This feature can serve as a powerful tool for facilitating learning and discussions about ER, not only among adolescents but also between adolescents and their parents.

Finally, P2 suggested adapting the game to reflect each player's reality better so that challenges and scenarios meet their individual needs.

Parents unanimously agreed that the game's scenarios were relevant to their parenting experiences. One parent noted that these situations could help adolescents reflect on their complex emotions, appreciating the alternative strategies presented as potential ways for adolescents to respond.

Parents agreed that the competencies learned are applicable to daily life. They also found several aspects of the game interesting, including its increasing difficulty, organization, teamwork, and the level of ER strategies training.

Most adolescent participants felt they learned new strategies for managing emotions that could be applied in daily life. However, one participant noted they did not gain new emotional management skills from the game and found it unlikely to use any learned competencies in real-life situations.

Additionally, adolescents highlighted their favorite aspects of the game, including its multiple levels with varying difficulties, the enigmas, and the thought-provoking challenges. One participant expressed that they liked everything about the game.

7.5 Discussion

Despite the small sample size, this usability study offered valuable insights into the user experience, effectiveness, and acceptability of *Emotion Odyssey*. A crucial feature of the usability evaluation was the incorporation of diverse perspectives, including those of health professionals, parents, and adolescents. This usability study included participants from the initial co-design phase, participants involved in both the first and second phases, and new target population members. This approach facilitated a comprehensive comparison of results across the various perspectives.

Overall, participants reported a positive gaming experience, with minimal negative feedback. They enjoyed the challenges the game presented and generally felt competent in overcoming them, with adolescents demonstrating the highest competence, followed by health professionals and parents. One of the aspects participants most positively reported was the sensory and imaginative immersion in the game world and its narrative. This highlights the importance of involving the target

population and health professionals in the co-design process to determine the most engaging scenarios and storylines. Such collaboration can enhance players' connection to and immersion in the game, ultimately improving their overall experience [55] [82]. Despite this, parents and adolescents reported moderate scores on the Flow component of the GEQ Core Module. This suggests they may not be experiencing the deep and effortless involvement typically associated with optimal game experiences. Improving the clarity of game goals may enhance players' focus and engagement, as suggested by P2.

One of the game's key features is its multiplayer modality, which fosters social interactions and teamwork. Participants responded positively to this aspect, demonstrating high levels of connectivity and active engagement with other players. The social interactions facilitated by the game were met with enthusiasm, and no negative feelings were reported, highlighting the success of this feature in enhancing cooperative gameplay and social enjoyment.

Participants generally responded very positively regarding the game's system performance, highlighting their appreciation for the user-friendly interface and the clarity of information provided. The results from the IMIp indicate that participants invested significant effort into playing the game, felt confident in overcoming challenges, and enjoyed the overall gaming experience. Additionally, no notable feelings of nervousness or pressure were reported, suggesting a tension-free and enjoyable gameplay environment. The systematic review of parental roles in serious games for promoting mental health in children and adolescents (see chapter 4) revealed a lack of existing tools for family involvement in the literature. However, findings from this usability study indicate that families appear to appreciate this type of intervention.

PA4's feedback on the PSSUQ highlighted challenges with adapting to the game's functionalities, primarily due to her limited familiarity with technology. However, no similar issues were reported by other parents or adolescents, indicating that the game is effectively suited to the target age groups. This is supported by the lack of reported difficulties from participants with limited gaming experience, including the mother-daughter dyad involved in the co-design phases.

P2 highlighted the ideal of adapting the game to reflect each player's unique reality and design challenges to individual needs. However, this was not technically feasible. Instead, the focus was on incorporating real-life situations identified during the initial co-design phase, ensuring that common contexts were represented to enhance the game's relatability to the target population.

The usability study revealed notable differences between the feedback provided by the psychologists, P1 and P2. P2 identified several issues with the game, such as missing key scenarios and the use of complex language. These discrepancies may be attributed to the timing of their involvement in the co-design process. P1, in addition to participating in the first co-design phase, also participated in the second phase of co-design, which involved reviewing an almost final version of the game. Consequently, P1's feedback was generally more positive, as previous complaints had been addressed and resolved in this later phase. Involving P2 in the second phase of co-design could have potentially addressed the issues highlighted, improving P2 feedback as well.

The parent-adolescent dyad PA1 and A1, who participated in the co-design phases, reported similar average values to other parent-adolescent dyads in the dimensions evaluated. This suggests that

their experiences were similar to those of the general target population. The insights and feedback provided by PA1 and A1 during the co-design process contributed to the development of a game that is both highly relatable and enjoyable for all parent-adolescent dyads.

An observation from the usability results is that both the parent and adolescent who played the game together often reported similar positive or negative insights, also leading to overall similar feedback from parents and adolescents. This similarity in feedback could reflect their shared perspective and experience with the game. The dynamics between the parent and adolescent might have shaped their game enjoyment and perception and, consequently, their assessments of the game, whether through direct interactions or simply their presence [83] [84].

When evaluating the usability results in relation to our main research question—"Is it possible to adapt to a SG the psychoeducation and training of ER strategies to adolescents and their parents?"—the findings are quite promising. The game received high acceptability from the target population, with participants reporting a positive experience in learning new ER skills applicable to their daily lives. Additionally, psychologists involved in the study affirmed the potential for using the game in professional treatment settings.

Despite some issues highlighted by both the target audience and health professionals, the serious game demonstrated strong performance overall. Addressing the identified issues and incorporating participant feedback could further enhance the game's effectiveness and usability. With these improvements, *Emotion Odyssey* has the potential to significantly advance its objective of integrating ER strategies into engaging and practical gameplay.

Chapter 8

Conclusion and Future Work

This project has been developed to address critical concerns in the field of mental health, specifically targeting the promotion of ER skills in adolescents. The limited access to mental health services for this target population presents a significant obstacle to early intervention and the fostering of healthy development, which this initiative aims to contribute.

Adolescence is a critical phase for developing ER competencies, and despite the growing independence of adolescents, parents shape their children's emotional and social skills. Therefore, it is essential to equip adolescents and their parents with effective ER strategies to help them constructively and positively manage emotions.

Despite parents' critical role in shaping their children's emotional development and well-being, existing interventions to promote ER skills often provide only a limited role for parents. Therefore, this project aimed to contribute by developing what, to our knowledge, is the first game specifically designed to enhance ER skills in both adolescents and their parents, nationally and internationally.

The game *Emotion Odyssey* is a two-player SG designed to enhance the knowledge of adolescents and parents about six primary emotions while also providing opportunities to learn and practice ER strategies. *Emotion Odyssey* features an escape room concept where players navigate various rooms, collaboratively facing challenges, exploring narratives, and engaging with the educational content embedded in the storylines. By involving stakeholders, such as health professionals, adolescents, and parents, in two co-design sessions at different stages of development, the game was developed to be highly relatable to the target audience, motivating, challenging, and enriched with appropriate educational information.

The final phase of the co-creation process for *Emotion Odyssey* involved a usability study, during which health professionals and the intended target population evaluated the game's acceptability. The game was highly regarded by the target population, who reported feeling competent and effective in navigating through the game. They experienced a deep immersion in the narratives and the game world, finding it motivating, enjoyable, and appropriately challenging across all levels. Overall, *Emotion Odyssey* successfully fulfilled its intended functions, delivered accurate information, and provided a broadly positive experience for the usability participants.

This dissertation investigated the feasibility of adapting psychoeducation and training of ER strategies to a SG for adolescents and their parents. The results reveal promising potential for this adaptation. Participants from the target populations expressed appreciation for the SG format and reported acquiring new ER competencies applicable to their daily lives. These findings suggest that the SG has the potential to serve as a valuable tool for promoting ER skills.

Limitations of this study include the limited sample size of participants involved in all phases of the game's co-creation process, so the findings may not be fully representative, as the small sample size could limit the variety of perspectives and experiences considered during the co-creation process. The second co-design phase was conducted with an even smaller subset of participants from the first phase. Ideally, this phase should have involved the same participants or an expanded group to further refine the game in its final development stage. Engaging a larger and more diverse participant pool would have allowed for addressing a broader range of feedback rather than relying on a minimal sample. This approach could have resolved some of the usability issues identified by participants who did not participate in the second co-design phase. Despite efforts to incorporate all the scenarios and narratives discussed during the co-design sessions, other numerous adolescence-specific experiences and environments that are important to explore did not make it into the game. This was highlighted in the usability feedback, which pointed out that certain important situations for the target population were not adequately covered. One final technical limitation is that the game was developed and tested exclusively on the Windows platform. This suggests that the game may not perform as expected on other operating systems, potentially limiting its accessibility and usability for users on different platforms.

The work completed in this project holds substantial practical implications, as the SG demonstrates notable potential for enhancing ER competencies among both adolescents and their parents. This project offers valuable theoretical contributions by expanding the existing literature on ER skill development through SGs and introducing a novel approach that includes the family as a central focus for the intervention. Furthermore, the project's designs and main results have been widely disseminated through participation in national and international conferences (see Annex A).

Given these considerations, it would be valuable for future research to evaluate *Emotion Odyssey* clinical efficacy, specifically examining its ability to enhance positive emotion experiences, reduce negative emotions, and increase the use of adaptive ER strategies. Additionally, incorporating the feedback from usability study participants and testing the intervention with a larger and more diverse sample of the target population would benefit subsequent studies.

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Appendix A

Scientific Divulcation

This project has been extensively disseminated across various scientific platforms, including national and international congresses. The sharing of research has raised awareness within the scientific community and served as an impulse for new scientific work. This section highlights the key scientific divulgation activities undertaken throughout the project.

A.1 A Systematic Review of Design Elements in Serious Games for Children and Adolescents: The Role of Parents

This systematic review aims to examine the role of parents in serious games designed to promote mental health in children and adolescents, focusing on the design choices implemented in each game. My contributions to this review include conceptualizing the research theme, participating in the literature search, participating in the study selection process, collecting data, and writing the methodology and results. The detailed findings of this systematic review are presented in a previous chapter of this dissertation (see chapter 4). The paper for this review is currently under development.

Title A Systematic Review of Design Elements in Serious Games for Children and Adolescents: The Role of Parents

Authors João Silva, Mónica Pereira, Luís Paulo Reis & Eliana Silva

A.2 6º Congresso das Ordem dos Psicólogos Portugueses

The Portuguese Psychologists' Association Congress, set for late September 2024, provides a valuable platform for showcasing innovative projects such as this. A presentation that integrates two distinct works conceptualized as components of a comprehensive gaming platform will be delivered. This platform includes serious games designed for parents and for both parents and

adolescents.

I contributed to the preparation of the abstract for the communication.

Title (Portuguese) Emoções em Família: Desenvolvimento Participativo de Jogos Sérios

Authors João Silva, Mónica Pereira, Luís Paulo Reis & Eliana Silva

A.3 Encontro de Investigação Jovem da U.Porto (IJUP)

The IJUP is an annual event that provides U.Porto students with the platform to present and discuss the findings of research projects they have been involved in as part of their early research experiences.

In this year's edition, held in early May, this dissertation was submitted through an abstract. The project was accepted for presentation in the form of a poster, accompanied by a brief oral presentation to a panel of judges. The work presented focused on the conceptualization of the project and the results from the initial phase of the co-design process.

I prepared the abstract, developed the poster, and delivered the presentation for this event.

Title Co-Creation of a Serious Game: An Innovative Approach for Promoting Emotion Regulation Skills in Parents and Adolescents

Authors João Silva, Eliana Silva & Luís Paulo Reis

A.4 Simpósio Internacional na Universidade Lusíada - XI Congresso Internacional de Intervenção Psicológica: Desafios e Potencialidades da Tecnologia na Intervenção Psicológica

In late May this year, the XI International Congress on Psychological Intervention took place at Lusíada University, centering on technological advancements, such as artificial intelligence, and their Impact on psychological intervention.

At the congress, three serious games designed to promote ER were showcased: one targeting adolescents, another aimed at parents, and a third, which is the focus of this dissertation, designed for both parents and adolescents. I contributed by writing the section related to my dissertation project.

Title (Portuguese) Emoções em Jogo (Sério): Uma Proposta Inovadora para Promoção de Competências de Regulação Emocional em Adolescentes e Pais

Authors Eliana Silva, Mónica Pereira, João Silva, Pedro França, Luís Paulo Reis & Simão Reis

A.5 Encontro Ciência 2024 - Encontro com a Ciência e a Tecnologia em Portugal

The annual science conference, held in July at the Alfândega do Porto Congress Center, included leading scientists, professors, and medical professionals. The event's central theme was "+Science for One Health and Global Well-Being." During the conference, the serious game *Emotion Odyssey* was presented through an E-Poster format, which I developed.

Title Co-Creation of a Serious Game: An Innovative Approach for Promoting Emotion Regulation Skills in Parents and Adolescents

Authors João Silva, Eliana Silva, Luís Paulo Reis & Simão Reis

Appendix B

Initial Co-Design Phase: Materials

B.1 Initial Co-Design Phase: Dissemination Leaflet

EMOÇÕES EM FAMÍLIA: CO-CRIAÇÃO DE UM JOGO SÉRIO PARA TREINO DE COMPETÊNCIAS DE REGULAÇÃO EMOCIONAL

QUAL O OBJETIVO?

No âmbito de uma Tese de Mestrado em Engenharia Informática e Computação da Faculdade de Engenharia da Universidade do Porto pretende-se, com a sua participação, a criação colaborativa de um jogo sério multijogador para o treino de estratégias de regulação emocional em adolescentes e pais, e a avaliação da sua usabilidade.



QUEM PODE PARTICIPAR?

Durante o estudo pretende-se a participação dos adolescentes entre os 10 e 14 anos e um dos seus pais ou tutores. Este estudo é voluntário, pelo que nenhuma consequência negativa advirá da desistência. Além disso, todos os dados compartilhados serão anónimos e confidenciais, utilizados exclusivamente para fins de investigação.

PORQUE É IMPORTANTE?

Durante o período da adolescência, os jovens enfrentam desafios emocionais significativos e os pais desempenham um papel fundamental no desenvolvimento emocional dos seus filhos, através de interações e respostas. Portanto, é crucial fornecer estratégias eficazes de regulação emocional para ajudar os adolescentes e pais.





EM QUE CONSISTE A MINHA PARTICIPAÇÃO?

A participação neste estudo estará dividida em três sessões:

- 1** Na primeira sessão, pretende-se realizar uma entrevista, online ou presencial, com o objetivo de obter sugestões e ideias iniciais para a elaboração de uma primeira versão do jogo.
- 2** A segunda sessão tem como objetivo a realização de um workshop no qual os participantes poderão testar a primeira versão do jogo e dar sugestões para futuras melhorias e alterações.
- 3** Finalmente, a última sessão, em formato online, destina-se à avaliação da usabilidade, ou seja, para compreender a aceitação e a viabilidade da versão final do jogo através da resposta a um conjunto de questionários online.



B.2 Initial Co-Design Phase: Interview Guide

Entrevista (versão para adolescentes e pais) Nós vamos desenhar um jogo de computador para ajudar adolescentes e os seus pais a aprenderem como podem lidar de uma melhor forma com as suas emoções. Gostaríamos de perceber o que gostaria(s) de incluir num jogo de computador, com este propósito, de forma que seja interessante e divertido.

Contextualização do Participante

1. Joga(s) jogos de computador (ou outros)?
2. Que tipo de jogos?
3. Que dispositivo utiliza(s) para jogar? (Exemplos: Telemóvel, Tablet, Computador, Consola)
4. Quais são os seus/(teus) jogos favoritos?
5. Quanto tempo passa(s), por dia, em média, a jogar jogos durante a semana (segunda a sexta)? (indicar em horas e minutos)
6. Quanto tempo passa(s), por dia, em média, a jogar jogos durante o fim de semana? (indicar em horas e minutos)
7. Pode(s) falar-me mais acerca das características dos seus(teus) jogos favoritos? (histórias, personagens, ambiente, sistema de recompensas e dificuldade)

Demonstração de interesse pelo tema

7. Gostaria(s) de jogar um jogo para ajudar a reconhecer as emoções no dia a dia?
8. Gostaria(s) que este jogo também ajudasse a lidar com as emoções, isto é, que ensinasse estratégias para regular as emoções?
9. Gostaria que o jogo fosse jogado juntamente com o/a seu/sua filho(a) ? / Gostarias que o jogo fosse jogado com um dos teus pais ?
10. [ADOLESCENTES] Que tipo de conhecimento sobre as emoções dos filhos consideras relevante que os teus pais adquiriram? Consegues dar exemplos de situações em que te sentes incompreendido pelos teus pais?
11. [PAIS] Que tipo de conhecimento gostaria de adquirir acerca das emoções dos seus filhos? Consegue dar exemplos de situações em que teve dificuldade em entender e responder adequadamente às necessidades emocionais dos seus filhos?

Motivação de Jogo

12. Gostaria(s) de jogar um jogo que fosse cooperativo ou competitivo ?
13. Consegue(s) dar exemplos de mecânicas cooperativas para serem integradas no jogo? (Exemplos: resolver puzzles/dilemas em conjunto; objetivos e recompensas compartilhadas)
14. Gostaria de saber se consegue(s) pensar em alguma história que achasse(s) interessante de incluir no jogo. (pode ser um exemplo dos jogos que joga(s))
15. Pode(s) dar-me alguns exemplos de personagens que gostaria(s) de ter no jogo?
16. Pode(s) dar-me alguns exemplos do que seria um bom ambiente/cenários para o jogo?

Recompensas e feedback

17. Como seriam as recompensas do jogo? (taças, moedas...)
18. O que acha(s) que deveria acontecer quando os jogadores atingissem o objetivo? E quando não atingissem?

Experiencia de Jogo

19. O que acha(s) que devemos incluir no jogo que o iria tornar mais divertido para si(ti)? O que devemos incluir quando o jogo é demasiado difícil (dicas, sistema de dificuldade...)?
20. O que gostava(s) de poder escolher no jogo? (roupa da personagem, decorar um espaço) ?
21. Para concluir, tem(tens) mais algum comentário ou sugestão para o jogo?
22. Tem disponibilidade para participar nas fases seguintes do estudo ?

Entrevista (versão para profissionais de saúde)

Gostava só de mencionar primeiro que todos os dados recolhidos aqui vão ser anónimos e confidenciais, se me der permissão esta entrevista vai ser gravada, apenas o audio e depois vai ser transcrita, mas os seus dados nunca vão aparecer na transcrição e tudo isto vai ser guardado e protegido com password. O objetivo desta entrevista é obter a sua perspetiva sobre o que devemos incluir para garantir que o jogo que iremos desenvolver, direcionado para o desenvolvimento de competências de regulação emocional para adolescentes e pais, seja adequado para esse público-alvo específico , Nós neste jogo vamos incluir estratégias como: escolher conscientemente boas situações no sentido emocional, mudar a nossa situação atual para nos sentir melhor, focar em coisas diferentes para não prestarmos atenção ao estímulo emocional, pensar de maneira diferente para lidar com as nossas emoções ou por exemplo suprimir as emoções.

Explicar a ideia base do jogo

Opinião do entrevistado sobre o tema

1. Qual a sua opinião sobre o desenvolvimento de um jogo sério para treino de competências de regulação emocional?
2. Considera que estas competências poderão ser promovidas em conjunto com pais e adolescentes?

Conceptualização do jogo

3. Que histórias devemos incluir que sejam envolventes e motivadoras para os pais e os adolescentes?
4. Qual seria um bom ambiente para o jogo / as salas?
5. Dado que se pretende neste jogo apresentar situações comuns em que o adolescente e o pai possam aprender sobre as estratégias de regulação de forma prática, com a tua experiência podes me dar exemplo de situações onde os adolescentes experienciam mais emoções desagradáveis e vice-versa?

Objetivo do jogo e como podemos ligar a parte de jogar à teoria

6. Como é que podemos assegurar que a experiência de aprendizagem é desafiante mas alcançável para os pais e os adolescentes?

Experiência de jogo

7. Que tipo de estratégias podemos adotar para personalizar o jogo para cada indivíduo e como podemos adaptá-lo para assegurarmos que é adequado para pais e adolescentes?
8. Para concluir, tem mais algum comentário ou sugestão para o jogo?

Appendix C

Second Co-Design Phase: Questionnaires

Profissionais de Saúde

Opinião sobre os objetivos de jogo ? Estão claros ?

O jogo é desafiante e motivador o suficiente para o público alvo ?

Em relação à parte educativa, sente que existe algo que falta ? o conteúdo está bem explícito ?

Está alinhado com o que tínhamos discutido anteriormente na entrevista inicial?

Qual é a opinião relativa às recompensas existentes no jogo?

Mais alguma sugestão em relação à versão atual do jogo?

Pais e Adolescentes

Os objetivos do jogo estão claros ? Consegue(s) entender facilmente o que precisa de fazer em cada etapa do jogo?

Acha(s) o jogo desafiante e motivador o suficiente? Há momentos em que se/te sente(s) muito frustrado/a ?

Sente(s) que aprendes-te/aprendeu algo novo sobre regulação emocional enquanto jogava(s) ? O conteúdo educativo está claro e é fácil de entender?

O que acha(s) das recompensas oferecidas no jogo? São motivadoras e dão vontade de continuar a jogar ?

Há algo que você gostaria de ver melhorado ou adicionado no jogo? Tem alguma sugestão que poderia tornar o jogo mais interessante ou educativo?

Appendix D

Game Instruction Manual

Manual de Instruções

Configurações Iniciais

Requisitos: É necessário ter um computador e é fortemente recomendado jogar com um rato, apesar que pode ser jogado com o touchpad do computador.

O jogo é para dois jogadores por isso jogador 1 joga no teclado do computador e jogador 2 joga no rato/touchpad.

O jogo está destinado para correr em Plataforma Windows com uma arquitetura Intel 64-bit.

Instalação: Extrair os ficheiros da pasta EmotionOdyssey.zip e abrir ThesisSG.exe (Video de explicação em anexo).

Objetivos do Jogo

O conceito do jogo é Escape Room. É necessário procurar pistas, resolver puzzles em cada nível para atingir o objetivo.

O objetivo do jogo nos primeiros seis níveis é descobrir que emoção entre Raiva, Tristeza, Alegria, Nojo, Medo, Surpresa é que se encontra representada naquela sala. É feito através de análise de pistas.

O objetivo do último nível é aprender 5 diferentes estratégias de regulação emocional e aplicá-las em certas situações.

A condição de vitória é sempre desbloquear a porta da sala de alguma maneira e resolver o enigma final e a condição de derrota é ficar sem tempo.

Controlos

Jogador 1: Pressionar B para interagir com objetivos ou fazer certas coisas e andar com as teclas WASD ou com as teclas das setas.

Jogador 2: Clicar com o botão direito do rato ou do touchpad numa posição no mapa e a personagem move-se sozinha para essa posição. Para interagir com os objetos na sala, clicar com o botão esquerdo do rato ou do touchpad em cima do próprio objeto.

Para ativar e desativar o menu de pausa é pressionar na tecla ESC.

Dicas

Quando um jogador pode interagir com certo objeto aparece sempre uma instrução sobre como fazê-lo, se não aparecer o jogador não consegue interagir com o objeto.

Para interagir com objetos, o jogador 2 tem clicar mesmo em cima do certo objeto com o rato.

Ler bem qualquer pista e os puzzles, para não escapar nada!

Qualquer dúvida, enviar email para up201906478@up.pt

Appendix E

Usability Survey

Sociodemographic Questions for Health Professionals

 LimeSurvey

10%

Dados Pessoais e Profissionais

Idade

• Este é um texto de ajuda da pergunta.
• Neste campo só é possível introduzir números.

Sexo

☒ Feminino ☐ Masculino ☐ Sem resposta

Nacionalidade

Profissão

Anos de Experiência Profissional

• Neste campo só é possível introduzir números.

Sociodemographic Questions for Adolescents

Dados Pessoais

Idade

Este é um texto de ajuda da pergunta.

Neste campo só é possível introduzir números.

Sexo

♀

Feminino

♂

Masculino

○

Sem resposta

Nacionalidade

Ano de Escolaridade (ano que estás a frequentar)

Neste campo só é possível introduzir números.

Sociodemographic Questions for Parents

Dados Pessoais e Familiares

Idade

🔗 Este é um texto de ajuda da pergunta.

🔗 Neste campo só é possível introduzir números.

Sexo



Feminino



Masculino



Sem resposta

Estado Civil

🔗 Escolha uma das seguintes respostas

Casado(a) / União de facto

Solteiro (a)

Separado(a) / Divorciado(a)

Sem resposta

Habilitações Literárias

🔗 Escolha uma das seguintes respostas

1º Ciclo (1º ao 4º ano)

2º Ciclo (5º ao 6º ano)

3º Ciclo (7º ao 9º ano)

Ensino Secundário
(10º ao 12º ano)

Licenciatura

Mestrado

Sem resposta

Tem filhos adolescentes?



Sim



Não



Sem resposta

Se sim, quantos?

🔗 Neste campo só é possível introduzir números.

Se sim, que idades?

🔗 Escrever idades separado por vírgulas. No caso de ser só um valor, escrever apenas o valor.

Game Experience Questionnaire



33%

Questionário de Experiência de Jogo

*Módulo Principal

Por favor indique como se sentiu/come te sentiste enquanto jogava(s) o jogo, para cada um dos seguintes itens:

	Nada - 0	Um pouco - 1	Moderadamente - 2	Bastante - 3	Extremamente - 4
Senti-me satisfeito	☐	☐	☐	☐	☐
Senti-me habilidoso	☐	☐	☐	☐	☐
Estava interessado na história do jogo	☐	☐	☐	☐	☐
Achei o jogo divertido	☐	☐	☐	☐	☐
Estava completamente focado no jogo	☐	☐	☐	☐	☐
Senti-me feliz	☐	☐	☐	☐	☐
O jogo deixou-me maldisposto	☐	☐	☐	☐	☐
Pensei em outras coisas durante o jogo	☐	☐	☐	☐	☐
Achei o jogo cansativo	☐	☐	☐	☐	☐
Senti-me competente	☐	☐	☐	☐	☐
Achei o jogo difícil	☐	☐	☐	☐	☐
O jogo é esteticamente agradável	☐	☐	☐	☐	☐
Esqueci tudo à minha volta	☐	☐	☐	☐	☐
Senti-me bem	☐	☐	☐	☐	☐
Fui bom no jogo	☐	☐	☐	☐	☐
Senti-me entediado	☐	☐	☐	☐	☐
Senti-me bem-sucedido	☐	☐	☐	☐	☐
Senti-me criativo	☐	☐	☐	☐	☐
Senti que podia explorar coisas	☐	☐	☐	☐	☐
Gostei do jogo	☐	☐	☐	☐	☐
Fui rápido a alcançar os objetivos do jogo	☐	☐	☐	☐	☐
Senti-me chateado	☐	☐	☐	☐	☐
Senti-me pressionado	☐	☐	☐	☐	☐
Senti-me irritado	☐	☐	☐	☐	☐
Perdi a noção do tempo	☐	☐	☐	☐	☐
Senti-me desafiado	☐	☐	☐	☐	☐
Achei o jogo impressionante	☐	☐	☐	☐	☐
Fiquei profundamente concentrado no jogo	☐	☐	☐	☐	☐
Senti-me frustrado	☐	☐	☐	☐	☐
Senti que foi uma experiência enriquecedora	☐	☐	☐	☐	☐
Desliguei-me do mundo exterior	☐	☐	☐	☐	☐
Senti a pressão do tempo	☐	☐	☐	☐	☐
Tive de me esforçar bastante no jogo	☐	☐	☐	☐	☐

*Módulo de presença social

Por favor, indique como se sentiu enquanto jogava o jogo, para cada um dos seguintes itens:

	Nada - 0	Um pouco - 1	Moderadamente - 2	Bastante - 3	Extremamente - 4
Senti empatia pelos outros	☐	☐	☐	☐	☐
As minhas ações dependeram das ações dos outros	☐	☐	☐	☐	☐
As ações dos outros dependeram das minhas ações	☐	☐	☐	☐	☐
Senti-me conectado com os outros	☐	☐	☐	☐	☐
Os outros prestaram-me atenção	☐	☐	☐	☐	☐
Prestei muita atenção aos outros	☐	☐	☐	☐	☐
Senti-me invejoso/a em relação aos outros	☐	☐	☐	☐	☐
Senti-me bem junto dos outros	☐	☐	☐	☐	☐
Quando eu estava feliz os outros estavam felizes	☐	☐	☐	☐	☐
Quando os outros estavam felizes eu estava feliz	☐	☐	☐	☐	☐
Influenciei o humor dos outros	☐	☐	☐	☐	☐
Senti-me influenciado/a pelo humor dos outros	☐	☐	☐	☐	☐
Admirei os outros	☐	☐	☐	☐	☐

As ações dos outros afetaram as minhas ações	☐	☐	☐	☐	☐
As minhas ações afetaram as ações dos outros	☐	☐	☐	☐	☐
Senti-me vingativo	☐	☐	☐	☐	☐
Senti-me contente quando os meus colegas falharam	☐	☐	☐	☐	☐

***Módulo Pós-Jogo**

Por favor indique como se sentiu logo após parar de jogo, para cada um dos seguintes itens:

	Nada - 0	Um pouco - 1	Moderadamente - 2	Bastante - 3	Extremamente - 4
Senti-me revitalizado	☐	☐	☐	☐	☐
Senti-me mal	☐	☐	☐	☐	☐
Achei difícil voltar à realidade	☐	☐	☐	☐	☐
Senti-me culpado	☐	☐	☐	☐	☐
Pareceu uma vitória	☐	☐	☐	☐	☐
Achei uma perda de tempo	☐	☐	☐	☐	☐
Senti-me com energia	☐	☐	☐	☐	☐
Senti-me satisfeito	☐	☐	☐	☐	☐
Senti-me desorientado	☐	☐	☐	☐	☐
Senti-me exausto	☐	☐	☐	☐	☐
Senti que podia ter feito coisas mais úteis	☐	☐	☐	☐	☐
Senti-me poderoso	☐	☐	☐	☐	☐
Senti-me cansado	☐	☐	☐	☐	☐
Senti-me arrependido	☐	☐	☐	☐	☐
Senti-me envergonhado	☐	☐	☐	☐	☐
Senti-me orgulhoso	☐	☐	☐	☐	☐
Tive a sensação de ter regressado de uma viagem	☐	☐	☐	☐	☐

Post-Study System Usability Questionnaire



Questionário Pós-Estudo de Usabilidade do Sistema

Classifique as seguintes afirmações numa escala de 'Concordo totalmente' a 'Discordo totalmente' e, se desejar, forneça um comentário sobre cada uma delas:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Em geral, estou satisfeito com a facilidade de utilização deste sistema.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Este sistema foi simples de utilizar.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Consegui completar as tarefas e os cenários utilizando este sistema.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Consegui completar rapidamente as tarefas e os cenários utilizando este sistema.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Consegui completar as tarefas e os cenários com eficiência utilizando este sistema.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Senti-me confortável a utilizar este sistema.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Foi fácil aprender a utilizar este sistema.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Acredito que me tornaria rapidamente produtivo se utilizasse este sistema.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
O sistema deu mensagens de erros que me indicaram claramente como resolver os problemas.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Sempre que cometi um erro durante a utilização do sistema, consegui recuperar de forma fácil e rápida.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

*

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
A informação fornecida pelo sistema (como ajuda online, mensagens no ecrã ou outra documentação) foi clara.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Foi fácil encontrar a informação que precisava.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
A informação fornecida pelo sistema foi fácil de entender.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
A informação foi eficaz para me ajudar a completar as tarefas e os cenários.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
A organização da informação que o sistema transmitiu foi clara.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

i A "interface" inclui aqueles itens que se utilizam para interagir com o sistema. Por exemplo, algumas componentes da interface são o teclado, o rato, o microfone e o ecrã (incluindo a utilização de gráficos e de linguagem).

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
A interface do sistema foi agradável.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Gostei de utilizar a interface deste sistema.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Este sistema tem todas as funcionalidades e capacidades que eu esperava.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

	1 - Concordo Totalmente	2	3	4	5	6	7 - Discordo Totalmente	Não aplicável
Em geral, estou satisfeito com este sistema.	☐	☐	☐	☐	☐	☐	☐	☐

Comentários:

Intrinsic Motivation Inventory (Portuguese Validated Version)

Inventário de Motivação Intrínseca

*Numa escala entre 'Discordo Totalmente' e 'Concordo Totalmente', classifique as seguintes afirmações:

	1 - Discordo Totalmente	2	3	4	5 - Concordo Totalmente
Gostei bastante do jogo	☐	☐	☐	☐	☐
Despendi muito esforço na prática do jogo	☐	☐	☐	☐	☐
Penso que fui bastante bom/boa no jogo	☐	☐	☐	☐	☐
Senti-me tenso/a enquanto praticava o jogo	☐	☐	☐	☐	☐
O jogo foi divertido	☐	☐	☐	☐	☐
Foi importante para mim fazer bem as coisas no jogo	☐	☐	☐	☐	☐
Estou satisfeito/a com o meu rendimento no jogo	☐	☐	☐	☐	☐
Senti-me nervoso/a enquanto praticava o jogo	☐	☐	☐	☐	☐
Descreveria o jogo como muito interessante	☐	☐	☐	☐	☐
Empenhei-me bastante no jogo	☐	☐	☐	☐	☐
Fui bastante bom/boa no jogo	☐	☐	☐	☐	☐
Senti-me descontraido/a enquanto praticava o jogo	☐	☐	☐	☐	☐

Enquanto praticava o jogo, estava a pensar em como gostava de o fazer	☐	☐	☐	☐	☐
O jogo não me despertou a atenção	☐	☐	☐	☐	☐
Não consegui praticar o jogo muito bem	☐	☐	☐	☐	☐
Senti-me pressionado/a enquanto praticava o jogo	☐	☐	☐	☐	☐
Não me esforcei muito no jogo	☐	☐	☐	☐	☐
Após praticar um bocado o jogo, senti-me bastante competente	☐	☐	☐	☐	☐

Open Questions for Health Professionals

Considera que o conteúdo do jogo é relevante e adequado para o público alvo?

Até que ponto os cenários do jogo refletem os desafios de regulação emocional da vida real que os pais e os adolescentes enfrentam?

Considera que este jogo tem potencial para ser integrado em cenários reais de tratamento? Porquê?

Open Questions Questions for Adolescents

Grupo de perguntas de resposta livre

Sentes que aprendes-te novas formas de gerir as tuas emoções através do jogo?

Qual é a probabilidade de utilizares as competências aprendidas no jogo em situações da vida real?

O que é que mais te agrada no jogo?

Open Questions for Parents

Grupo de perguntas de resposta livre

Os cenários e desafios do jogo parecem relevantes para as suas experiências como pai, mãe ou tutor?

Qual é a probabilidade de utilizar as competências aprendidas no jogo em situações da vida real?

Que aspectos do jogo considera mais interessantes ou agradáveis?

Appendix F

Informed Consent Document (Portuguese Version)

CONSENTIMENTO INFORMADO, LIVRE E ESCLARECIDO PARA PARTICIPAÇÃO EM INVESTIGAÇÃO

de acordo com a Declaração de Helsínquia¹ e a Convenção de Oviedo²

Por favor, leia com atenção a seguinte informação. Se achar que algo está incorreto ou que não está claro, não hesite em solicitar mais informações. Se concorda com a proposta que lhe foi feita, queira assinar este documento.

Título do Estudo: Emoções em família: Co-criação de um Jogo Sérioso para Treino de Competências de Regulação Emocional

Enquadramento do Estudo: A adolescência é um período crucial de desenvolvimento em que os adolescentes buscam maior autonomia e enfrentam desafios emocionais. Embora muitos melhorem as suas competências para lidar com as emoções, alguns enfrentam dificuldades nesse aspeto. Os pais desempenham um papel significativo ao ensinar sobre emoções, influenciando como os filhos expressam e entendem as emoções. Para auxiliar os filhos, os pais precisam compreender e gerir as suas próprias emoções.

No caso dos adolescentes, mesmo apresentado as suas próprias competências emocionais, continuam a aprender a aplicá-las, recebendo influência significativa dos pais nesse processo. Reconhecendo a importância da saúde mental na adolescência, investigadores reconhecem o desenvolvimento de jogos sérios, aproveitando avanços na tecnologia, como ferramentas eficazes de intervenção. A co-criação desses jogos, com a colaboração do público-alvo, não só fornece informações valiosas, mas também promove a colaboração para alcançar objetivos comuns.

Explicação do Estudo: No âmbito de uma Tese de Mestrado em Engenharia Informática e Computação da Faculdade de Engenharia da Universidade do Porto pretende-se, com a sua participação, a co-criação de um jogo sério multijogador para o treino de estratégias de regulação

¹http://portal.arsnorte.min-saude.pt/portal/page/portal/ARSNorte/Comiss%C3%A3o%20de%20%C3%89tica/Ficheiros/Declaracao_Helsinki_2008.pdf

²<http://dre.pt/pdf1sdip/2001/01/002A00/00140036.pdf>

emocional em adolescentes e pais, com a avaliação da sua usabilidade para compreender a sua experiência de jogo e aceitação.

A realização deste projeto estará dividida em três sessões:

- Na primeira sessão, pretende-se realizar uma entrevista, online ou presencial, com o objetivo de obter sugestões e ideias conceptuais para a elaboração de uma primeira versão do jogo.
- A segunda sessão tem como objetivo a realização de um workshop presencial no qual os participantes poderão testar a primeira versão do jogo e dar sugestões para futuras melhorias e alterações.
- Finalmente, a última sessão destina-se à avaliação da usabilidade, ou seja, para compreender a aceitação e a viabilidade da versão final do jogo através da resposta a um conjunto de questionários online.

Condições: A sua participação é estritamente voluntária. Assim, a qualquer momento, poderá desistir e nenhuma consequência negativa advirá dessa decisão.

Condições e financiamento: Todos os adultos participantes serão solicitados a fornecer Consentimento Informado, Livre e Esclarecido para inclusão na investigação, juntamente com o consentimento dos pais para a participação de seus filhos adolescentes. Os adolescentes serão convidados a fornecer Assentimento Informado por escrito.

Possíveis benefícios imediatos da participação neste projeto de pesquisa incluem uma melhor compreensão das emoções e seus atributos, assim como o conhecimento de estratégias para lidar com as emoções no dia a dia. Não são esperados riscos resultantes da participação. Não está prevista nenhuma forma de compensação financeira pela participação no estudo, e não serão incorridos quaisquer custos para os participantes.

O estudo obteve um Parecer favorável da Comissão de Ética da Universidade do Porto, assim como das Comissões de Ética das Escolas onde está a ser realizado. [caso se verifique]

Os participantes interessados terão a oportunidade de solicitar as conclusões do estudo à equipa de investigação, estes serão divulgados através de publicações científicas para apresentar o jogo sério.

A participação é completamente voluntária, e não acarretará qualquer prejuízo caso decida não participar ou opte por interromper a sua participação.

Este projeto é suportado pelo Financiamento Base - UIDB/00027/2020 da Unidade de Investigação - Laboratório de Inteligência Artificial e Ciência de Computadores - LIACC, financiado por fundos nacionais através da FCT/MCTES (PIDDAC).

Confidencialidade e anonimato: Todos os dados compartilhados durante estas sessões serão anónimos e confidenciais, utilizados exclusivamente para fins de investigação.

De acordo com as suas características, a recolha de dados online será estritamente de acordo com os requisitos de anonimato, segurança e confidencialidade, assim como qualquer dado recolhido durante a investigação será armazenado anonimamente num computador protegido por palavra-passe, acessível apenas pela equipa de investigação. Informações de identificação, como dados sociodemográficos e endereços de email para envio de consentimento informado, serão armazenadas separadamente e protegidos por palavra-passe.

A recolha de autorrelatos online será efetuada através de um sistema de questionários online que garanta o controlo de acesso e anonimização dos dados recolhidos. Estes dados serão armazenados num servidor institucional, sem qualquer transmissão a terceiros. A segurança física e eletrónica dos dados será garantida durante e após a realização do estudo.

Em todos os casos, as identidades dos participantes permanecerão confidenciais, sem qualquer divulgação pública. Ainda, comprometemo-nos a usar exclusivamente os dados recolhidos para este estudo, mantendo o anonimato dos participantes. Todos os contatos serão realizados em ambientes que respeitem a privacidade dos indivíduos.

Em nome da equipa agradecemos a sua participação.

Estudante: João Silva (email: up201906478@edu.fe.up.pt)

Orientadora: Eliana Silva (email: elianasilva@fe.up.pt)

Assinatura:

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Declaro ter lido e compreendido este documento, bem como as informações que me foram fornecidas pela pessoa que acima assina. Foi-me garantida a possibilidade de, em qualquer altura, recusar participar neste estudo sem qualquer tipo de consequências. Desta forma, aceito participar neste estudo e permito a utilização dos dados que de forma voluntária forneço, confiando em que apenas serão utilizados para esta investigação e nas garantias de confidencialidade e anonimato que me são dadas pelo investigador.

Nome:

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Assinatura:

.

Data: / /

SE NÃO FOR O PRÓPRIO A ASSINAR POR IDADE OU INCAPACIDADE

(se o menor tiver discernimento deve também assinar em cima, se consentir)

NOME:

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BI/CD N°: DATA OU VALIDADE / /

GRAU DE PARENTESCO OU TIPO DE REPRESENTAÇÃO:

ASSINATURA

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**ESTE DOCUMENTO É COMPOSTO DE 3 PÁGINAS E FEITO EM DUPLICADO:
UMA VIA PARA O INVESTIGADOR, OUTRA PARA A PESSOA QUE CONSENTE**

Appendix G

Informed Assent Document (Portuguese Version)

ASSENTIMENTO INFORMADO, LIVRE E ESCLARECIDO PARA PARTICIPAÇÃO EM INVESTIGAÇÃO

de acordo com a Declaração de Helsínquia¹ e a Convenção de Oviedo²

Por favor, lê com atenção a seguinte informação. Se achares que algo está incorreto ou que não está claro, não hesites em solicitar mais informações. Se concordas com a proposta que te foi feita, podes assinar este documento.

Título do Estudo: Emoções em família: Co-criação de um Jogo Sérioso para Treino de Competências de Regulação Emocional

Enquadramento do Estudo: A adolescência é um período crucial de desenvolvimento em que os adolescentes buscam maior autonomia e enfrentam desafios emocionais. Embora muitos melhorem as suas competências para lidar com as emoções, alguns enfrentam dificuldades nesse aspeto. Os pais desempenham um papel significativo ao ensinar sobre emoções, influenciando como os filhos expressam e entendem as emoções. Para auxiliar os filhos, os pais precisam compreender e gerir as suas próprias emoções.

No caso dos adolescentes, mesmo apresentado as suas próprias competências emocionais, continuam a aprender a aplicá-las, recebendo influência significativa dos pais nesse processo. Reconhecendo a importância da saúde mental na adolescência, investigadores reconhecem o desenvolvimento de jogos sérios, aproveitando avanços na tecnologia, como ferramentas eficazes de intervenção. A co-criação desses jogos, com a colaboração do público-alvo, não só fornece informações valiosas, mas também promove a colaboração para alcançar objetivos comuns.

Explicação do Estudo: No âmbito de uma Tese de Mestrado em Engenharia Informática e Computação da Faculdade de Engenharia da Universidade do Porto pretende-se, com a sua participação, a co-criação de um jogo sério multijogador para o treino de estratégias de regulação

¹http://portal.arsnorte.min-saude.pt/portal/page/portal/ARSNorte/Comiss%C3%A3o%20de%C3%89tica/Ficheiros/Declaracao_Helsinquia_2008.pdf

²<http://dre.pt/pdf1sdip/2001/01/002A00/00140036.pdf>

emocional em adolescentes e pais, com a avaliação da sua usabilidade para compreender a sua experiência de jogo e aceitação.

A realização deste projeto estará dividida em três sessões:

- Na primeira sessão, pretende-se realizar uma entrevista, online ou presencial, com o objetivo de obter sugestões e ideias conceptuais para a elaboração de uma primeira versão do jogo.
- A segunda sessão tem como objetivo a realização de um workshop presencial no qual os participantes poderão testar a primeira versão do jogo e dar sugestões para futuras melhorias e alterações.
- Finalmente, a última sessão destina-se à avaliação da usabilidade, ou seja, para compreender a aceitação e a viabilidade da versão final do jogo através da resposta a um conjunto de questionários online.

Condições: A tua participação é estritamente voluntária. Assim, a qualquer momento, poderás desistir e nenhuma consequência negativa advirá dessa decisão.

Condições e financiamento: Todos os adultos participantes serão solicitados a fornecer Consentimento Informado, Livre e Esclarecido para inclusão na investigação, juntamente com o consentimento dos pais para a participação de seus filhos adolescentes. Os adolescentes serão convidados a fornecer Assentimento Informado por escrito.

Possíveis benefícios imediatos da participação neste projeto de pesquisa incluem uma melhor compreensão das emoções e seus atributos, assim como o conhecimento de estratégias para lidar com as emoções no dia a dia. Não são esperados riscos resultantes da participação. Não está prevista nenhuma forma de compensação financeira pela participação no estudo, e não serão incorridos quaisquer custos para os participantes.

O estudo obteve um Parecer favorável da Comissão de Ética da Universidade do Porto, assim como das Comissões de Ética das Escolas onde está a ser realizado. [caso se verifique]

Os participantes interessados terão a oportunidade de solicitar as conclusões do estudo à equipa de investigação, estes serão divulgados através de publicações científicas para apresentar o jogo sério.

A participação é completamente voluntária, e não acarretará qualquer prejuízo caso decidas não participar ou optes por interromper a tua participação.

Este projeto é suportado pelo Financiamento Base - UIDB/00027/2020 da Unidade de Investigação - Laboratório de Inteligência Artificial e Ciência de Computadores - LIACC, financiado por fundos nacionais através da FCT/MCTES (PIDDAC).

Confidencialidade e anonimato: Todos os dados compartilhados durante estas sessões serão anónimos e confidenciais, utilizados exclusivamente para fins de investigação.

De acordo com as suas características, a recolha de dados online será estritamente de acordo com os requisitos de anonimato, segurança e confidencialidade, assim como qualquer dado recolhido durante a investigação será armazenado anonimamente num computador protegido por palavra-passe, acessível apenas pela equipa de investigação. Informações de identificação, como dados sociodemográficos e endereços de email para envio de consentimento informado, serão armazenadas separadamente e protegidos por palavra-passe.

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Em todos os casos, as identidades dos participantes permanecerão confidenciais, sem qualquer divulgação pública. Ainda, comprometemo-nos a usar exclusivamente os dados recolhidos para este estudo, mantendo o anonimato dos participantes. Todos os contatos serão realizados em ambientes que respeitem a privacidade dos indivíduos.

Em nome da equipa agradecemos a tua participação.

Estudante: João Silva (email: up201906478@edu.fe.up.pt)

Orientadora: Eliana Silva (email: elianasilva@fe.up.pt)

Assinatura:

... ..

Declaro ter lido e compreendido este documento, bem como as informações que me foram fornecidas pela pessoa que acima assina. Foi-me garantida a possibilidade de, em qualquer altura, recusar participar neste estudo sem qualquer tipo de consequências. Desta forma, aceito participar neste estudo e permito a utilização dos dados que de forma voluntária forneço, confiando em que apenas serão utilizados para esta investigação e nas garantias de confidencialidade e anonimato que me são dadas pela investigadora.

Nome (Adolescente):

... ..

Assinatura (Adolescente):

... .. Data: /..... /.....

Dados dos Pais

SE NÃO FOR O PRÓPRIO A ASSINAR POR IDADE

(se o menor tiver discernimento deve também assinar em cima, se consentir)

NOME:

... ..

BI/CD N°: DATA OU VALIDADE /..... /.....

GRAU DE PARENTESCO OU TIPO DE REPRESENTAÇÃO:

ASSINATURA

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