

FACULDADE DE ENGENHARIA DA UNIVERSIDADE DO PORTO

Emotion Rush: A Serious Game to Promote Emotion Regulation in Adolescents in Residential Care

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Mestrado em Engenharia Informática e Computação

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July 18, 2025

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Resumo

A Regulação Emocional (RE) é a competência de um indivíduo de controlar o seu próprio estado emocional, fazendo dela uma habilidade importante no desenvolvimento psicológico e social. A adolescência é um período significativo para o desenvolvimento e aperfeiçoamento das competências de regulação emocional devido às diferentes alterações experienciadas e a novas experiências emocionais. Adolescentes em situação de Acolhimento Residencial - isto é, que não estão integrados numa família - estão expostos a um maior número de situações stressantes, ao mesmo tempo que muitas vezes não têm o apoio proporcionado por uma relação segura com um adulto em quem possam confiar. Assim como com muitas outras intervenções para a promoção da saúde na adolescência, jogos sérios - isto é, jogos para ensinar e treinar os seus utilizadores num tópico específico - ao invés de apenas proporcionar entretenimento, são uma abordagem popular para a promoção da saúde na adolescência por proporcionarem um formato apelativo. Apesar de existirem atualmente vários jogos que promovem a Regulação Emocional de adolescentes, não há conhecimento de nenhum Jogo Sério desenvolvido especificamente para adolescentes em situação de Acolhimento Residencial. O propósito principal desta dissertação foi o desenvolvimento de um Jogo Sério para preencher essa lacuna, seguindo uma abordagem de co-design envolvendo profissionais de saúde na sua conceptualização e nos seus testes de usabilidade. O resultado foi o Emotion Rush, um *arcade* RPG para dispositivos móveis desenvolvido em Unity 6 para treinar adolescentes no reconhecimento de emoções e no uso da reavaliação cognitiva e da supressão emocional. Ensinando jogadores através do reforço positivo ao mesmo tempo que faz uso de mecânicas que incentivam a rejogabilidade, o Emotion Rush proporciona um espaço seguro para o adolescente explorar e desenvolver a sua Regulação Emocional. O envolvimento de profissionais de saúde na fase de conceptualização no jogo foi assegurado através de um processo de entrevistas semi-estruturadas com 3 profissionais de saúde da área da psicologia de adolescentes, através das quais se apuraram os requisitos necessários para o jogo, definindo-se o seu género, o ambiente retratado e as suas mecânicas principais, além de se estabelecer a importância da rejogabilidade, do contexto narrativo e do reforço positivo. Após um período de desenvolvimento, ao atingir o Produto Mínimo Viável (PMV), a versão atual do jogo foi enviada via email a profissionais de saúde, em conjunto com um questionário para um estudo de usabilidade respondido por 2 participantes, conduzindo à conclusão de que o Emotion Rush é adequado à promoção da Regulação Emocional em adolescentes em Acolhimento Residencial e se encontra pronto para ser testado com adolescentes no futuro, assim como com uma maior amostra de profissionais de saúde.

Keywords — Serious Game, Game Development, Emotion Regulation, Adolescents, Residential Care

Abstract

Emotion Regulation is the skill of controlling one's emotional state making it an important skill for psychological and social development. Adolescence is a significant period for the development and improvement of Emotion Regulation skills, due to different experienced changes and new emotional experiences. Adolescents in Residential Care contexts - that is, non-familiar based group settings - are exposed to a higher number of stressful situations, while many times lacking the support of a secure relationship with an adult they can trust in. As with many other interventions for promoting adolescent health, serious games - that is, games for teaching and educating users on a topic, rather than just entertaining - are a popular approach for promoting health in adolescents as they provide an appealing format. Despite there being currently many games for promoting adolescent Emotion Regulation, there is no knowledge of a serious game developed specifically for adolescents in Residential Care. The main purpose of this dissertation was the development of a serious game to fill in that gap, following a co-design approach involving healthcare professionals in its conceptualization and its usability tests. The result was Emotion Rush, a mobile arcade RPG developed in Unity 6 for training adolescents in emotion recognition and using cognitive reappraisal and emotional suppression. Teaching players through positive reinforcement while making use of mechanics that encourage replayability, Emotion Rush provides a safe space for adolescents to explore and develop their Emotion Regulation. The involvement of healthcare professionals in the game's conceptualization phase was assured through a semi-structured interview process with 3 adolescent psychology experts, through which game requirements were gathered, defining the game's genre, environment and main mechanics, as well as establishing the importance of replayability, narrative context and positive reinforcement. After the development period, as the Minimum Viable Product (MVP) was achieved, the current version of the game was sent via email to healthcare professionals, together with a questionnaire for a usability study that was answered by 2 participants, leading to the conclusion that Emotion Rush is adequate for promoting Emotion Regulation in adolescents in Residential Care and is ready for being tested with adolescents in the future, as well as with a bigger sample of healthcare professionals.

Keywords — Serious Game, Game Development, Emotion Regulation, Adolescents, Residential Care

UN Sustainable Development Goals

The 17 United Nations Sustainable Development Goals (SDGs) are the core of the 2030 Agenda for Sustainable Development, adopted by the all United Nations member states in 2015.

The investigation and development work carried out in this dissertation directly contributes for three of these 17 goals, which are:

SDG 1 End poverty in all its forms everywhere.

Target 1.4 of this first Sustainable Development Goal specifically mentions that all people, especially the poorer and the more vulnerable, should have access, among other things, to technology. The development of a serious game for promoting Emotion Regulation for adolescents in Residential Care, considered a vulnerable population regarding mental health, contributes towards their access to technology. This dissertation not only contributes with the development of a serious game to be made available and accessible for a vulnerable population, but it also contributes with research to incentive future works on other serious games for promoting Emotion Regulation or even other aspects of Mental Health in the same population.

SDG 3 Ensure healthy lives and promote well-being for all at all ages.

Target 3.4 mentions the promotion of mental health and well-being. Emotion Rush's main objective is the promotion of Emotion Regulation in adolescents in Residential Care, teaching them healthy strategies to regulate their emotions and training them in identifying them. Because of this, this dissertation contributes towards the promotion of mental health and well-being.

SDG 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Emotion Rush is the first Serious Game for promoting Emotion Regulation in adolescents in Residential Care. By developing a Serious Game focusing on a particular group that has scarcely been researched before in this matter, this dissertation contribute towards making these interventions more inclusive towards adolescents in Residential Care, while at the same time incentivizing further research and development targetting them.

The table in the following page synthesizes the Sustainable Development Goals that this dissertation contributes to, as well as which specific targets, how the carried out work contributes to them and what performance indicators and metrics are associated can reflect this contribution in the long run.

SDG	Target	Contribution	Performance Indicators and Metrics
1	1.4	Developing a Serious Game for promoting Emotion Regulation in adolescents in Residential Care makes this kinds of interventions more accessible and appealing for these adolescents, that are currently a vulnerable group regarding this matter. It also increases research on the area.	Increase in the amount of research carried out on Serious Games for promoting Emotion Regulation in Residential Care, as well as the amount of serious games developed for this audience.
3	3.3	The development of a Serious Game for promoting adolescent Emotion Regulation contributes to the promotion of mental health and well-being, as well as raising awareness towards the importance of Emotion Regulation.	Percentage of occurrences influenced by Emotion Regulation difficulties in adolescents, such as school bullying, self-harm or suicide.
4	4.a	Developing a Serious Game targeting adolescents in Residential Care, allows for adolescents in these situations to receive the same support towards learning and raising their awareness about Emotion Regulation as other adolescents in familiar settings.	Increase in the amount of adolescents in Residential Care involved in Emotion Regulation promotion interventions and with access to Serious Games for Mental Health, increase in the research and development of Serious Games for adolescents in Residential Care.

Acknowledgements

First, I would like to thank my supervisors, Professor Eliana Silva and Professor Luís Paulo Reis for supporting me throughout the development of this dissertation, clarifying any doubts I had and remaining available through the whole dissertation development process. I would also like to thank Professor Mariana Sousa and Designer Marta Reis for their collaboration and contribution during the project. Additionally, I would like to thank all participants of the interview process and the usability testing phases, as their contribution was crucial for the development of this dissertation and of Emotion Rush.

I am especially thankful for my parents, who always supported me throughout my path through university and always helped me see the brighter side of things, encouraging me to keep doing my best until the end. I want to extend my thanks to the rest of my family, who always checked on me to know how I was doing, supporting me and showing interest in my achievements, as well as those who already passed away, but keep on being an inspiration for me and for what kind of person I want to become in the future. I also can't thank my girlfriend enough for her support through university and through the development of this dissertation, as she always believed in me and was there to hear me and cheer me up any time I needed.

I am grateful for all the friends I have made throughout these 5 years in FEUP, with whom I was able to learn and laugh a lot and from whom I received unconditional support. I also extend my thanks to my professors in Computer Graphics, Game Development and Multimedia, that supported me throughout the course and fueled my interest in those areas that was one of the reasons that made me enroll in this course in the first place.

I would also like to thank all my other friends that went through my life, some that I met before even starting university and some that have joined me over the past 5 years, for believing on me and being part of the highest and lowest moments of my life and supporting me when I needed the most.

Thank you all for your support, for your presence in my life and for believing in me. This project wouldn't have been the same without you all.

Pedro Manuel Costa Aguiar Botelho Gomes

“Emotions do not force us to respond in certain ways, they only make it more likely we will do so.”

James J. Gross

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Abbreviations

ASD	Autism Spectrum Disorder
ER	Emotion Regulation
GUI	Graphical User Interface
HCI	Human-Computer Interaction
MVP	Minimum Viable Product
ND	Not Defined
NPC	Non-Playable Characters
PC	Personal Computer
RC	Residential Care
RPG	Role-Playing Games
SG	Serious Game
SGH	Serious Games for Health
VR	Virtual Reality

Chapter 1

Introduction

1.1 Context

This dissertation was developed as part of a project at the Artificial Intelligence and Computer Science Laboratory (LIACC) at FEUP that aims towards the development of tools for the promotion and development of Emotion Regulation (ER) practices in adolescents, in the form of Serious Games (SG's). In previous years, the promotion and development of ER practices in adolescents was already approached through the development of a SG meant to be played by young adolescents [9] and another meant to be played by their parents [10]. This dissertation complemented the previously carried out work by focusing in the research and development of a SG for Adolescents in Residential Care (RC), a more specific group of adolescents where research is currently scarce, counting with the partnership of Professor Mariana Sousa, professor and research in the Psychology for Development Research Center in Lusíada University, Porto.

ER is the ability to control one's emotional state, involving different strategies to deal with different emotions [11] [12] . As such, the development of ER mechanisms and strategies since childhood is considerably important for the psychological development and growth of any individual over the course of their life. Depending on several circumstances and factors relative to the environment where an individual lives, the development and learning of ER strategies can be positively or negatively impacted. Childhood and adolescence are especially significant periods in the development of those coping mechanisms, making the impact of said factors during that phase of growth even more important.

According to several studies regarding the attachment theory, the existence of an emotional relationship between an adolescent and a tutor such as a parental figure significantly impacts the individual's cognitive and social development, leading to higher stimulation in the construction of life aspirations and the better development of adaptive ER strategies [13]. Having a figure to guide the adolescent, providing them a relationship built in trust, confidence and safety proves beneficial to the development of the adolescent, and that role is more commonly associated with parents or their guardian. For adolescents and children in RC situations, that is, non-familiar based group settings, there are multiple new variables at play, making it more difficult for an healthy

adolescent-guardian relationship to develop, which will directly impact their psychological and psycho-social development, namely in terms of ER skills. In RC contexts, the primary guardian of the adolescent is not a parent or a family member, but a staff member of the institution where the individual is inserted in. Depending on factors such as the age of first institutionalization and its motives, as well as the amount of times the adolescent switched institutions (and thus, got a new primary caregiver assigned to them), the development of a secure and healthy relationship between an institutionalized adolescent and their primary caregiver presents new challenges and difficulties that are non-existent in familiar contexts and that can lead to life-long consequences in the development of ER strategies and, consequently in their psychological and psycho-social development trajectory if they aren't taken into consideration and managed from the beginning [13]. After all, adolescents tend to develop expectations on future relationships based on relationships established on the past, which means that adolescents in RC, which are more likely exposed to unstable relationships, are also more likely to have trouble forming healthy relationships in the future [14] [15] [16] [17].

1.2 Motivation

Serious Games for Health (SGH) consist in games that are focused in teaching or educating the players on a theme regarding health rather than serving for merely entertainment purposes [12]. Despite there being multiple games developed in the area of ER and targeting adolescents, there wasn't knowledge of any ER focused serious games specifically developed for adolescents in RC contexts, at the time this dissertation's research started.

One of the main challenges in the teaching of ER strategies to adolescents is making the learning process attractive for them, so that they feel committed to practicing them [12]. Considering video games are an appealing format for adolescents (12-to-18-year-olds) nowadays [9] [18] and considering the recent advancements in terms of studies on the effectiveness of SGH and the amount of data available, the development of a SG for the promotion and development of ER competences in institutionalized adolescents provides a helpful and appealing tool for those that might be negatively affected by the particular circumstances of growing under RC contexts. It also allows them to further develop their ER competencies and mitigate possible negative impacts that those different circumstances might cause on the development of each individual of said age group.

In order to further increase the positive impact of a SG developed for adolescents in RC context, it was considered important to adopt a co-design approach, involving the target audience, RC institution workers and health and psychology experts in the conceptualization and development process. Multiple studies hint that co-design approaches increase the acceptance of a solution, as it is built with the feedback and collaboration of those that will use it in the future, tailoring it to their needs and concerns [19]. Co-design would thus increase the acceptance and appeal of the game to the younger audiences, as the game would be developed with them and for them.

1.3 Objectives

The main goal of this dissertation was the iterative development of a tool, in the form of a SG, to improve ER strategies of non-clinical 12-to-18-year-old individuals in RC contexts, involving samples of the target group, psychology and health experts and institution caretakers in certain steps of the process to aim for a higher chance of acceptance and effectiveness through a co-design approach.

For this to be possible, researching the available knowledge on this matter, both in the development of serious games related to ER and targeting this age group, was also defined as an objective in order to understand the reality of RC, the knowledge behind adolescent ER and the most effective intervention approaches regarding the development of serious games for promoting ER and for promoting adolescent health.

It was also the objective of this dissertation to contribute towards the scientific community by documenting the process through which this game was developed, in order to serve as a reference for future carried out work in this area.

Finally, this dissertation aimed to assess the acceptance of this serious game with usability tests involving a group of adolescents in Residential Care and the consultation of healthcare professionals in the area of Children and Adolescent Psychology.

In short, this dissertation aimed to answer the following research question: is it possible to co-design and develop a theory-driven serious game for promoting and developing ER competences in 12-to-18-year-old adolescents living in RC contexts?

1.4 Document Structure

After this introductory chapter that briefly describes the work of this dissertation, the next chapters approach each step of this dissertation work in bigger detail, following the structure described below.

Chapter 2 presents the **Background** of this dissertation providing an in-depth introduction to the concepts related to ER, to the reality of RC contexts and to SG Development, presenting the initial research conducted in order to better understand the key concepts of this dissertation.

Chapter 3 is the **Systematic Review of Serious Games for Adolescent Emotion Regulation** chapter and describes in detail the systematic review process through which a set of SG's for Adolescent ER were obtained, selected and analyzed. It also presents the result analysis of the systematic review, breaking down the gathered literature and presenting the analyzed games in detail, as well as making a comparative analysis of these games and drawing conclusions from it.

Chapter 4 describes **Other Serious Games for Adolescent Mental Health** that were analyzed and used as reference for the development of this dissertation, once again presenting each one in detail, making a comparative analysis and drawing conclusions from it, in order to allow this dissertation to have a broader sample of SG's for adolescents to base itself in when conceptualizing Emotion Rush.

Chapter 5 contains the description of the **Solution Proposal** that was devised after conclusions were taken from the literature, based solely on the information extracted from it, detailing tasks, milestones, deliverables and objectives for the project, as well as foreseen limitations and planned mitigations. This chapter also shows a comparison between the initially devised development plan and the plan that ended up being carried out, according to the limitations encountered and the way they were dealt with, according to the plan.

Chapter 6 is the **Co-Design: Conceptualization** chapter, describing the process through which initial requirements, preferences and insights were gathered from stakeholders, in order to fuel the conceptualization process before development kicked off, presenting the methods and obtained results of this process, as well as a discussion regarding them and their contribution towards Emotion Rush's game concept.

Chapter 7 is the **Emotion Rush** chapter, presenting the game developed through the course of this dissertation, through a description of an overview of its gameplay flow, features, mechanics and Graphical User Interface (GUI), as well as the development process behind it, including assets and tools used, a development log of what was done in each sprint and some detail on its architecture.

Chapter 8 is the **Co-Design: Validation** chapter, detailing the procedures through which Emotion Rush was validated, their results and the conclusions reached with them regarding the latest version of Emotion Rush achieved during the course of the dissertation.

Chapter 9 is the **Conclusion and Future Work** chapter, where the work carried out over the course of this dissertation is summarized, as well as the conclusions taken from it. Future work to be done is also presented in this chapter.

Chapter 2

Background

This chapter consists on an overview of the key concepts related to the three main dimensions of this dissertation: RC contexts, ER and SG development.

In the first section, the concept of RC is explained in more detail, as well as the main challenges these contexts create and the role of attachment relationships in the lives of adolescents living in these institutions. Data is also presented regarding the specific situation of RC in Portugal.

The second section explains the concept of ER and expands on it with knowledge taken from the literature. It presents Paul Ekman's Model of Emotions -that defines seven universal emotions, as well as their triggers, signals, intensities and ways to deal with them - and James Gross' Process Model of ER - a theoretical model that explains Emotion Regulation processes -. two models that served as theoretical basis for this project, as well as detailing specific aspects of ER regarding adolescents, RC and digital interventions.

Finally, the last section gives a small overview on SG development, including some guidelines, frameworks and insights gathered through research.

2.1 Residential Care

RC is a protection measure that consists in having minors live under the care of an entity with human resources and permanent facilities to ensure them the care they need for their psycho-social development [14]. It is designed to be a temporary measure and can be caused by diverse situations related to the past familiar context of the individual, such as abandonment, parental neglect or abuse or lack of socioeconomic conditions [20].

2.1.1 The Challenges of Residential Care

There are plenty of factors that deeply impact the psycho-social development of adolescents in RC that do not apply to adolescents in familiar settings.

Institutionalized adolescents often come from backgrounds of neglect and abuse [21] and reveal difficulties in executive processes that lead to emotional and behavioral problems [22] [23]

that are often caused by harmful experiences prior to institutionalization [24]. Common difficulties are adapting to stressful, new or challenging situations and regulating one's behavior and emotional state, as well as identifying and understanding their feelings and sudden mood changes [22] [23] [25].

According to multiple studies, difficulties in ER are not equally common between genders, with female adolescents commonly having more problems regulating their emotional state and behavior than male adolescents [23] [26] [27].

When it comes to the meaningful relationships of institutionalized adolescents, it is important to take into account that there are situations where, despite adolescents being separated from their families, they still keep in contact with, at least, some of their relatives that might or might not have been their primary caregivers before their institutionalization [20]. In these situations, it is important to maintain a good articulation between the interactions with the adolescent's family and with the institution's caregivers from the start of the process, in order to ensure the development of secure and healthy relationships between the adolescent and both sides of their new life context [15] [20], as healthy relationships both with caregivers and the adolescent's family contribute positively to their well-being [13] [17] [24] [28].

At the same time, there are cases where siblings are institutionalized together in the same institution. On one side, the presence of siblings might make each of them feel safer and more secure in the new RC environment, allowing them to easily be more open to speak about feelings and emotions while also easing their adaptation to their new situation [14], also suggesting that adolescents in RC engage less frequently in rule-breaking behavior when in the same institution as siblings [29]. However, the presence of siblings may also lead to counterproductive situations towards the development of the adolescents, when there are situations of excessive dominance, rivalry, abuse or violence between them. In these situations, the quality and impacts of this relationship must be carefully analyzed and, in extreme cases, sibling separation might be necessary for a better development of both [14].

According to some studies [30], institutionalized adolescents not only have difficulty in regulating their attention, behavior and emotions, but also in understanding how their behavior might impact others around them. Adolescents also reveal difficulties in dealing with significant situational changes and to initiate tasks autonomously [26]. The literature also concluded a greater prevalence of behavioural problems in adolescents between 13 and 15 years of age [30].

Adolescents in RC are subjected to a higher emotional instability as relationships with peers and caregivers may constantly change and even abruptly end because of circumstances such as caregiver burnout, caregiver turnover or peers leaving the institution for diverse reasons, which contributes to difficulties in developing healthy long-lasting relationships [13] [17].

2.1.2 Residential Care in Portugal

In 2019, Portugal was one of the European countries with the highest prevalence rates of children and adolescents inserted in RC contexts, with 86.8% of the number of children and adolescents under protection and prevention measures being institutionalized [20].

According to the latest CASA report [31], referring to the year of 2022, there were 3,217 institutionalized adolescents, representing 50.69% of the cases of individuals in RC contexts in that period in the whole country. There was a raise of 19% in terms of the number of institutionalizations in comparison to the previous year, with the most common motive of institutionalization being neglect (71.5%), either through lack of supervision and family support, educational neglect or exposure to deviant parental models. At the same time, there was a raise of 2% in terms of the number of children and adolescents that left Residential Contexts, with the majority of these situations consisting in the return of the institutionalized individuals to their parents or other family members (63%) or in adoption (8%). The average time spent in Residential Care by an institutionalized individual is 3 years.

The aforementioned report also contains information obtained from questionnaires made to children and adolescents in RC contexts. It's worth noting that the questionnaires were also answered by individuals outside this project's targeted age group, but the results still contain important information regarding the way institutionalized individuals feel. About 28% of the 2380 inquired individuals declared they do not feel like they can speak with their caregivers about their day and their thoughts on school. Almost 23% also stated not feeling encouraged to share those thoughts and opinions with their caregivers.

The integration and adaptation to an RC context is a highly stressful process for the adolescents, that by themselves are already living a stressful phase of their lives, making it so that adolescent's well-being, even after only a few months of institutionalization, is highly unstable as their perception of well-being changes over time [17].

According to a 2019 study [26], adolescents in RC overall deal with more problems than adolescents in familiar contexts. At the same time, institutionalized adolescents are more involved in activities like sports, reading and playing games, as RC programs focus on incentivizing these types of activities after school hours. These activities lead to higher levels of resilience and lower chances of delinquent behaviors. These adolescents are also more involved in house-keeping tasks than adolescents living with their families, which reduces defiant and aggressive behavior. Adolescents in RC also report a higher number of close friends on average, giving them more value because of the absent or limited relationship with family members and other adults. This social network of close friends, however, might not provide exactly what these adolescents need, but as other studies point out, adolescents with better social support relationships, be it family, friends or peers, have better expectations for their own future and a better self-esteem and self-image [13] [32].

Most institutionalized adolescents lose contact with their siblings, normally because they end up living in different RC centers, which may prove problematic as contacts with siblings, parents and other significant adults reduces emotional and behavioral problems [26] [28].

The literature also points out different challenges depending on the adolescent's genre [27], with female adolescents reporting more frequently feeling a threatened emotional state or exhibiting behavioral or emotional problems [29] [26]. Some studies associated this with a smaller involvement of female adolescents in sports and other after school activities promoted by their in-

stitutions [21], while others emphasize the influence of Western culture, where men are expected to be emotionally controlled, dominant and aggressive while women are expected to be more emotionally expressive [33], which might have influenced the participants' answers to the self-report questionnaires. At the same time, male adolescents reportedly perceive caregiver support as lower than female adolescents, with their relationships with caregivers being more frequently marked by tension and conflict [33]. Therefore, these differences in the type of problems faced in RC and the characteristics of caregiver interaction and intervention must be considered in the development of new interventions for these adolescents [34].

2.1.3 Residential Care and Attachment Relationships

Based on John Bowlby's Attachment Theory, attachment is the willingness of human beings to develop affective bonds with others that evolve and extend over time [20] [35]. The establishment of these bonds is important in the development of humans throughout life and, despite the scarcity in studies, better relationships with caregivers positively impact the satisfaction of the adolescents in the RC environment while defining adolescent insecurity as a factor that decreases that feeling of satisfaction [16]. Other studies don't find this correlation but state that better relationships with caregivers are negatively correlated with the development of unhealthy relationships, even if that correlation is a low magnitude one [20]. The improvement of quality of the adolescent-caregiver relationship in RC contexts also leads to a raise in the adolescent's self-esteem [15].

2.1.3.1 Secure and Insecure Attachment Patterns

Attachment Relationships can be categorized into secure and insecure relationships. When it comes to relationships between an adolescent and a significant figure in their life, there are certain specific factors that influence the relationship into one of these two categories.

Secure Attachment Relationships are influenced and encouraged by the significant figure's ability of reacting adaptively and responsively to the necessities of the adolescent, showing sensitivity to cues and signals of their emotional state and making themselves emotionally available to support the adolescent, allowing them to explore the environment safely and contact their significant figure when needed [14] [27]. After all, adolescents that seek more proximity with their caregivers often report higher satisfaction on their relationship with them [16] and this proximity often leads to higher well-being, self-confidence and an increase in the perception of the institution as a safe space, which creates a better environment for the development of adaptive ER competences and skills [17] [33] [35].

Insecure Attachment Relationships between an adolescent and their significant figure are usually caused by inconsistency, unavailability, non-responsiveness and unpredictability in the responses of the significant figure to the necessities that are expressed by the adolescent, such as emotional support or validation [14]. This leads to the loss of trust in the exploration of the environment and difficulty in establishing future relationships with others [14] [16], as adolescents in

RC contexts tend to present insecure attachment patterns [36] and consequently more difficulties in ER [35].

While adolescents in familiar contexts are also exposed to secure and insecure attachment relationships, adolescents in RC go through a stressful adaptation process that adds to the overall stress they already go through in this developmental phase [17] [26] and their feelings of trust and safety towards the RC environment they live in positively impact healthy ER development [35].

2.1.3.2 The Role of the Adolescent-Caregiver Attachment Relationship

Adolescents in RC show preference for a significant figure who is calm, respectful and willing to listen [37]. The development of a close emotional relationship between the adolescent and their respective RC institution caregiver is associated with the adolescent's well-being and self-confidence [17] [33].

Considering that, as mentioned earlier, neglect is the most common motive of institutionalization in Portugal [31] and that caregivers in RC contexts often act as a second chance secure base for the adolescent that was removed from their familiar group setting [14], it's important for the attachment relationship between the adolescent and the caregiver to be a secure one [17], as the predominant attachment pattern in past relationships leads adolescents to model their current and future relationships based on it, creating expectations about themselves and others that influence their social development and skills [14] [15] [16] [17]. Literature also suggests that individuals in insecure attachment relationships in the past that go through a change after institutionalization present more adaptation difficulties than adolescents with an history of secure relationships [16].

One of the big challenges of RC contexts then resides on the high adolescent-caregiver ratio that reduces social interaction time between adolescents and their caregivers [16]. Studies also point that constant changes in personnel also contribute to the deterioration of adolescent-caregiver relationships [16] [37]. At the same time, there are situations where caregivers believe their role should focus mainly on the care of the adolescents in the institution, ignoring the core task that is behavioral change, as both cure and care are core dimensions of therapeutical RC [37]. However, there are also instances of studies that support the idea that the importance of the interaction between the caregiver and adolescent should be reinforced in natural daily interactions rather than only at therapeutical intervention moments [33].

2.2 Emotion Regulation

Emotions are responses for recurrent adaptive problems, triggered by many different factors such as scenarios where something important is directly at stake or is at least perceived like that after analysis [2] [11]. Sometimes, those emotions align themselves with the most adequate way to react to situations, but in other occasions, they may also influence individuals to react with behaviors that may be problematic or harmful towards themselves, others or both [2] [11]. However, emotions don't determine the way someone will react to those problems, despite influencing it, meaning that they and their influence can be regulated [2].

According to James Gross' definition, ER is the process through which an individual influences the emotions they have, when they have them and how they experience and express them [11] [12] [2]. In other words, an ER strategy is a strategy that an individual uses to deal with a specific emotion they experience, by influencing the way they feel it, when they feel it and how they behave when it happens.

The development of ER strategies is an important step in the psycho-social and psychological development of an individual and adolescence is a period in an individual's life where poor ER skills start becoming more evident through signals such as the development of disruptive behavior, development of psychological disorders or situations like school-age bullying [38] [39]. There are multiple factors in the life of an adolescent that impact their ER mechanisms and that might lead to the development of dysfunctional strategies to deal with emotions that lead to life-lasting consequences for an individual.

According to James Gross [2], it's important to understand three aspects of ER:

- ER is more than just decreasing or suppressing negative emotions when they arise. People often increase and decrease both positive and negative emotions.
- ER may happen consciously or unconsciously. An individual can, for example, consciously decide to change the topic of an upsetting conversation or, in another situation, may exaggerate happiness when receiving a gift they didn't want, without consciously doing it to regulate emotion.
- ER is not inherently good or bad on its own. While it can for example help medical professionals achieve better performance in procedures, it can also neutralize empathic distress in criminals. In the same way, not all ER strategies have positive effects.

James Gross also defends that ER is deeply related to the context of each individual, as different people differ in their life contexts, the emotions they experience and the ways they regulate them [11].

2.2.1 Paul Ekman's Model of Emotions

According to Paul Ekman, emotions are automatic processes that help individuals deal with important events without having to think about them. Individuals don't choose to feel emotions, they just happen automatically [40].

Paul Ekman says there are seven emotions all individuals feel and those are Anger, Contempt, Disgust, Enjoyment, Fear, Sadness and Surprise. While most studies support the existence of five of these as universal emotions, Paul Ekman adds Contempt and Surprise to his model. Each of these has different signals - such as facial and vocal expressions, sensations and postures-, timelines - starting with a trigger that leads to feeling an emotion and then to a reaction, like illustrated in **Figure 2.1** - and ways to deal with each of them. Each of these emotions can be felt with different intensities, like shown on **Figure 2.2**, that influence the ways people can react based on them [40] [1].

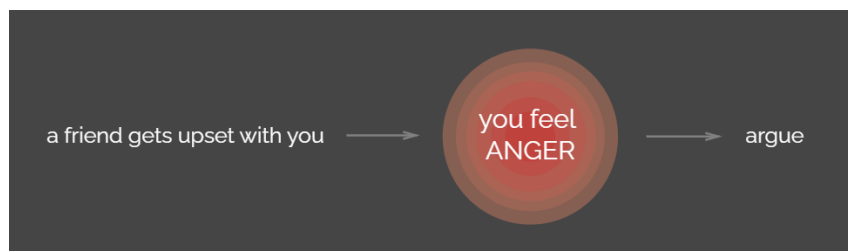


Figure 2.1: Example of an Anger Timeline [1]

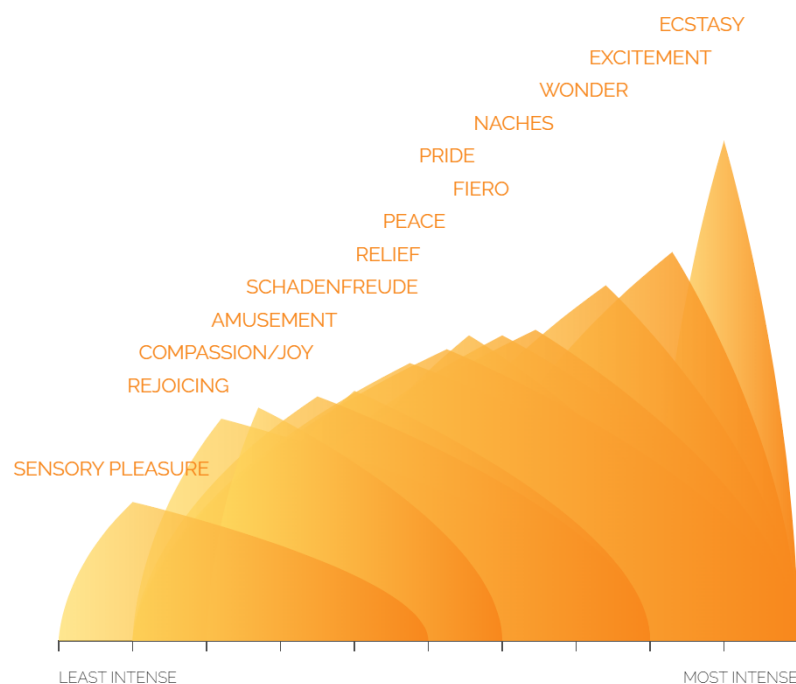


Figure 2.2: Different Enjoyment Intensities [1]

2.2.2 James Gross' Process Model of Emotion Regulation

The main problem in the study of ER is organizing the possibly limitless amount of ER strategies in a way that allows for a more rigorous study. James Gross' approach was the development of the process model represented by **Figure 2.3**, that will serve as a basis for this project's work [2].

This model is based on the idea that ER strategies can be differentiated based on the timeline of the emotional response to a specific situation. First off, there is a distinction between Antecedent-focused ER, that is, strategies that are used before the emotional response is fully activated and already changing an individual's behavior (i.e. seeing a school exam as a chance to self-assess knowledge on the subject, rather than just a pass-or-fail test), and Response-focused ER strategies, strategies that are applied once the emotional response has already changed one's behavior (i.e. avoiding displaying signs of nervousness or anxiety when speaking in public).

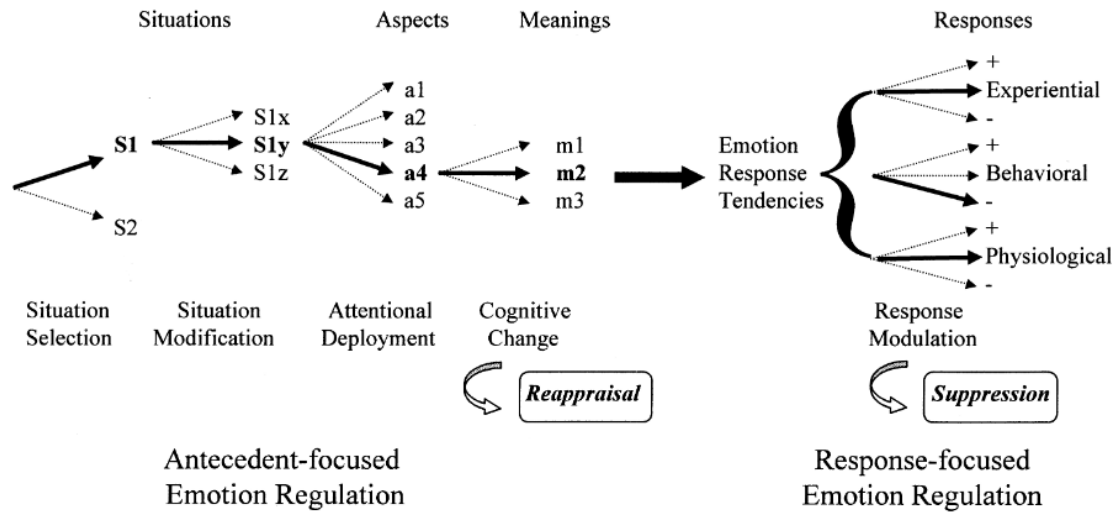


Figure 2.3: James Gross' ER Process Model [2]

Strategies can also be separated in five more specific groups: Situation Selection, Situation Modification, Attentional Deployment, Cognitive Change and Response Modulation.

Situation Selection strategies involve approaching or avoiding certain people, places or things with the intent to regulate emotion (i. e. choosing to hang out with a friend that makes one laugh before an important exam instead of studying with other nervous students). These strategies often involve choosing between short-term and long-term emotional benefits.

Situation Modification strategies involve adjusting the situation that was selected in the previous step of the model in order to modify its emotional impact (i.e. asking the friend one decided to hang out with to avoid speaking about the exam). Once again, impacts of different modifications to the situation selected previously might have better or worse short-term and long-term emotional benefits.

Attentional Deployment strategies are associated with the aspects of the situation selected before the individual decides to focus on (i. e. distracting oneself from an upsetting conversation topic by looking at what's playing on the TV). This type of strategy can either consist on distracting oneself from certain aspects of the selected situation or deciding to focus more on certain aspects, in order to solve a problem, either concentrating intensely or ruminating on it.

Cognitive Change refers to which possible meaning an individual attaches to the aspects they decided to focus on on the previous step (i.e. deciding to think about an exam as "only a test" and not a measure of worth), being frequently used to reduce emotional responses but also allowing to increase that response or even change the emotion itself, being profoundly related to the personal meaning the situation has for the individual.

Finally, **Response Modulation** is related to influencing the emotional response after it activates, using ER strategies to deal with it and control the resultant behavior response coming from it [2].

It is important to take note that not all strategies described below are positive and healthy ER

strategies. Their mentions serve only for acquiring a better understanding of different conscious and unconscious ways that individuals regulate their emotions, independent of if they are benefic for their mental health or not.

2.2.2.1 Cognitive Reappraisal

Cognitive Reappraisal is a Cognitive Change strategy for reducing emotion that consists in thinking about a situation that would normally have a strong emotional impact in a calm, non-emotional way [2] [11] [41]. Studies suggest this strategy is capable of reducing the emotional expressive behavior associated with its response by reducing the strong emotional impact of a situation [2] [11].

2.2.2.2 Expressive Suppression

Expressive Suppression is a Response Modulation strategy that consists in inhibiting the expression of emotions through behavioral responses [2] [11] [42] [41]. Some studies suggest that emotionally inexpressive individuals have a tendency to be more reactive when compared to expressive individuals, because they suppress their emotions, while others support the idea that when people are instructed to suppress a certain emotion, they usually show less reactivity [2] [11].

2.2.2.3 Repression

Repression often appears as an unconscious attentional defense against unpleasant situations, sometimes involving the increase of attention to pleasant thoughts [11], which frames itself as an Attentional Deployment strategy. While individuals with repressive ER coping mechanisms report lower levels of anxiety and less frequent negative emotional experiences, literature suggests that repressors reveal increased physiological response to stressing situations, leading to the conclusion that suppressing emotion expression does not equate suppressing emotional experience.

2.2.2.4 Rumination

Rumination consists in consciously and intensively focusing one's attention on worries, problems or feelings associated to stressing situations to reduce depressive symptoms and feelings associated with those situations [11], which would be considered an Attentional Deployment strategy according to James Gross' Process Model of ER. However, this approach tends to have the opposite effect, normally making them last longer and worsening their long-term impact [11].

2.2.3 Emotion Regulation in Adolescents

The development of adaptive ER strategies in adolescents is associated with multiple dimensions regarding adolescent's well-being and their psycho social development [39].

First, the capacity of adaptively identifying emotions and controlling them are associated with a decrease in problems like exhaustion and burnout in school [42].

The literature suggests that past memories of safeness and well developed ER strategies have a protective effect against situations of self-harm and suicidal ideation in adolescents, pointing out that ER mechanisms strengthen the impact that positive memories have on preventing these problems on adolescents[43]. In a study conducted with all adolescents studying in the public education system in Azores, Portugal in 2023 [43], it was concluded that self-harm often happens as an obviously unhealthy ER mechanism, indicating low levels of adaptive ER, and that while male adolescents showed higher levels of self harm signals , female adolescents showed higher level of suicidal ideation [43]. The study also concluded that self-harm decreases as ER skills improve with age [43], which supports the idea that younger adolescents are more vulnerable to the consequences of unhealthy or underdeveloped ER strategies.

Supporting the evidence reviewed regarding attachment relationships, the literature presents evidence that maternal behaviors such as punishing or silencing expressions of overjoy or other strong emotions lead either to internal struggles like anxiety and depression or to problematic externalizations like aggression [44]. This occurrence was more significant for boys and this might be caused by the fact that mothers report speaking about emotions with their daughters more frequently than with their sons [44], which may once again be related to the influence of Western culture in reinforcing the idea that men should appear more emotionally controlled and women are expected to express their emotions more frequently [33].

2.2.4 Emotion Regulation in Adolescents in Residential Care

Based on a study conducted over a span of 10 years in Switzerland in a sample of adolescents in RC contexts [45], the dysregulation of feelings of anger and irritation leads to adjustment problems and the externalization of those problems through aggressive or otherwise problematic behaviors. Younger participants at the start of the study were the ones with more ER difficulties and behavioral problems at the end of the ten year period. This proves that the promotion of ER skills in adolescence is crucial for the better development of adolescents in RC contexts and that younger institutionalized adolescents may be at bigger risk and normally reveal more ER difficulties [29] and thus should be motivated and supported to improve their ER competences as early as possible.

Age of institutionalization and length of institutionalization are not directly related to negative impacts of the life in RC contexts, as no correlation has been found in the majority of studies contained in the literature and, when found, it is contradictory from study to study [36]. These inconsistencies may be due to differences in the quality of care of each institution [36]. This is supported by the fact that earlier institutionalized children and adolescents that went through few or none transitions from one institution to another present higher well-being [17], which points out that multiple placement moves have higher negative impact in these adolescents than the length of time placed in a single institution [24].

Certain studies point to a higher emotional closeness between adolescents with ER problems and caregivers, which might be explained by the fact that caregivers will focus their attention on adolescents that they perceive as needing more help in the development of their ER competences [36]. However, the literature also suggests that the quality of caregiver-adolescent relationships

not only leads to an increased feeling of safety in the RC environment, but also leads to the development of healthy ER mechanisms [35].

Some studies point out the importance of cognition in the process of ER, based on the fact that adolescents that are less capable of identifying their emotions have more trouble developing trust, bonding or communicating with their peers.[34]. As mentioned before, the quality of relationships with caregivers impact the development of the adolescent's ER strategies and may lead them to creating healthy or unhealthy ER mechanisms, depending on the attachment style of the relationships, as they are the closest to a parental relationship that these adolescents usually have [14] [15] [16] [17].

A 2019 Australian study [46] suggests that adolescents in RC are more likely to develop problematic eating habits, with the more common ones being overeating and hoarding food, and that the development of ER competences and the development of secure attachment relationships made managing these eating problems easier for caregivers.

2.2.5 Digital Emotion Regulation

With technological and Human-Computer Interaction (HCI) advancements in the last two decades, different forms of traditional entertainment and leisure shifted to digital media, leading to the creation of a vast amount of applications that created emotional impact in users. With the creation of smartphones, digital content, as it is the case of videogames, have become easily and rapidly accessible for basically everyone around the globe [47].

The literature supports the theory that games provide a safe and controlled environment for players to express their emotions, while they learn their own ways of coping with them [48]. As these games involve problem solving and decision making, they aid the cognitive restructuring of players, helping them moving away from unhealthy ER mechanisms [48].

2.3 Serious Game Development

As mentioned before, Serious Games are games developed with an educational intent, prioritizing the development of certain competences on players over generating entertainment for them [12]. Multiple studies support the theory that videogames are more appealing than other approaches for younger audiences, allowing for more motivating interventions in children and adolescents [49] [50] [9] [18], with some studies even suggesting that the interactivity factor is often what makes these approaches more effective in younger audiences [51].

Following the research process of this dissertation, a set of different guidelines for the development of the serious game were reviewed, based on the available literature on serious game development.

2.3.1 Game Development and Validation Methodologies

In a systematic review published in 2019 [52], Sara Verschueren proposed a theory-driven evidence-based framework for developing serious games for health, defending that these games should be iteratively developed following a user-centered or participatory approach and involving different stakeholders [49].

Verschueren also defends the need to conduct trials and quality evaluations to test serious games in different development phases and also the publishing of these studies in order to support the development process of other serious games in the future [52]. Verschueren's framework [52] also points out the importance of defining the foundations of the serious game before the development, dividing development in different steps:

- **Step 1 - Scientific Foundations:** Who is the target audience? What outcome needs to be achieved? How can it be achieved through a serious game? How can we evaluate if the serious game achieved this outcome?
- **Step 2 - Design Foundations:** Which game mechanics are better suited to achieve the intended outcome? What are the design requirements? How can the game design be adapted for the evaluation trial?
- **Step 3 - Game Development:** What will be the game genre, rules, content and visuals? Which tools are going to be used?
- **Step 4 - Game Evaluation:** After the final version of the game is ready, the game can now be formally evaluated.
- **Step 5 - Implementation:** Based on the findings of the previous step, the game may be refined and results should be published to aid in the future development of other serious games.

Using Agile methodologies and SCRUM is also highly incentivized, despite there being no consensus on how to adapt it to a participatory approach to development [52].

Defining a framework from the start of the game's design process is also recommended, but there is no consensus among the community on which framework should be considered the standard approach to serious game design [49]. In the design and development process, it is also important to define a set of heuristics to use as a reference for the development state of the game [3]. **Figure 2.4** illustrates a set of heuristics for a mobile serious game, mentioned further in **Chapter 4: Other Serious Games for Adolescent Mental Health**.

2.3.2 Important Game Aspects

Some studies indicate that player immersion in the game significantly improves the user experience [50], thereby enhancing the possible impact that the game will have by captivating them to play for more time.

No	Game Usability Heuristics
GU_1	Audio-visual elements used in the game should be accepted by the players.
GU_2	Screen layout is visually comfortable.
GU_3	Device and game interfaces are used for their own.
GU_4	Indicators are visible and easy to spot.
GU_5	The player can understand the hints provided easily.
GU_6	Navigation through the game is logical.
GU_7	Control keys are easily accessible.
GU_8	Game controls are convenient and flexible.
GU_9	Feedback provided to players on specific actions are short and clear.
GU_{10}	The player cannot make irreversible errors.
GU_{11}	The player does not have to memorize things.
GU_{12}	Type of helps provided in the game is adequate to the level of the player.

Figure 2.4: Mobile Game Heuristics used in Qatar Diabetes Game development [3]

Researchers point narrative, game objectives, feedback and rewards, difficulty and interaction as the most important design elements of a serious game [49]. The literature also suggests that some serious games face the problem of not considering fun as an element in the design process, leading to lack of user interest in playing them [49] [3].

A dutch study from 2024 [4] explored the hexad approach to separating adolescent user profiles in terms of their preferences in gaming and, more specifically, serious games for health and adapted it to a separation in three categories, resulting on the three profiles illustrated in **Figure 2.5**.

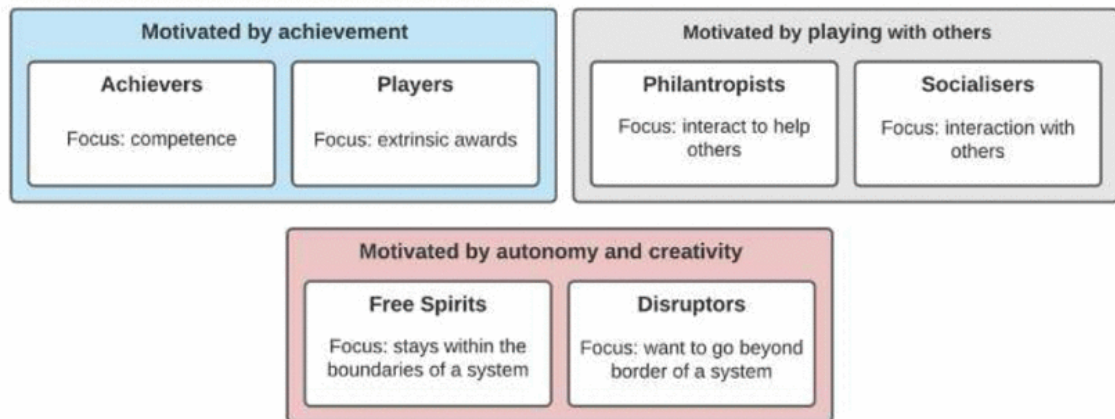


Figure 2.5: Serious Games for Health User Profiles [4]

While the Hexad approach separates users in six different types (Achievers, Players, Philantropists, Socialisers, Free Spirits and Disruptors), this study grouped them two by two according to their motivations when playing games, like illustrated in Figure 3.3, categorizing three different types of motivations for serious game for health players:

- **Achievement:** While Achievers are focusing on becoming better and more competent at the game, Players aim to obtain other extrinsic rewards that come from playing the game better but both are motivated to obtain a reward of some kind.

- **Playing with Others:** While Philantropists enjoy interacting with others to help them, Socialisers enjoy the social aspect of the game on its own but both are motivated to play because of that chance at social interaction.
- **Autonomy and Creativity:** While Free Spirits try to be creative with the mechanics and rules of the game while respecting its boundaries, Disruptors focus mainly on trying to go beyond those limits but both are motivated by their chance to be autonomous and creative in the game.

A study on translating educational information in the form of data to serious games [7] also suggests that when a large amount of data is to be presented, it is more appealing for the adolescents if the data is presented through mini-games, that is, sub-segments of the game with different mechanics or objectives. This study defends the importance of not overloading players with information, especially from younger audiences. This approach is not only used in educational games, but also in commercial games, in scenarios where the player has to make a task that would be too complicated and boring to do if the game replicated reality. The mini-games should be connected by some kind of logic or concept, in order to make them work as a set of mini-games inside a single serious game and not a set of small games presented in a platform that is treated like it is a game on its own.

In the case of games that focus on the replayability aspect, in order for the player to learn more the more they replay the game, it is suggested that depth and dynamicism are important, that is, the game must either contain a considerable volume of content or the content needs to be dynamic enough that the player can't just memorize it without understanding it and effectively learning what the game intends to teach [7].

Chapter 3

Systematic Review of Serious Games for Adolescent Emotion Regulation

This chapter presents the systematic review that served as a basis for the development of the Serious Game for promoting ER in adolescents in RC that was the main objective of this dissertation, synthesizing all the investigation and research made revolving around already existent games for promoting adolescent ER.

The first section contains a detailed description of the methodology through which the systematic review of Serious Games for Adolescent ER was conducted.

The second section presents the information extracted from this Systematic Review, including an analysis of each of the games present in the literature, as well as the conclusions taken from the review process.

3.1 Methodology

This systematic review followed a thorough and detailed methodology that is detailed below, based in the PRISMA protocol.

3.1.1 Search Query Formulation

As the main focus of this dissertation consisted on the development of a SG for promoting ER in adolescents in RC, it was considered important to research the literature in order to obtain the biggest amount of information on recently developed SG's for promoting ER in adolescents. For that purpose and in order to ensure more complete results, a systematic review on the topic was conducted to serve as a reference through development.

For this purpose, a single query was elaborated to be used in academical research databases:

(Serious Games OR Game-Based) AND (Adolescents OR Youth) AND (Emotion Regulation OR Emotional Regulation OR Emotion Dysregulation OR Emotional Dysregulation OR Emotion)

3.1.2 Search Strategy

After selecting and refining the query to be used in this research process, the three databases selected for researching these search queries were *IEEE Xplore*, selected with the intention of looking at the problem through the lens of engineering, paired with *Scopus* and *Springer*, for obtaining insight on health sciences, more specifically psychology. After defining some criteria for which retrieved documents would be relevant to this dissertation, some of them were already applied as filters to the research done in each database.

Generally speaking, research was restricted to documents published in the last 9 years and ordered by relevance. When possible, inclusion and exclusion criteria were already taken into account when filtering the results through the database search. The identification phase ended with 101 documents retrieved, with more detailed results specified in the table below:

Table 3.1: Identification Phase Outcomes

	<i>IEEE Xplore</i>	<i>Scopus</i>	<i>Springer</i>	Total
Number of Articles	10	19	72	101

3.1.3 Literature Screening and Selection

After the Identification phase, from the set of 101 documents retrieved from the three chosen databases, 95 unique documents were obtained after duplicates were removed.

After removing the duplicates from the set of documents retrieved from the databases, the 95 results were searched and examined, in order to remove irrelevant results from the set. Below are the criteria according to which this selection was done.

It is important to highlight that, when possible, the inclusion and exclusion criteria were also applied through filtering options on the three selected databases when possible, as explained below:

- ***IEEE Xplore*:** Articles were filtered by date (published between 2016 and 2025) with "Publication Topics" set as "Serious Games" and "Emotion Regulation".
- ***Scopus*:** Articles were filtered by date (published between 2016 and 2025) and language (english only), with "Keywords" set as "Serious Games", "Emotion Regulation" and "Adolescent" and "Document Type" set as "Conference Paper" and "Article".
- ***Springer*:** Articles were filtered by date (published between 2016 and 2025) and language (english only), with "Content Type" set as "Article" and "Conference Paper" and "Subjects" set as "Game Development" and "Game Studies".

3.1.3.1 Inclusion Criteria

As mentioned above, during the research process, some criteria was considered regarding which articles would be selected, consisting on five inclusion criteria. In this research, the objectives were to include research documents:

1. Published in English
2. Categorized as Articles or Conference Papers
3. Published between 2016 and 2025
4. About Serious Games or Game-Based Approaches for Adolescent Emotion Regulation
5. With access to full-text available

3.1.3.2 Exclusion Criteria

In order to filter out some unwanted results from the resulting literature after applying the inclusion criteria, three exclusion criteria were defined. Therefore, the research excluded documents:

1. Presenting systematic reviews of the topic
2. Presenting physical board games
3. Presenting exergames

From the 95 documents retrieved from the screening phase, 12 were kept according to these criteria.

3.1.4 Literature Characteristics

After gathering the available literature on SG's for adolescent ER, the obtained data was analyzed, in order to best understand the data available to work with. First, **Figure 3.1** describes and synthesizes the whole literature review process:

The bar plot in **Figure 3.2** describes the distribution of the literature documents along the years of publication. The articles are evenly scattered through the 9 year interval, suggesting that the obtained literature reflects this interval without a significant bias towards a specific section of this time period.

3.2 Results

After the whole research process, the resulting literature for this systematic review was carefully reviewed and analyzed, leading to the results presented in the section below, that contributed a lot to the development process. First, the methodology through which this comparative analysis

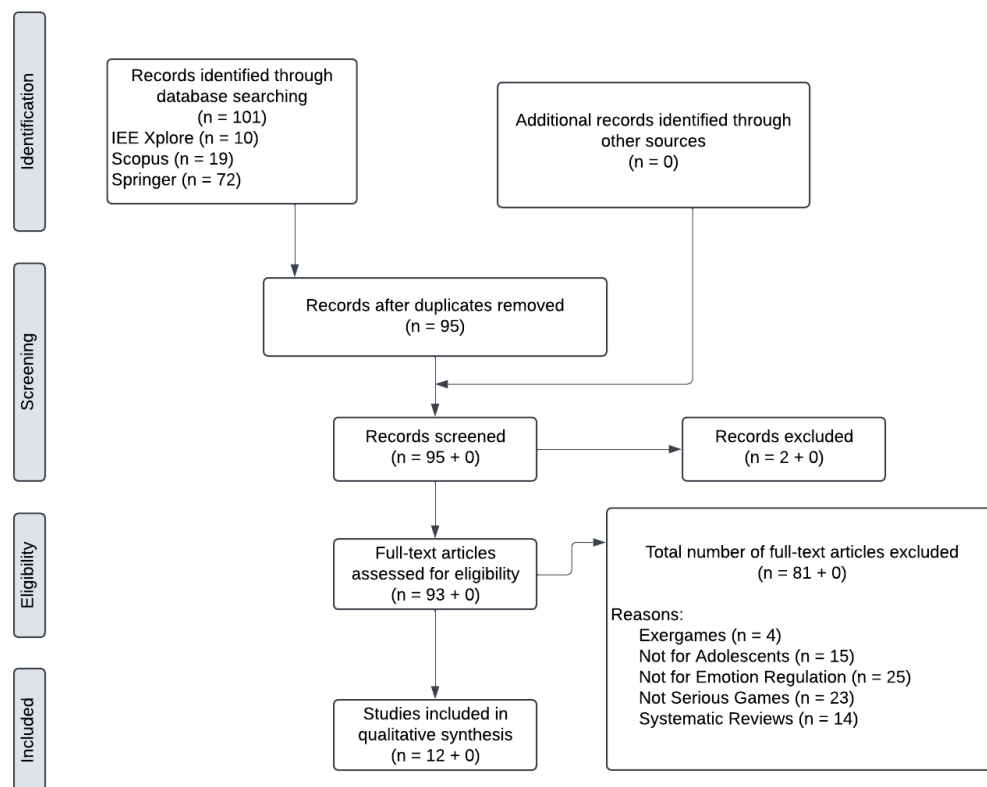


Figure 3.1: Diagram Synthesizing the Systematic Review Process

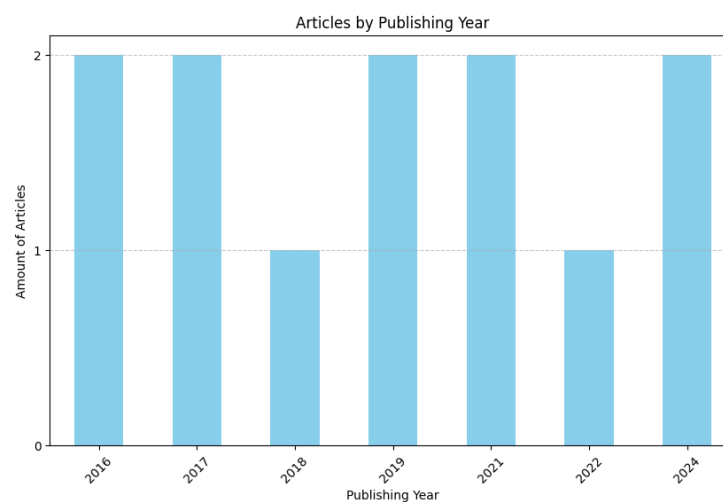


Figure 3.2: Articles per Publishing Year

was done is described, listing the key characteristics that were analyzed in all the games in order to allow for a rigorous comparison between them. Afterwards, all the games that were analyzed from the literature gathered in this systematic review process are listed and described with as many details as possible, using the information gathered from the articles obtained in this systematic

review process. Lastly, this section provides a comparative game analysis, where the results and conclusions of this review process are presented.

3.2.1 Serious Game Characteristics

For researching and analyzing the SG examples available in the literature and use them as reference for the development of a serious game for promoting ER among institutionalized adolescents, a specific analysis methodology was defined previously. With that objective, the gathered information on each game consisted in:

- Name, Genre and Target Audience
- Platform and Additional Equipment Required
- Development Tools and Methodologies Used
- Features, Mechanics and Gameplay Flow
- Intent of the Game

In some situations, some of these parameters were not publicly available and thus will be considered as Not Defined (ND) below.

3.2.2 Analyzed Games Breakdown

3.2.2.1 *Altruism/Antisocial*

Altruism/Antisocial [53] is a choice-based RPG where players have to make decisions on whether to accept or reject money offers where they benefit at the cost of decreasing the amount of money that would be donated to the Red Cross. The intent of the game is to study callous unemotional traits in male adolescents.

The game presents the players with multiple choice sequences where they are presented with how much money they will receive and how much money will be deducted from the Red Cross donation if they accept the money offer. Then the player selects the preferred option and is presented with the consequences of that choice, through seeing how much money they have and how much money will still be donated, before a new money offer is presented. There are three types of situations that test the players in this game: some situations were both the player and the Red Cross would win or lose money, where there is an obvious correct answer, to assess the attention of the player, some where the player is instead asked to determine who would benefit most from a given money offer and others where the player must choose based on the balance between his gain and Red Cross' loss. In each choice sequence, players have 5 seconds to analyze the offer and 1 second to choose either to accept it or reject it.

3.2.2.2 *EmoTIC*

EmoTIC [54] is a mobile adventure game developed for developing social-emotional competences in adolescents. The game was developed following a theoretical model, called the ability model of emotional intelligence.

In this game, the player is tasked with rebuilding a spaceship in order to return to Earth. *EmoTIC* was planned as a four week game-based intervention program. Each session would start with each player making an emotional self-examination and sharing it with other participants. Then, group dynamics were carried out according to the session's topic, followed by a group discussion. Finally, the teacher would finish the session with a summary of what was discussed. The participants would also receive three tasks to do at home. There is not much information available about how this session structure was integrated in the game or how exactly the game worked.

3.2.2.3 *GamEmotion*

GamEmotion [9] is a action-adventure 3D platformer game to promote ER skills in adolescents. The game was developed for computer and was based on Gross' Process Model of ER.

In *GamEmotion* [9], the player embarks in a journey through six castles that thematically represent Happiness, Sadness, Fear, Surprise, Anger and Disgust. The player can visit the castles in any other and, to progress, must explore them completely and complete the challenges and puzzles inside each one, that consist on identifying the emotion that each castle represents. There is a seventh bigger castle in the game, that will only be unlocked when all the six emotion castles are completed, where the player will face a quiz puzzle involving what they have learned so far. A book accessible by the player at any time keeps record of what the player has learned so far about the emotions, updating over time as the player progresses through the game.

Afterwards, the player finally manages to return to the spaceship where they are rewarded with learning one of two emotional regulation strategies they can choose from: Cognitive Reappraisal or Expressive Suppression. If they choose Cognitive Reappraisal, a sequence begins in a old and dark classroom, where the player is taught by the narrator how he can reanalyze the room in order to make it less frightening. As this happens, the room becomes more well lit and less scary. When the player chooses Expressive Suppression, a scene begins where a girl is bullying a clone of the player and the player is asked how they would react to this. Two buttons appear: one for reacting with anger and the other for suppressing anger. The game then shows the consequences of the chosen option.

3.2.2.4 *GT-System*

GT-System [55] (or *GameTeen System*) is a serious game for teaching ER for adolescents. The game is divided in two phases: a joy induction game and a breathing strategy game. In the first phase, the player is allowed to play a 3 minute sequence in a virtual amusement park, where balloons appear around the player and they have to pop as many as they can with different types

of ammunition. Feedback messages incentivizing the player appear every 30 seconds. After the 3 minute sequence, the player enters a breathing strategy game, through following the movements of a feather, to regulate their joy.

3.2.2.5 iER Adventure Game

This unnamed game [56] was developed in RPG Maker MV for 10-to-14-year-olds and consists in a single-player role-play and adventure game which has three different levels, connected by a hub world and was developed with the objective of teaching interpersonal ER skills. This game is played in a top-down perspective and is playable directly on a computer browser or in a phone. It was developed involving members of the target group through workshops, to include their feedback and ideas in the final result, while also considering available literature in the topic.

The player plays the role of a pupil, having to rescue students from their school after skipping a day due to being sick. To do that, the player must interact with the students NPC's (Non-Playable Characters) that they find along the way using coping mechanisms to help them deal with their own emotions. At the same time, players also interact with NPC's that aid them, giving them guidance on how to deal with those emotions.

The player can only progress by choosing the correct interactions to aid the NPC's in dealing with their emotions throughout the game, receiving different types of feedback such as sounds playing and pictures appearing to signal correct and incorrect approaches, NPC reactions to the interactions and rewards and achievements.

3.2.2.6 JeStiMule

JeStiMule [57] is a computer game for developing emotion recognition skills in children and young adolescents with Autism Spectrum Disorder (ASD), based on Plutchick's emotional wheel, comprising six basic emotions (happiness, anger, disgust, fear, sadness and surprise), a complex emotion (pain) and two complementary emotions (neutral and "funny face"). The emotions were associated with colors based on the emotional wheel.

Each *JeStiMule* game session had three phases. The first phase consisted on a tactile calibration phase where the game was adjusted according to the player's previously assessed sensory tactile profile. The second phase was the learning phase, where the player faced three levels, where they were supposed to identify the emotions displayed to them through faces, gestures and verbal or non-verbal codes. These levels increased in difficulty, firstly showing emotions through faces, a visual non-verbal code and a specific tactile stimulation, secondly combining them with gestures and, lastly, combining them with a verbal written code. The last phase was a training phase where the player's knowledge was tested in three modules.

3.2.2.7 RETHink

RETHink [5] [58] [59] [60] is a game developed for iOS for the promotion of ER competences in children and adolescents aged 9 to 16 years old.

In the game, the players control *RETMAN* and his friends on a quest to help people on Earth against a villain named *Irrationalizer* and his followers. *RETMAN*'s friends are representations of rational beliefs: *Preferilizer* (preference beliefs), *Ponderancer* (non-awfulizing beliefs), *Toleraser* (high frustration beliefs), *Acceptableizer* (unconditional acceptance beliefs) and *Optimizer* (happiness). The followers of *Irrationalizer* represent irrational beliefs: *Necessitizer* (demandingness beliefs), *Awfulizer* (awfulizing beliefs), *Frustralizer* (low frustration tolerance beliefs) and *Discourager* (global evaluation beliefs). The game counts with seven levels focusing on different aspects of the REBT model and in different parts of the Earth:

- **Level 1:** Emotion Identification and Differentiation. Basic, Complex, Functional and Dysfunctional Emotions
- **Level 2:** Cognitive Process Identification
- **Level 3:** Relation between Cognitive Processes, Emotions and Behavioral Reactions
- **Level 4:** Turning irrational cognitions into rational cognitions
- **Level 5:** Problem Solving Skills
- **Level 6:** Relaxation Skills
- **Level 7:** Skill Consolidation and Building Happiness Skills

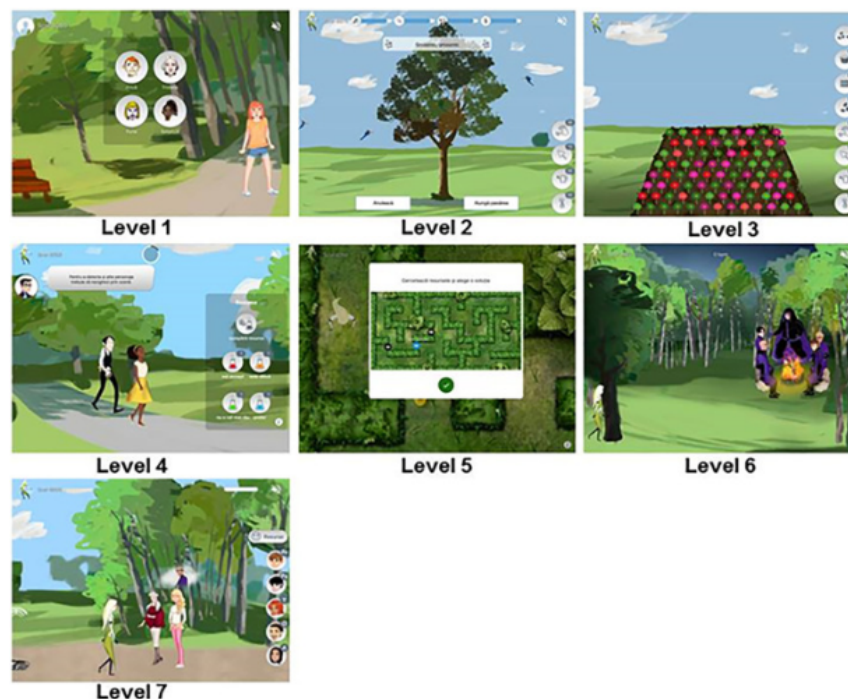


Figure 3.3: *REThink* Levels [5]

RETMAN introduces the player to each level, its objectives and a short training section before starting the actual level gameplay. Player performance was tracked in real time and players would

have to restart the level or sublevel if they made too many wrong actions throughout the level or at least too many wrong actions in a short amount of time. The player only gets the key to the next level once they complete the previous one.

3.2.2.8 Unnamed Emotion Elicitation Game

Unnamed Emotion Elicitation Game [61] is a mobile RPG for eliciting emotions in adolescents with ASD regarding socio-economic and trust based decision-making scenarios. It was developed based on Game Theory paradigms.

The player controls Joe, a character who has to perform daily tasks through interaction with NPC's and using limited resources (money, health and food) to satisfy the Overlord. Throughout the game, the player is confronted with socio-economic trust based choice sequences such as borrowing money from someone rude or being rewarded after helping a stranger. After each interaction, NPC's indicate the next location for the player to go and players can also use a navigation map to locate themselves. The player only concludes a level by reaching the end of it with at least two of the three resources above certain values. After each interaction, players are presented with a self-report prompt where they must select what they are feeling from six options: Happy, Surprise, Sad, Angry, Fear, and Disgust.

3.2.2.9 World of Emotions

World of Emotions [62] is a digital tabletop board game for teaching emotion recognition and self-regulation for adolescents. The game is played with 8 to 12 players and was developed for Windows operative system.

The players are divided into teams of a maximum of 6 players each. Each team is represented by a colored token in the tabletop and teams take turns rolling dices and moving their tokens. The representative team member to roll the dice rotates each turn and depending on where the token ends up moving, the team representative must solve a task that can be answering a question about emotions or listening to a fact about it. The first team to visit the 6 emotion sectors and complete all 6 emotion tasks wins. Everytime a team representative fails one of the tasks, the team token is sent back to the starting position.

3.2.3 Comparative Analysis

After an in-depth breakdown of each of the 9 analyzed games in this systematic review, these games were thus compared and analyzed side-by-side, which allowed to take some conclusions about SG's for adolescent ER in general.

Near half of these games followed a co-design approach ($n = 4$), some of them combining it with theory-driven methodologies ($n = 2$). In general, these SG's often use a theory model as a basis for development ($n = 6$). There was little detail regarding development methodologies, so it is hard to determine if these games have or not used iterative approaches. Despite involving or not

co-design approaches, all of these games were subjected to some form of usability tests ($n = 9$). These characteristics are illustrated in **Table 3.2**.

Table 3.2: Serious Games for Adolescent ER Development Methodologies

	Co-Design	Theory-Driven	Iterative
<i>Altruism/Antisocial</i> [53]	ND	Yes	ND
<i>EmoTIC</i> [54]	ND	Yes	ND
<i>GamEmotion</i> [9]	Yes	Yes	ND
<i>GT-System</i> [55]	ND	ND	ND
<i>iER Game</i> [56]	Yes	Yes	ND
<i>JeStiMulE</i> [57]	ND	Yes	ND
Unnamed Emotion Elicitation Game [61]	Yes	ND	ND
<i>REThink</i> [5] [58] [59] [42]	ND	Yes	ND
World of Emotions [62]	Yes	No	No

Regarding platforms, Personal Computers (PC) are the most popular ($n = 6$), followed by Mobile ($n = 3$). VR games are not as common, but some cases were also found ($n = 1$).

There isn't much information regarding engines and other technologies used in the development of these games, with Unity ($n = 1$) and RPG Maker MV ($n = 2$) being the ones identified in some cases. There's a approximately equal amount of 2D games ($n = 5$) and 3D games ($n = 4$).

Platforms and technologies are detailed in **Table 6.2**.

Table 3.3: Serious Games for Adolescent ER Platforms and Technologies

	Platforms	Engine	Graphics
<i>Altruism/Antisocial</i> [53]	PC	ND	2D
<i>EmoTIC</i> [54]	Mobile	ND	3D
<i>GamEmotion</i> [9]	PC	Unity	3D
<i>GT-System</i> [55]	VR	ND	3D
<i>iER Game</i> [56]	PC	RPG Maker MV	2D
<i>JeStiMulE</i> [57]	PC	ND	2D
Unnamed Emotion Elicitation Game [61]	Mobile	ND	3D
<i>REThink</i> [5] [58] [59] [42]	Mobile,PC	RPG Maker MV	2D
World of Emotions [62]	PC (Windows)	ND	2D

The most common game genres among SG's for adolescent ER are adventure ($n = 4$) and Role-Playing games (RPG) ($n = 3$), with a case where both genres are combined ($n = 1$). There is also a significant amount of arcade games ($n = 2$).

The games vary vastly in terms of features and mechanics. In terms of structure, the majority of these games follow a level structure ($n = 5$), where the game is divided into multiple stages where the players use the same mechanics and features to play. There's also a case of a game that is structured like a set of minigames ($n = 1$), that is, mechanically different stages that almost seem like different games inside the same game's context.

Some games present their content linearly ($n = 5$), that is, in an order that is not controlled by the player, while others are non-linear, allowing the player to choose which contents to explore next ($n = 2$). Some games integrate choices as a central game mechanic ($n = 2$), making them impactful in the game's context, while others make use of UI elements to guide the player, such as

navigation maps ($n = 1$) or documents that update themselves with useful information throughout the game, as the player progresses ($n = 1$). One of the games also includes a tutorial ($n = 1$) to explain users how to play.

The vast majority of analyzed games are single-player ($n = 8$), despite sometimes being network connected for technical purposes. There is only an instance of a multiplayer game, that functions as a local co-op team game ($n = 1$). At least one game from the set collects data through the game ($n = 1$) and through self-report prompts that appear to the player during the game session ($n = 1$).

The two most common mechanics in these games are NPC Interaction ($n = 3$), quizzes ($n = 2$) and reward systems ($n = 2$), reinforcing the importance of player immersion and positive reinforcement of learning with the game and using healthy ER strategies while playing. Some other mechanics included timed challenges ($n = 1$), puzzles ($n = 1$) and emotion induction ($n = 1$), that is, provoking a specific emotion on players before teaching them to regulate it.

Regarding dynamic camera perspectives, there is at least a case of first-person view ($n = 1$) and a case of top-down perspective ($n = 1$).

All the characteristics above are synthesized in **Table 3.4**.

Table 3.4: Serious Games for Adolescent ER Game Genres and Mechanics

	Genre	Features/Mechanics
<i>Altruism/Antisocial</i> [53]	RPG	Choices, Levels, Linear, Single-Player, Timed
<i>EmoTIC</i> [54]	Adventure	ND
<i>GamEmotion</i> [9]	Action, Adventure, Platformer	Documents, Levels, Non-Linear, NPC Interaction, Puzzles, Single-Player
<i>GT-System</i> [55]	Arcade	Emotion Induction, Linear, Minigames, Single-Player
<i>iER Game</i> [56]	Adventure, RPG	Levels, NPC Interaction, Rewards, Single-Player, Top-Down Perspective
<i>JeStiMulE</i> [57]	Arcade	Levels, Linear, Quiz, Single-Player
<i>REThink</i> [5] [58] [59] [42]	Adventure	Levels, Linear, Rewards, Single-Player, Tutorial
Unnamed Emotion Elicitation Game [61]	RPG	Choices, First-Person, In-Game Data Collection, Levels, Linear, Navigation Map, NPC Interaction, Self-Reports, Single-Player
World of Emotions [62]	Tabletop	Customization, Local Co-Op, Multiplayer, Non-Linear, Quiz, Single-Player

About the state of the literature in terms of serious games and serious game development, no records about other serious games developed for promoting ER in adolescents in RC were found.

During this research, it was also noted that articles about SG's for adolescent ER often lack useful information for future analysis and development reference, particularly regarding technologies and development methodologies used or, sometimes, a clear description of their gameplay flow. These conditions made this comparative analysis harder and limited the conclusions to be taken from it.

3.2.4 Discussion

While multiple games didn't describe development methodologies in big detail, if any, the games that did show a clear preference for Co-Design and Theory-Driven approaches, which indicates that basing the serious game on a theoretical model and designing it together with adolescents in RC and healthcare professionals would prove beneficial to this Emotion Rush's development. While multiple games did not provide detailed accounts of their development processes, those that did highlighted the use of iterative methodologies such as Agile and SCRUM.

Regarding platforms, while most analyzed SG's are developed for PC, it is necessary to take into account that these games were not developed with adolescents in RC contexts in mind. Therefore, the selection of the platform for this SG cannot be based solely on previously developed SG's, but must also take into account the particular characteristics of RC contexts, especially the institution where usability tests will be carried out. This decision required additional data from stakeholders, obtained later throughout the project.

RPG's and adventure games being the most common emphasize the importance of narrative elements and world interaction for enhancing the immersion of the players, making them more engaged in the game, which also raises its impacts on the adolescents. The prominence of Arcade games also suggests that replayability may be an important aspect to raise effectiveness of the SG.

SG's for Adolescent ER seem to prioritize linear structures where players face different situations using the same game mechanics, while having these situations be connected through some narrative context presented in the game. Once again, RPG's and adventure games usually adopt these structures, challenging players by confronting them with choices that change the course of the game. A tutorial sequence to explain the core mechanics of the game might also impact gameplay positively, depending on the designed mechanics.

Single player games are easier to implement and thus more popular for these interventions. They are also most likely easier to be used as such than a multiplayer game within RC contexts and the same seems to be true for SG's for ER of adolescents in general.

About the state of the literature in terms of serious games and serious game development, no records about other serious games developed for promoting ER in adolescents in RC were found. Additionally, the literature on SG's for adolescent ER in the last 9 years is pretty scarce. However, this systematic review allowed to understand what SG's for adolescent ER promotion already exist and what strategies were used to achieve these games, which surely provided useful insight for guiding the development process.

Chapter 4

Other Serious Games for Adolescent Mental Health

This chapter describes an additional scoping review conducted in order to obtain information on additional developed SG's for adolescent mental health, besides the already obtained games for adolescent ER, in order to gather a bigger reference base for development. This review was carried out in *IEEE Xplore*, *Scopus* and *Springer*, including articles from 2016 to 2025.

The first section presents the multiple analyzed SG's for adolescent mental health one by one, describing them and their characteristics in as much detail as possible, based on the researched data.

The second section of this chapter makes a comparative analysis of all the games analyzed in this chapter, drawing some conclusions from it.

It is worth mentioning that, in order to allow for comparisons between these serious games and the SG's for adolescent ER analyzed in the systematic review detailed in the **Chapter 3: Systematic Review of Serious Games for Adolescent Emotion Regulation**, this analysis process focused on the same characteristics as the comparative analysis made on the SG's for adolescent ER listed in that chapter.

4.1 Analyzed Games

In this section, all relevant information on researched serious games for health that targeted adolescents or that focused on the promotion and development of emotion regulation in other age groups. This information was taken as a reference to elements and mechanic that are frequently used in games targeting the same age group as this dissertation, regardless of the health practices being promoted by them, or that are frequently used in games regarding ER, regardless of the age group being targeted .

4.1.1 *Aquamorra*

Aquamorra [63] is a serious game for treating childhood obesity. It consists on an adventure game for mobile platforms that was developed in Unity's Game Engine, more specifically Unity2D. An iterative development methodology was adopted for the game development and members of the target audience were involved in the process.

In this game, the player plays the role of a human astronaut of customizable gender whose spaceship crashed into a planet named *Aquamorra*, that is inhabited by three competing families, and are now stuck in an escape capsule. The character can manipulate the surrounding environment to control the capsule through labyrinthic levels and eventually reach their spaceship, which they can control and use to further interact with the game world.

The spaceship can be upgraded as the game progresses, through a trade system, increasing the capacity of the player influencing and changing the game world around them. The game also contains a mood mechanic, allowing for three modes of interaction (open, protective and aggressive) while mood is high and locking the player in aggressive mode if mood is low. The game also has a friendship mechanic, altering NPC reactions and responses based on the interaction modes the player uses with each of the families. These relationships also effect the mood, raising it when positive and decreasing it when negative.

The spaceship requires oxygen to move and the player can obtain more oxygen through collecting green, yellow and red bubbles, representing three categories of food that give different amounts of oxygen to the ship. Green bubbles give small amounts of oxygen but increase mood, yellow bubbles give more oxygen and do not alter mood and red bubbles provide highest oxygen supplies but also significantly decrease mood. More oxygen can be obtained through quests.

The mechanics of the game are designed to convey the message that while eating can help the player regulate their mood temporarily, the long-term effects of binge-eating are negative.

4.1.2 *Barty*

Barty [64] is a mobile game developed for Android with the intent of fighting childhood obesity.

This game consists of three different challenges selected randomly when the player starts the game. The Grocery challenge consists in the player separating food shown in the game in three categories: red (to be avoided), yellow (to be eaten sometimes) and green (to be eaten frequently). The other two challenges, Breakfast and Lunch, consist in similar exercises where the player must select which types of food to eat and which types to avoid. As players get better playing the challenges, *Barty*, the game's mascot which is a carrot, will look happier and with a better looking color and sounds of victory are played everytime the player concludes a challenge correctly.

4.1.3 *ConCiencia Contra las Drogas*

ConCiencia Contra las Drogas [6] is a 3D role-playing game for computer, developed in the Unity Game Engine for 12-to-19-year-old adolescents and aiming to raise awareness about the consequences of substance use.

The game has six mini games and tells the story of Roberto, the character the player controls, is looking for a friend after school when he finds him near another boy who abandoned school. After that, he becomes involved in six different situations, represented by the mini games that give him new information about substance use and the player has to use this information to help his schoolmates avoid these situations. At the end, Roberto reveals the identity of the boy that abandoned school. During the game, a character named Professor X guides the player through tutorial sessions explained how each mini game works. After completing each mini game, the player will only be able to proceed if they score high enough and, even then, they will have the option to replay the game to try and improve their score. The mini-games consist on interacting with characters around the school and applying the information about substance use that is presented by Professor X to the player.



Figure 4.1: *ConCiencia Contra las Drogas* Gameplay Screenshot [6]

4.1.4 DECIDIX

DECIDIX [65] is a narrative game developed for 11-to-19-year-old adolescents with the objective of promoting healthy sexual and reproductive practices, aiming to raise awareness on the topics of affective relationships and unplanned pregnancies.

The game simulates a messaging application where the adolescent is contacted by other characters in the game and has to choose how to respond to their messages, with those choices effecting the outcome of the story. At the end of the game, players get a suggestion to replay the game and try to achieve a different ending for it. The game achieves a certain degree with immersion with the players, not only by simulating a messaging app, but also by being accurate in the way the adolescent characters in the story speak and act, making the experience more impactful for users.

4.1.5 Dumb Driver

Dumb Driver [66] is a simulation game for adolescents, developed for computer with the intent of raising awareness about the dangers of drinking and drunk driving.

In the game, the players have to drive a car while they go through pit stops. In those pit stops, an alcoholic drink is randomly selected from a spinning wheel and the player character has to drink it, before being sent to drive again towards the next pit stop. The objective of the game is driving while the drinks take effect and make controlling the car harder, while avoiding the obstacles on the road. If the player hits enough obstacles, the game comes to an end, as the car stops and the police arrives on the spot.

4.1.6 Express Cooking Train

Express Cooking Train [67] is a roguelike cooking game with puzzle mechanics following a theory-driven design approach and using the Game Maker Studio platform for Windows and Android. The objective of the serious game is the development of nutrition and food literacy skills.

In this game, the player controls a train in a post apocalyptic setting and must cook meals for the monsters that will attack the train if food is not launched at them to distract them. The user performance is evaluated by the cooking methods and ingredients used to make the food, representing how healthy the resulting dish is. The game counts with upgrade mechanics for the kitchen and train, allowing for more cooking options and for progressing through more advanced parts of the game. By progressing, players gain new recipes and new upgrades, raise their score and explore the game world.

4.1.7 Friendly Attac

Friendly Attac [68] is a narrative game developed for adolescents to avoid bystander behavior in cyberbullying. This game followed a user-centered design, involving adolescents in different development phases through their feedback and preferences.

The game tells a story about a hate page created on a social media website in order to post pictures of members of the same school as the character the player controls and calling them ugly. The player character is then sent to the past to speak with students using positive bystander behavior towards cyberbullying and getting the hate page removed from the web. Throughout the game, the player character can walk around the school and interact with NPC's by checking their recent activity on the website and choosing between four options of reactions to it. The posts would also have likes and dislikes, signaling the opinion of other NPC's on the post. The posts found could be either neutral behaviors, moderate or severe forms of cyberbullying and the game would go on until a number of cyberbullying interactions were correctly or incorrectly handled, by presenting the player with a message telling them if they had succeeded or not. Afterwards, a feedback section would show information about the options the player picked and the correct ones. This game is played in first-person perspective and the player character is customizable.

4.1.8 *OutSMART*

OutSMART [19] is a web-based computer choice-based narrative game built using Unity WebGL for educating adolescents on cancer. It was developed following a co-design approach.

It consists on a first-person game where players play the role of an adolescent and face three scenarios, relative to breast, colon and lung cancers. Players interact with the game by making choices that move the story along, completing scene after scene until the end. For example, one of the scenarios involves the player character discovering that their mother has breast cancer and going to the doctor with her, while learning more about the disease.

4.1.9 *Perfect Pour*

Perfect Pour [66] is a computer game for adolescents to incentivize drinking moderation.

In this game, players are instructed to pour different types of alcoholic drinks by pressing their spacebar, with the goal of achieving 100% pouring accuracy. Messages appear on screen when players overpour or underpour the drink.

4.1.10 *PlayForward*

PlayForward [69] is a role-playing game for teaching adolescents about sexual risk, substance use and other risk behaviors in adolescence. The development process involved healthcare professionals, commercial and serious game designers and adolescents and followed an iterative approach.

The game consisted on a set of 5 minigames and 12 different challenges involving the player controlling their virtual character through middle and high school by making choices that affect their future and being able to see how those decisions affect the hopes and dreams they defined for their future when they first created their character.

4.1.11 *PEGASO's Game*

This game [7] is a serious game for 14-to-16-year-olds to promote a healthier lifestyle. The game was developed using Unity and is combined with PEGASO, a platform of services for teaching nutritional learning to adolescents.

In this game, the player has a day-night cycle, having to play 4 mini-games to collect about 3,000 different food cards and use them to upgrade abilities during the day and using those abilities during the night to fight off waves of zombies. The game also separates food cards in low, medium and high levels depending on nutritional aspects of the food and as an Energy mechanic, where the player spends energy upgrading and has to use certain aspects of the game to recover said energy. The four minigames are:

- **Research:** In this mini-game, the player combines a food type and a recipe to upgrade specific character abilities. Depending on the combination, the rank of the upgrade may be higher or lower. The nutritional information of cards is hidden, but the player can expend energy to reveal it.

- **Hacking:** In this mini-game, the player searches for crates around the world and has to answer a nutrition themed quiz to hack them and obtain new abilities. Energy is expended with each crate that is opened.
- **Bartering:** This mini-game consists on a quiz similar to the Hacking mini-game that is initiated through interactions with NPC's around the game world and that gives the player Food Cards.
- **Scavenging:** This mini-game is a icon-matching game similar to "Candy Crush Saga" where the icons are food groups and the player obtains food from the groups they match, to make them play strategically thinking on which foods they need the most at each moment.

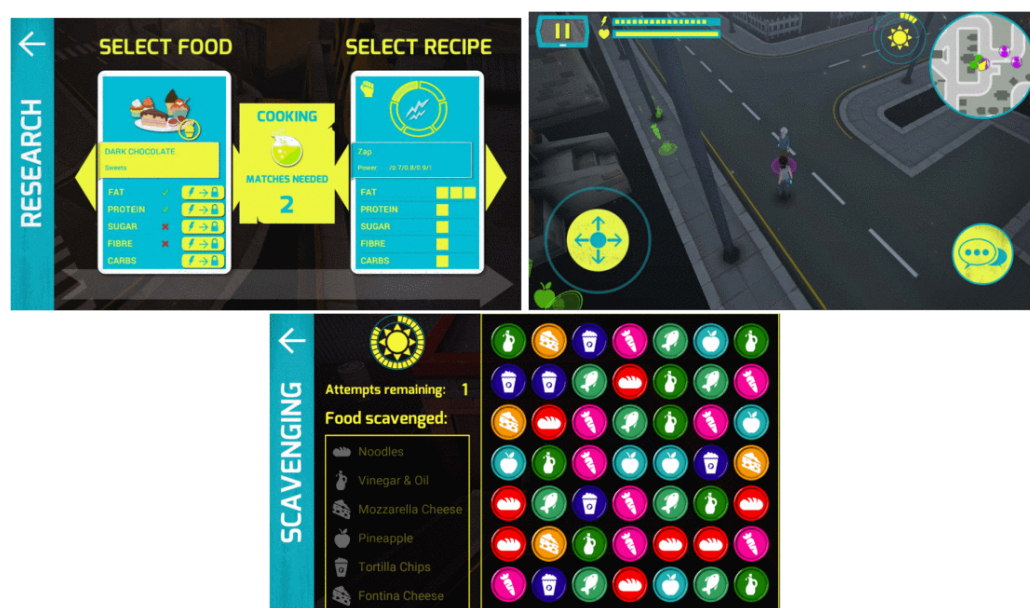


Figure 4.2: Research, Hacking and Scavenging Mini-Games [7]

4.1.12 Pure Rush

Pure Rush [70] is a mobile platform game for 14-to-16-year-olds, developed with the intent of promoting drug education. This game not only involved the target audience and health professionals in the development process but also involved consultation with a game development company. It was developed for Android.

The objective of the game is to arrive at a music festival before tickets sell out. Players are able to select between a female and male character and have to traverse the platformer levels, picking power-ups and avoiding obstacles that represent different types of drugs, that when picked have negative effects on the character and make them lose health points. When drug obstacles are avoided, reinforcing messages appear on the screen.

4.1.13 Silver

Silver [8] is a game developed for 12-to-16-year-olds with the intent to tackle cognitive vulnerability in this age group. The game was developed using a user-centered approach, involving target users and healthcare professionals in the development process.

The game takes place in 3 different worlds inhabited by anthropomorphic animals where different game chapters can be played. The game always starts with an animal character stuck in their own mind, described as a "glitch". The player watches a flashback of the incident before the "glitch", that represents relatable difficult situations in adolescence. Then, the player sees the character's thoughts and has to decide for each one if it is an helpful thought or not, considering the situation. If the choices are correct, the unhelpful thoughts are destroyed by little robots and the helpful thoughts are sent to the animal's mind. When the animal accumulates enough helpful thoughts, it gets freed from the "glitch", completing the chapter. As the game progresses, the player also has to discover the type of cognitive distortion each unhelpful thought represents, making the game more difficult.

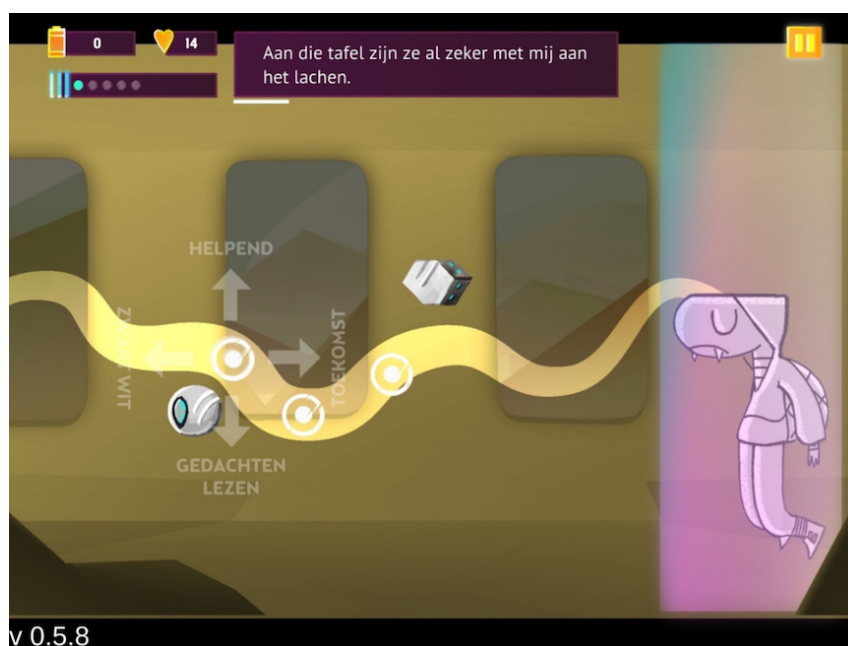


Figure 4.3: Silver Thought Classification Mechanic [8]

4.1.14 Stigma Stop

Stigma Stop [71] is a game for adolescents that intends to reduce the stigma associated with mental health and mental illness.

Throughout the game, the player interacts with four characters that are experiencing different psychological disorders in order to work together with them in a video game contest. The player will be given choices to deal with each character as they present behaviors that are common on their specific disorders. At first, the player will have to choose what they think is the best option,

but as the game progresses, the player will receive information that will help them making better decisions in future game choices. The game also requires the player to answer questions about if they think they are capable of helping the characters or if they ever felt like them. As the player concludes the interactions with a character, a mini-game is unlocked that gives additional information about mental health.

4.1.15 The Messenger

The Messenger [72] is a mystery game developed using a theory-driven approach, by reviewing literature on the subject and involving studies with adolescents, educators and parents to understand bystander behavior towards cyberbullying. The game was developed using the Intervention Mapping Protocol.

In the game, the player controls the son of Barbara West, a journalist who was killed by a cyberterrorist before being able to unveil the identity of the cyberterrorist. The player character's father, Professor West, creates a time machine in order to go back in time and save Barbara, but when the player and the professor use the time machine, the player ends up being sent 30 years to the past to her mother's school, realizing this place is related to the cyberterrorist and having to save her mother and solve the mystery of the cyberterrorist on their own, by preventing the cyberterrorist of becoming one in the past.

4.1.16 Qatar Diabetes Game (QDG)

Qatar Diabetes Game (QDG) [3] is a mobile arcade game developed following a user-centered design where the player controls Abood, a diabetic man, having to move him to the left and to the right by touching the screen in order to catch food and insulin injections falling from the sky. The different types of food will effect Abood's blood sugar level differently. The game has no winning condition, so the player can keep playing until they loose all their lives by failing to regulate Abood's blood sugar level with insulin or by making him eat too much unhealthy food, making the main goal of the game reaching the highest score possible to compete with other players, which forces the player to replay the game and learn which food options are healthier to increase their score.

4.1.17 Untitled Game for Obsessive-Compulsive Disorders Therapy

This game [73] is a puzzle virtual reality game developed with the Unity Game Engine, requiring an headset with camera tracking and two wireless controllers, with the intent of supporting therapy for people with obsessive-compulsive disorders. Healthcare professionals were involved in the development of the game, in order to better translate the necessities of the target audience into game mechanics.

This game takes place on an apartment where players can interact with different puzzles that help them de-ritualize compulsions of different types such as order and symmetry, cleaning and contamination, doubt and verification and taboos. These puzzles put players in situations where

they have to perform tasks that can possibly trigger their anxiety and their compulsions, in order to achieve success in the game. For example, one of the puzzles involves ordering cups in the kitchen in the order specified by the TV that is not the size order, while other involves organizing books of different colors in shelves of varying colors, in a way that the books are not in the corresponding shelves. An objective board was used to conduct the players throughout the tasks, as the game was intended to be used during timed therapy sessions.

4.2 Comparative Serious Game Analysis

The analysis of these SG's for adolescent mental health has lead to multiple important conclusions that will serve as guides towards the development of the serious game that was the main focus of this dissertation.

As shown in **Table 4.1**, more than half of these games ($n = 15$) were developed through a co-design approach. Theory-driven approaches, while not as much used ($n = 4$), were sometimes combined with this development methodology ($n = 3$), proving that it is possible to combine information available in the literature with feedback from users to achieve a better final outcome. Many games do not detail their development methodologies, but, in some case ($n = 2$), iterative approaches were used.

Table 4.1: Development Methodologies

	Co-Design	Theory-Driven	Iterative
<i>Aquamorra</i> [63]	Yes	Yes	Yes
<i>Barty</i> [64]	Yes	ND	ND
<i>ConCiencia Contra Las Drogas</i> [6]	Yes	ND	ND
<i>DECIDIX</i> [65]	Yes	ND	ND
<i>Dumb Driver</i> [66]	Yes	ND	ND
<i>Express Cooking Train</i> [67]	Yes	Yes	ND
<i>Friendly Attac</i> [68]	Yes	ND	ND
<i>OutSMART</i> [19]	Yes	ND	ND
<i>Perfect Pour</i> [66]	Yes	ND	ND
<i>PlayForward</i> [69]	Yes	ND	Yes
<i>PEGASO's Game</i> [7]	ND	Yes	ND
<i>Pure Rush</i> [70]	Yes	ND	ND
<i>Silver</i> [8]	Yes	ND	ND
<i>Stigma Stop</i> [71]	ND	ND	ND
<i>The Messenger</i> [72]	Yes	Yes	ND
<i>Qatar Diabetes Game</i> [3]	ND	ND	ND
<i>Untitled OCD Game</i> [73]	Yes	ND	ND

When it comes to technologies used for these games, like shown in **Table 4.2** some of them were developed for being played in personal computers (PC's) ($n = 5$), others were developed for mobile ($n = 7$) and a small amount of them was developed for VR ($n = 1$). Unity is the most frequently used game engine ($n = 5$) and there are approximately the same amount of 2D ($n = 4$) and 3D ($n = 3$) games in the sample. It's worth noting, once again, that many articles do not specify these characteristics, making it harder to analyze and compare them.

Table 4.2: Platforms and Technologies

	Platforms	Engine	Graphics
<i>Aquamorra</i> [63]	Mobile	Unity	2D
<i>Barty</i> [64]	Mobile	ND	ND
<i>ConCiencia Contra Las Drogas</i> [6]	PC	Unity	3D
<i>DECIDIX</i> [65]	ND	ND	ND
<i>Dumb Driver</i> [66]	PC	ND	ND
<i>Express Cooking Train</i> [67]	Mobile, PC	Game Maker Studio	2D
<i>Friendly Attac</i> [68]	ND	ND	ND
<i>OutSMART</i> [19]	PC	Unity	ND
<i>Perfect Pour</i> [66]	PC	ND	ND
<i>PlayForward</i> [69]	ND	ND	ND
<i>PEGASO's Game</i> [7]	Mobile	Unity	3D
<i>Pure Rush</i> [70]	Mobile	ND	ND
<i>Silver</i> [8]	ND	ND	2D
<i>Stigma Stop</i> [71]	ND	ND	ND
<i>The Messenger</i> [72]	ND	ND	ND
<i>Qatar Diabetes Game</i> [3]	Mobile	ND	2D
<i>Untitled OCD Game</i> [73]	VR	Unity	3D

In terms of game genre and mechanics, there is a big diversity of genres used for serious games and a big diversity of features and mechanics that can be found in them. The most common game genres are narrative ($n = 6$), RPG ($n = 4$) and arcade ($n = 3$).

When it comes to features and mechanics, some studied games follow a level structure ($n = 4$), where they separate the content through different phases of increasing difficulty but similar mechanics the player has to progress through, or a minigame structure ($n = 5$), where they have different small games with different mechanics that the player can interact, connected through a bigger context explained inside the game.

Some of the analyzed games are linear ($n = 5$), that is, present content in an order that can't be altered by the player through interaction, while others take a non-linear approach ($n = 4$), changing the order of presented contents depending on the player's actions and decisions in-game.

A lot of games rely on NPC interaction ($n = 8$), Customization options ($n = 3$) or Choices ($n = 9$) as gameplay mechanics, which once again emphasizes the idea that role-playing a character and making decisions as they get players more immersed and interested in the game. Some games

also use Rewards ($n = 3$) or Scoring systems ($n = 3$) as ways to boost engagement and player enjoyment, with some combining them with Trade System mechanics ($n = 3$) to incentivize the player to try their best to gain rewards and spend them in in-game items or upgrades, in order to make them keep playing in order to obtain more and more resources to progress.

These characteristics are synthesized in **Table 4.3**.

Table 4.3: Game Genres and Mechanics

	Genre	Features/Mechanics
<i>Aquamorra</i> [63]	Adventure, RPG	Choices, Collectibles, Customization, Levels, Non-Linear, NPC Interaction, Rewards, Trade System
<i>Barty</i> [64]	Arcade	Item Organization, Linear, Minigames
<i>ConCiencia Contra Las Drogas</i> [6]	RPG	Minigames, NPC Interaction, Tutorial
<i>DECIDIX</i> [65]	Narrative, Simulation	Choices, Non-Linear, NPC Interaction
<i>Dumb Driver</i> [66]	Endless Runner	Linear, Random Generation
<i>Express Cooking Train</i> [67]	Puzzle, Roguelike	Combat, Choices, Exploration, Reward, Trade System, Scoring
<i>Friendly Attac</i> [68]	Narrative, RPG	Choices, Customization, First-Person, Non-Linear, NPC Interaction
<i>OutSMART</i> [19]	Narrative	Choices, First-Person, Levels, NPC Interaction
<i>Perfect Pour</i> [66]	Arcade	Linear, Scoring
<i>PlayForward</i> [69]	RPG	Choices, Minigames
<i>PEGASO's Game</i> [7]	Survival	Minigames, Non-Linear, Rewards, Trade System
<i>Pure Rush</i> [70]	Platformer	Collectibles, Customization, Linear, Health Points
<i>Silver</i> [8]	Narrative	Choices, Levels, NPC Interaction
<i>Stigma Stop</i> [71]	Narrative	Choices, NPC Interaction
<i>The Messenger</i> [72]	Mistery	ND
<i>Qatar Diabetes Game</i> [3]	Arcade	Collectibles, Linear
<i>Untitled OCD Game</i> [73]	Puzzle	Linear, Minigames

4.3 Discussion

Once again, Co-Design and Theory-Driven approaches seem to be highly incentivized for the development of SG's for adolescents. Development processes are not frequently presented in much detail, but the few cases that do seem to also follow iterative approaches like Agile and SCRUM.

Comparatively to the SG's for Adolescent ER, the prominence of RPG's, adventure games and arcade games did not change, which once again emphasizes the importance of narrative context and replayability in these SG's, as well as player immersion, boosted through mechanics like NPC interaction and choice-based mechanics.

However, some of these games seem to deviate from the level structure that was most commonly encountered in SG's for Adolescent ER towards a more modular approach, presenting multiple minigames connected by a single game hub to the players. While linearity is still common in these games, there is a higher prominence of non-linear games, which suggests non-linearity is also a viable structure for development. At the same time, these SG's also highlight other effective approaches such as reward and trade systems, as well as scoring, suggesting the effectiveness of positive reinforcement in teaching the player.

The literature on SG's for health promotion in adolescence obviously proves itself significantly richer than the literature on SG's for adolescent ER, but the games are once again presented in a non-standardized way, with some documents omitting important information such as game platforms, technologies and methodologies used or even game mechanics and features, making it difficult to compare them and use them as references for the development of a new serious game for adolescents. Still, the gathered information was still significantly useful towards decision making regarding Emotion Rush's design and development.

Chapter 5

Solution Proposal

This chapter presents in detail how the final objectives of this dissertation were accomplished and what solution was proposed after research was carried out.

The first section of this chapter presents the overall solution that was initially proposed after the research described in previous chapters.

The second section details the co-design process that was planned out to support development and how this co-design process ended up being carried out in comparison to the original plan.

The third section presents the full dissertation development plan in big detail, as it was devised initially and as it was then carried out.

The last section presents foreseen limitations and obstacles that could impact the work plan and what mitigations were also thought of to deal with those possibilities.

5.1 Solution Definition

This dissertation aimed for the development of a serious game for adolescents in RC contexts that promotes ER development. After reviewing the available literature, it was concluded that there is no public knowledge of serious games developed with this same goal for the same target audience. There is a shortage of serious games for adolescents in RC, and as these adolescents are exposed to a very particular and complex reality that can damage their ER skills and have life-lasting consequences for them, it's important to create solutions to educate them towards healthy ER mechanisms. As the literature also proves, games are an appealing format for adolescents and thus are a good approach for the goals of this dissertation.

As the literature points out many SG's developed for health promotion in adolescents adopt a Co-Design approach, this was also the approach used in this dissertation, by having healthcare professionals and institutionalized adolescents contribute with feedback for improving the design and conceptualization of the game in different phases of its development. Their involvement was planned through questionnaires, interview processes and demonstration sessions that are explained in more detail in the following sections of this chapter.

The expected outcomes of this dissertation were not only Emotion Rush, the fully developed SG for ER promotion in adolescents in RC institutions, but also the full documentation about its development, the co-design interventions that took place and what conclusions were taken from those, and the perceived effects of adolescents before and after playing the game for a week, as well as the feedback from both adolescents and healthcare professionals. More than just developing a SG for the ER development of institutionalized adolescents, this dissertation aimed to compile all methodologies used and results obtained in the research, development and co-design processes in order to aid future investigation developed in this area.

5.2 Research Process

This section describes in detail how the research process for this dissertation was initially planned, after the initial research presented in the previous chapters.

5.2.1 Research Context and Population

The studies involving institutionalized adolescents were planned to be carried out in a RC institution for adolescents. The study was designed to be carried out for adolescents between 12 and 18-years-old, which corresponds to the target audience initially planned for the serious game.

The healthcare professionals involved in the studies would be part of a convenience sample, formed of professionals already in collaboration with other projects in LIACC, contacted via email.

The research process was planned in four phases, detailed below:

- **Phase 1 - Requirements Specification:** Before the development process, 12-to-18-year-olds from an RC institution would be interviewed in order to understand their preferences regarding videogames and their reality, in order to gather data to aid in the initial conceptualization of the serious game.
- **Phase 2 - Conceptualization Feedback:** After deciding on the game concept, healthcare professionals would be involved in a second interview process, in order to adjust the concept and ensure it was adequate and correctly translates the important aspects of ER promotion in adolescents.
- **Phase 3 - Demonstration with Test Version:** A demonstration version of the game would be made available for both adolescents at the collaborating institution and healthcare professionals and their experience and feedback regarding the current state of the game. This feedback would be used to make adjustments, correct bugs and further improve the experience of the final version of the game.
- **Phase 4 - Final Version Validation:** The final version of the game would be made available to adolescents at the collaborating institution and to healthcare professionals and a usability test would be conducted over the course of a week, in order to assess possible positive or

negative effects the game might have had on the users. If possible and necessary, adjustments would be done to correct performance issues and bugs after this final test.

5.2.2 Data Collection, Instruments and Ethics

For gathering information from participants, the methods used would be interview processes and questionnaires while participants played the game, as well as observing them while they played.

Questionnaires, interview scripts and informed assent and consent forms were sent to the ethics committee, in order to obtain permission for their realization.

Participants were never asked to identify themselves throughout the studies, all data gathered on them was anonymized and kept in a safe device, protected by a password only known to the dissertation's investigators.

5.3 Development Plan

This section presents the carried out development plan for the whole dissertation development process, from coding and research to scientific dissemination and dissertation document development. First, the overall development plan for the whole dissertation is presented in a Gantt chart and then, each diagram activity is described in more detail.

The Gantt chart with the overall development plan is presented in the next page. Each activity on the chart is described in more detail below. The activities were separated by the three dimensions of the work to be carried out:

- **Dissertation Document Writing:** The elaboration of this document for the whole duration of this dissertation.
- **Emotion Rush's Development:** Development process of the serious game itself.
- **Research:** Research studies with adolescents and healthcare professionals and processing data gathered through them including both the co-design process and usability testing procedures.

5.3.0.1 Dissertation Document Writing Activities

This dimension reflected each of the parts of the dissertation document that were worked from this point until the conclusion of the dissertation, lasting the whole rest of the dissertation process and resulting in the complete dissertation document. The production of this document was broken down in smaller and simpler activities, in order for more detailed and organized planning. The activities in this dimension are, as follows:

- **Development Log:** This activity would consist on keeping a consistent register of what was developed in each sprint of development, to present a clear development timeline in the end of the dissertation, compiling the whole development process. Thus, the deliverable

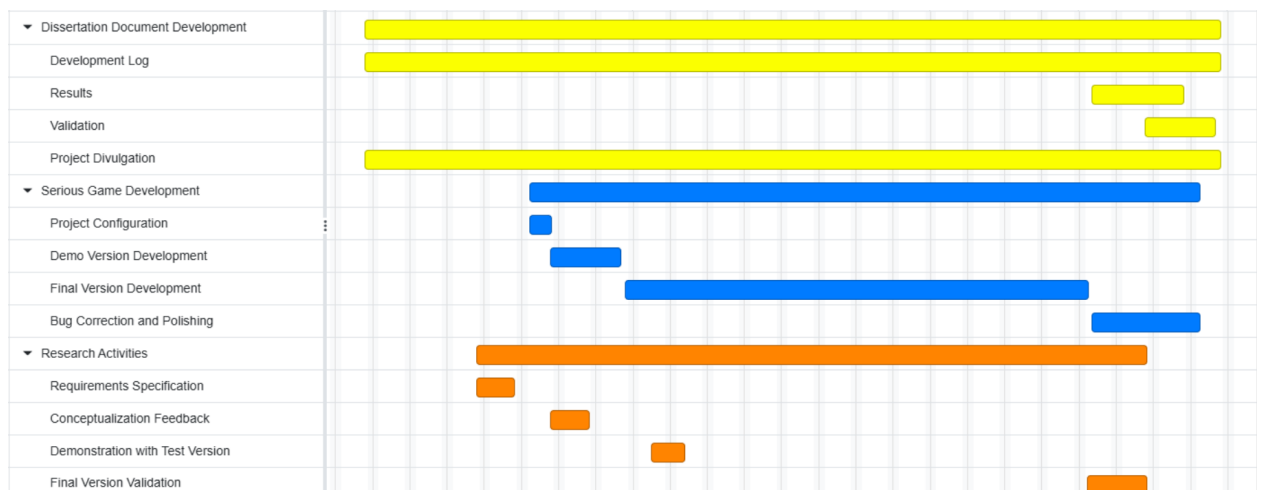


Figure 5.1: Development Plan Gantt Chart

associated with this activity would be part of a chapter dedicated to synthesizing the whole development process throughout time, resulting in a section of **Chapter 7 : Emotion Rush**.

- **Results:** This activity would consist on writing descriptions about the game overview, features and architecture after it was developed over the course of the dissertation. This activity would be started shortly before the development process is over, as the results could be described and presented before the game was completely polished. This activity's deliverable resulted in **Chapter 7 : Emotion Rush**.
- **Validation:** This activity would consist on writing about the results of the validation process of the game, all conclusions taken from it and any possible problems, adjustments and corrections made after it. This activity's deliverable resulted in **Chapter 8 : Co-Design: Validation**.
- **Project Divulgence:** This activity would consist on publishing the carried out work and divulging the project on national and international conferences, namely serious games conferences during the remaining time until the conclusion of the project. From this activity resulted as deliverables all documents that are published and used to divulge the project, as detailed in **Chapter 9: Conclusion and Future Work**.

5.3.0.2 Serious Game Development

This dimension reflected the development of the serious game that was the main objective of this dissertation. As observed in the previous chapter, many serious games developed for health promotion in adolescents adopt a Co-Design approach and, as studies pointed out in the literature, Agile methodologies like SCRUM and other iterative approaches are highly incentivized for Co-Design approaches [52].

Considering the literature and the fact that previous games developed for the project this dissertation is inserted in have used Co-Design approaches paired with iterative frameworks, the serious

game developed in this dissertation followed a co-design approach combined with SCRUM, with each sprint having two weeks.

The development process is presented below, split in multiple activities for easier comprehension and better organization:

- **Project Configuration:** This activity would consist on configuring the project for initiating development and making sure the chosen tech stack was working accordingly. It would be considered the Sprint 0 of Emotion Rush, lasting only one week and having as a deliverable a blank project, ready for the **Demo Version Development**.
- **Demo Version Development:** This activity would be the Sprint 1 of the development process, aimed to have a first basic prototype of the game ready for testing with adolescents in the **Demonstration with Test Version** activity, in order to gain some feedback on adjustments for the final version. The deliverable for this activity would be the demo version of the game, which would serve as a basis for the **Final Version Development** activity.
- **Final Version Development:** This activity comprised Sprints 2 to 8 and consists on the development of the final version of the game, which will take into account the feedback obtained from the **Demonstration with Test Version** activity and prior Research activities. The deliverable for this activity would be the final version of the game to be used in the **Final Version Validation** activity.
- **Bug Correction and Polishing:** This activity would consist on making the final adjustments and correcting any problems encountered in the **Final Version Validation** activity, as well as polishing the game as well as possible. The activity would have the definitive final version as its deliverable.

5.3.1 Research Activities

This dimension comprises any activities related to the studies that are going to be realized for the elaboration of this dissertation, involving institutionalized adolescents and healthcare professionals that are interested to participate. This process was broken into smaller activities for organizational purposes:

- **Requirements Specification:** This activity would consist on the realization of an interview process with 12-to-18-year-olds from the selected RC institution to understand their preferences in videogames and the reality they live in. This activity would also comprise a small time period after the interview process, in order for the data gathered from the study to be processed and integrated into the dissertation work. This activity's deliverable would be the data registered from the interviews, organized for future reference during development.
- **Conceptualization Feedback:** This activity would consist on consulting healthcare professionals to obtain their feedback and guidance on the initial game concept, created based on

the results from the **Requirements Specification** activity. This activity would also comprise a small time period after the interview process, to organize, process and integrate the gathered data into the dissertation work. This activity's deliverable would be the organized obtained data to use as a reference during development.

- **Demonstration with Test Version:** This activity would consist on making demonstration sessions with adolescents and healthcare professionals, in order for them to test the demo version of the game created in the **Demo Version Development** activity and observing and registering their experience with the demo. This activity would also comprise a short period of time to, once again, organize the data gathered from this phase of the study and integrate it into the dissertation work, to use as future reference.
- **Final Version Validation:** This activity would consist on having adolescents and healthcare professionals try the final game version out for a week and filling a set of questionnaires before and after playing, to take conclusions about how the game effects the audience. This activity would also comprise additional time to compile this information and integrate it into the dissertation work, to use as a reference.

5.4 Limitations and Mitigation Plans

This section compiles all foreseen limitations for the solution proposed, as well as mitigation plans for those same limitations. These limitations and mitigations were defined before the development process took place.

5.4.1 Development Delays and Scheduling Adjustments

The chance of any of the phases of development becoming delayed because of difficulties encountered when developing the serious game was foreseen from the beginning. For that reason, multiple adjustments were planned for mitigating the impact of said delays, as detailed below:

- **Project Configuration:** As highly unlikely as this phase was to cause delays, tools could be configured as they were needed on the project.
- **Demo Version Development:** Depending on what's determined as necessary to be in this version, the phase for demo development could need to include additional sprints that would be reduced from the final version development phase. This would also mean that the **Demonstration with Test Version** activity would have to be delayed and possibly rescheduled.
- **Final Version Development:** As this phase takes the biggest amount of time from the development process and is one of the latter, delays occurring in this phase of development would lead to cutting less priority content, to focus on delivering a complete game, even if it has less options and features than initially planned.

- **Bug Correction and Polishing:** While being relatively shorter and simpler, this phase would only involve solving problems that heavily impact the game experience negatively and polishing aspects that are possible to improve in the available time.

5.4.2 Research Study Scheduling Problems

One foreseen limitation was the possibility of problems when scheduling the four study phases for the co-design development process, namely only being able to schedule some or all studies later than planned or being unable to realize part of the studies for some unforeseen circumstance. The mitigation plan for impossibility or delay of each study phase was:

- **Requirements Specification:** To avoid delaying the beginning of the development process, if this study couldn't be scheduled in the planned period, it would be canceled and the initial game concept would be defined based on the information compiled in the State of the Art chapter, combined with an interview process with healthcare professionals that aims for gathering requirements for the game. **Conceptualization Feedbacks** could thus be canceled, as healthcare professionals would already be involved in the conceptualization process in this phase.
- **Conceptualization Feedbacks:** To reduce the chance of scheduling problems, this phase of the study would be done through online conference, allowing for more flexibility and convenience for the participants. If, even like that, scheduling with all participants in the defined period proved impossible, participants that couldn't contribute with their feedback in this moment can contribute later, when validating the SG.
- **Demonstration with Test Version:** As this phase of the study was particularly important to be realized in person, for allowing observation of participants, once again the study would be realized only with the adolescents and healthcare professionals that are available during the defined period, only being delayed if there are no participants available. If that is the case, additional discussed content that is implemented in the meantime would be added to this version of the game, in order to make sure no development time is wasted. In case development was delayed at this point or the scheduling was not possible, this phase could be canceled and focus would shift towards the development of the Final Version.
- **Final Version Validation:** As the usability test was of big importance for the realization of this dissertation, if previous study phases proved difficult to schedule, the best approach would be to have a final version of the game available as soon as possible and start scheduling the validation period as fast as possible. If more time is necessary, the time period for participants to test the game can also be reduced or, if the game is stable and doesn't present many technical problems, this study could be postponed to the time period for bug correction and fixes, if it is really necessary. Additionally, if no permission for this study was given from the ethics committee, usability testing could be done solely with healthcare

professionals in a convenience sample, through interviews regarding their experience and feedback.

5.5 Research and Development Adjustments

This section details the adjustments that had to be done to the initially devised plan based on the limitations encountered throughout the project, based on the foreseen limitations and planned mitigations and the decisions made at the time they arose.

5.5.1 Adjustments to the Research Process

When the research process was planned, an institution for carrying out the studies was already selected, as explained previously. Despite having interview scripts for requirements specification, questionnaires for usability testing, the informed consent and assent forms for the adolescents and the institution and the project documentation ready and sent to the ethics committee since early December of 2024, no response was obtained up until March, when it was concluded that waiting any further for the co-design procedure to be authorized would significantly delay development, so the co-design procedure had to be carried out without adolescent participation, as detailed further in this chapter. Further down the process, after development was initiated, there was still no response from the ethics committee, which led to the adjustment of the plan for the usability tests, that only involved healthcare professionals. Because of this, testing with adolescents in RC had to be moved into Future Work.

The healthcare professionals contacted for the conceptualization and usability testing phases were part of a convenience sample made of healthcare professionals that have previously collaborated with other projects in LIACC. Considering the found limitations, the contact with these professionals was crucial for Emotion Rush's co-design.

In the end, after the necessary adjustments to the project in order to avoid major delays and minimize the impact of the found limitations on the final outcomes of the dissertation, the carried out research plan was the following:

- **Phase 1 - Requirements Specification:** Before initiating development, an interview process was carried out with healthcare professionals, in order to assess the needs of adolescents in RC regarding ER and their preferences in terms of games, as well as the insights of the participants regarding how the game should be designed.
- **Phase 2 - Conceptualization Feedback:** As healthcare professionals were already involved in the first phase and the game would be solely based on their initial feedback, together with the previously carried out research, the conceptualization feedback interview process was replaced by contact with the collaborating healthcare professionals when needed throughout development.

- **Phase 3 - Game Validation:** Usability tests were carried out with healthcare professionals, who received a copy of the game and were asked to play it for as many time as they desired, before filling out questionnaires regarding their experience with the game and their insights regarding the impact it could have on the ER skills of adolescents in RC. Adjustments were then made to that version, based on the final feedback from participants.

It's important to highlight that the planning for this dissertation was adjusted twice taking into account the limitations regarding co-designing the SG with adolescents in RC. The first happened in March, where the first meet-up with adolescents to kick off the conceptualization process should have happened, whereas the second happened in May, where, still without an answer, the demonstration session and one-week trial with adolescents were also not possible inside the time constraints of this dissertation.

5.5.2 Adjustments to the Development Plan

The following section showcases the adjustments made to the initially devised work plan for this dissertation.

5.5.2.1 Dissertation Document Writing Adjustments

No encountered limitation impacted the writing of the dissertation writing in any way. Therefore, this part of the plan hasn't suffered any changes from the original plan to the one carried out.

The **Development Log** and the **Results** were merged into **Chapter 7 : Emotion Rush** of this dissertation, while **Validation** became **Chapter 8 : Co-Design: Validation and Project Divulga-tion** was detailed in **Chapter 9: Conclusion and Future Work**.

5.5.2.2 Serious Game Development Adjustments

Considering the delay caused by the absence of answer regarding the authorization of the co-design with adolescents in RC, this dimension of the plan suffered some adjustments, leading to a smaller number of sprints and the plan ending up like the following:

- **Project Configuration:** This activity started some weeks later than initially planned but didn't change it's objectives or deliverable.
- **Final Version Development:** As there was no possibility for validating a demonstration version with adolescents, Sprints 1 to 4 were dedicated to developing Emotion Rush' MVP, which was the deliverable for this activity.
- **Bug Correction and Polishing:** This activity didn't suffer changes, consisting on Sprint 5 and resulting on the latest release of Emotion Rush.

More detail on the achievements of each Sprint can be read in **Chapter 7 : Emotion Rush**.

5.5.2.3 Adjustment to Research Activities

Similar to the SG development plan, the research plan also underwent some changes, because of the found limitations, as shown below:

- **Requirements Specification:** This activity ended up converted in an interview process with healthcare professionals, instead of adolescents. These interviews kicked off the conceptualization phase, before development started. The **Conceptualization Feedback** ended up discarded, as the first contact with healthcare professionals was established in this phase already.
- **Final Version Validation:** Like specified in the updated development plan, because of delays in kicking off development, the focus of development was, from the beginning, achieving Emotion Rush's MVP, which lead to the canceling of the **Demonstration with Test Version** as it wouldn't be possible with adolescents and the time constraints wouldn't allow it. Instead, the game was only tested after the MVP was ready, and only with healthcare professionals.

5.6 Proposal Conclusions

In this phase of the dissertation, initial research on the context of RC and ER allowed for a better understanding of the existing problems and obstacles and possible approaches for solving them. The reviewed literature drove the decisions made towards the solution to develop in for the remaining duration of the dissertation. Despite the absence of information on previous approaches to developing a serious game promoting ER for institutionalized adolescents and the fact that some serious games for health that were used as reference omit some information that would have been useful for better taking conclusions out of their analysis, the literature review process conducted the dissertation towards a defined solution and a development plan to conceptualize, design and develop the serious game in the remaining time available.

This section is an overall analysis of what was achieved up to this point and what could already be concluded after the solution proposal is defined and planned.

As already defined earlier in this chapter, the goals of this dissertation were, in priority order:

- Developing a serious game for institutionalized adolescents that promotes and teaches healthy ER mechanisms.
- Involving stakeholders as much as possible in a co-design process through questionnaires, interviews and demonstrations, in order to gather requirements for Emotion Rush, as well as find out how to translate ER promotion into game mechanics, and further test the game and gather feedback from them after a development period.
- Documenting the whole research, conceptualization, design and development of the serious game for organization purposes and for future reference on other projects in the area.

These goals were already accounted for in the previously presented development plan, subdivided in activities, scheduled and all of them measured through the deliverables associated with each one.

One of the big strengths of this proposed solution was the uniqueness of it. Up to this point, there was no register of a serious game developed for this specific target audience promoting healthy ER mechanisms, which meant this game was more than necessary to address the particularities of a population that was not yet addressed when it came to this problem. Another strength was the in-depth literature review carried out before the solution proposal was defined, referencing more than 70 articles that provided a solid base for the work to be developed and allowed a significantly good understanding of the context of the dissertation and the work to be done. At last, the partnerships that allowed for rapidly establishing contact with healthcare professionals and the previously developed projects in the area of ER at LIACC proved significantly helpful in solidifying the development plan for this solution.

The main weakness with this dissertation was the heavy dependence that the project had on the co-design conceptualization phase, as development couldn't start before this study was done, making it so that any delay on this process resulted on a delay for the entire project.

In terms of opportunities, this solution was, at least according to the gathered literature, the first serious game developed for promoting ER in institutionalized adolescents, opening up new possibilities for future research in the area and potentiating the investment in ER education in such a vulnerable population.

Chapter 6

Co-Design: Conceptualization

This chapter details the co-design process that supported the development of the SG and its main conclusions, as well as how it influenced the development process. It details the interview process carried out with healthcare professionals before initiating development, in order to gather their insights and include them in the design and conceptualization phase.

The first section details the procedure planned for the interview process, including how the interviews were carried out, which materials were used and how data was gathered, processed and analyzed, as well as the motivations that lead to opting for that approach.

The second section presents the sample of participants of this study in more detail, presenting sociodemographic data gathered during the procedures, such as age and nationality, among others.

The third sections presents the methods used to collect data during these interviews in more detail, as well as how the data collection was organized and planned before starting the procedure.

The fourth section presents the methodology through which the gathered data was analyzed, leading to the results of this study, presented afterwards.

The fifth section presents the results of this interview process, separated in four different themes and including data regarding how many participants mentioned each topic but also direct quotes from the transcriptions.

The sixth and last section of this chapter presents an in-depth discussion of the results of this interview process and their impact in Emotion Rush's development.

6.1 Procedure

During the interview, participants were asked to fill in an anonymous sociodemographic questionnaire, in order to allow an analysis of the sample of participants, presented in the following section.

This interview process followed a script, to ensure the same questions were made to all participants and focused on understanding the healthcare implications that need to be taken in consideration during development. The interviews were carried out through voice chat online, to allow

for more convenience for both sides. They were also recorded with the authorization of all participants. After each interview, recordings were digitally transcribed and anonymized before being stored in a computer only accessible to the team. Afterwards, the transcriptions were analyzed and conclusions were drawn from them, that would later be translated into decisions regarding Emotion Rush's design. Interviews took between around 40 minutes and 90 minutes each.

The process was specially useful to confront the theoretical information obtained through research with the practical experience of professionals who deal with adolescents in RC and were able to contribute with their insights.

6.2 Participants

As summarized on **Table 6.1** the sample used for this interview consisted of three portuguese women, graduated in Psychology with ages ranging from 34 to 55 ($M = 44.67$; $SD = 8.57$) and that are currently working or have already worked with adolescents in RC contexts. These experts have 7 to 31 years of experience ($M = 16.00$; $SD = 10.68$) and only one of them reported having used modern technologies for ER promotion in the past, mentioning the use of smartphones and computers in interventions. None of these experts have used digital games or other digital tools for promoting ER in the past.

Table 6.1: Participants' Sociodemographic Data

	<i>n</i>	%	$\bar{X}(\text{range})$
<i>Professionals</i>			
Gender			
Female	3	100%	
Male	0	0%	
Age (range)			44.67 (34–55)
Years of Experience (range)			16 (7–31)
Past use of technology in ER promotion			
Yes	1	33.33%	
No	2	66.67%	
Past use of SG's or digital tools in ER promotion			
Yes	0	0%	
No	3	100%	

6.3 Data Collection Methods

During the interviews, participants were asked to fill in a short questionnaire regarding their sociodemographic data, from which the data presented in the previous section was gathered.

Afterwards, interviews followed a semi-structured approach, following a script organized around the following themes:

- **ER Needs of Adolescents in RC:** Psychologist perspectives on what are the most important aspects of ER that should be promoted in an SG directed at adolescents in RC contexts.
- **Game Conceptualization:** Discussion on game genre, structure, features, mechanics and other characteristics that may more accurately promote ER in adolescents in RC.
- **Development Process:** Discussion on the development plan and possible limitations or adjustments that may be necessary for achieving a more effective development process.

6.4 Data Analysis

The interview data was analyzed following a thematic analysis approach [74]. Using interview recordings to obtain transcripts of each interview, the analysis consisted in the repeated review of these transcripts and the identification of themes that synthesized the ideas of the participants.

6.5 Results

This section presents the results of the thematic analysis described above, including direct quotes translated from the interviews, to illustrate the insights of the participants. Participants were identified as Participant 1, Participant 2 and Participant 3 in the presented quotes. The thematic analysis resulted in three different themes, as presented below.

6.5.1 Theme 1: Emotion Regulation Needs of Adolescents in Residential Care

Psychologists highlighted emotion recognition ($n = 2$), empathy ($n = 1$), emotion expression ($n = 3$) and communication ($n = 2$), as well as ER strategies such as cognitive reappraisal ($n = 2$) and expressive suppression ($n = 2$) as the most important aspects of ER to teach adolescents in RC contexts.

"Having a more assertive communication, being more empathic and putting themselves in the shoes of others (...)"[2, Participant]

"It's important for them (adolescents in RC) to be able to switch their focus while in certain situations and make them able to focus on what really matters."[1, Participant]

Participants pointed out the increasing exposure to stressing situations that leads to more intense emotional reaction ($n = 3$), as supported by the literature, especially when dealing with anger ($n = 1$) as the biggest difficulty regarding ER in adolescents in RC.

"They (adolescents in RC) have a lot of trouble in anticipating the consequences of their actions and thus the immediacy is typical of the reactions of these adolescents."
[3, Participant]

"Adolescence itself is a period marked by a lot of mood spikes (...) everything is lived with higher intensity." [2, Participant]

"(...) when you live through traumatic situations that feel like threats to our safety, we always live in high alert, and so the tendency of these adolescents is to always be ready to flee, fight or freeze, which are the three reactions that protect us from threats (...)" [3, Participant]

Participants highlighted the importance of restricting the age gap of the target audience, as the interests of 12-year-olds and 18-year-olds are significantly different, and it will be hard to create an appealing experience for both in the same game ($n = 2$).

"We have boys in the institution that are 12 years old, others that are 18 years old (...) their maturity level is very different (...) for a 12-year-old we have to use a different type of language than we would use for an 18-year-old (...)" [1, Participant]

6.5.2 Theme 2: Game Conceptualization

Regarding game genre, psychologists mentioned RPG's ($n = 2$), adventure games ($n = 1$) and simulators ($n = 1$) as the best options in terms of game genre. Participants also admitted having some difficulty into translating the ER needs of adolescents in RC contexts into game mechanics ($n = 3$).

"(...) this game needs to be relaxing (...) where they go after what helps calming them down, making them feel safe (...)" [3, Participant]

"(...) based on the group dynamics I usually do with them (adolescents in RC), I think roleplay would be important (...) Adolescents have less and less real social interaction (...) it can be interesting to allow them to play roles (...)" [1, Participant]

Choice-based mechanics with in-game consequences ($n = 2$), scoring and reward systems ($n = 2$) were mentioned as the most interesting approaches for promoting ER. Some participants specified that they believe reward systems would only be positive in single-player games ($n = 1$). Participants also supported the idea of having some options for adolescents to customize the experience to their liking ($n = 3$).

"(...) if possible, having a narrative where they were co-creators, that is, where they could make their own choices (...) Anything that makes these adolescents feel empowered in their path is very important." [3, Participant]

Some participants defended a more explicit approach for the SG, with a more direct approach where ER concepts and scenarios are openly and clearly presented to adolescents ($n = 1$).

"I think it should be as explicit as possible, with adapted language, with real situations (...) Sometimes people are afraid of speaking about things with adolescents and they like us to go straight to the point and speak directly about things." [1, Participant]

Others expressed interest on a game where ER is promoted implicitly through the game context, without being clearly presented theoretically ($n = 2$), with one participant defending that an explicit approach would be more appropriate for a game to be used in therapeutic dynamics ($n = 1$).

"I think an implicit approach would be better. I think an explicit approach would be more of a psychoeducational game and I don't think that's what you intend." [2, Participant]

Most participants agreed that the game should follow a non-linear approach ($n = 2$), giving certain freedom for adolescents to choose what to do next inside the game.

"(...) it would be interesting for them to understand that, using certain ER skills and acting in different ways, the consequences will be different." [1, Participant]

The most mentioned environments where the game could take place were school ($n = 2$), institution ($n = 2$), places for practicing sports or other hobbies ($n = 1$) or places where adolescents like to hang out ($n = 1$), for an approach that presents a game context closer to the player's reality.

"(...) we can have the school, the institution, a place for practicing sports... We could have multiple contexts here and let them choose (...)" [1, Participant]

Participants also suggested the inclusion of characters from these adolescents' daily lives such as classmates, teachers, institution caregivers and other institution adolescents ($n = 1$). They also expressed the importance of a narrative context inside the game ($n = 2$) and one of them highlighted that appealing environments change from adolescent to adolescent, as well as what may be triggering or unpleasant for them ($n = 1$). It was also mentioned that this serious game shouldn't be violent ($n = 2$).

"About narrative, I like to work using narratives with them. I personally work a lot using narrative with these adolescents because I think it's important." [2, Participant]

"I think it can be interesting to create different contexts and different characters of the adolescent's reality (...)" [1, Participant]

Regarding platforms, the ones that were highlighted as more accessible for these adolescents are mobile ($n = 2$) and console ($n = 2$).

"There are always more smartphones available than consoles, certainly. Everyone has their own smartphone." [2, Participant]

Some participants mentioned commercial games that adolescents usually play or that may be useful as reference, such as *Clash Royale* ($n = 1$), *Fortnite* ($n = 1$), *The Sims* ($n = 1$) and *Grand Theft Auto* ($n = 1$).

6.5.3 Theme 3: Gameplay Sessions

All participants showed preference for a game that can be played in shorter sessions, lasting an hour or less ($n = 3$). Some of them expressed difficulty in determining what would be desirable in terms of game session duration, as it would depend on the game's characteristics ($n = 1$).

"(...)what I do in group dynamics is about an hour (...) I think it will depend on the format of the game." [2, Participant]

"If on one side, the more we play the game, the more we work ER here, on the other, we need to account for the addiction (...) so I think it would depend a lot on the type of game (...)" [1, Participant]

All participants agreed on the importance of incentivizing replayability through in-game mechanics ($n = 3$).

"I believe it (the game) shouldn't have an ending in order for them (adolescents in RC) to understand that it (ER) is something that is always in development(...)" [2, Participant]

"if we are training skills, sometimes returning to that training is important (...) it's not enough to do it once, sometimes it's necessary to insist on it." [3, Participant]

One participant suggested the game to be played once a week ($n = 1$), while another suggested twice or thrice a week ($n = 1$).

6.6 Discussion

Overall, the interviews lead to relatively similar results, with participants showing relatively similar opinions in different aspects and regarding the different themes of the carried out thematic analysis. The majority of the insights gathered was also in agreement with the previously researched literature.

Regarding the ER needs of adolescents in RC, participants agreed on the importance of skills like empathy, emotion expression and communication, emphasizing the impact that ER development would have in the relationships and social interactions these adolescents have with others, something that was also frequently pointed out in the literature regarding RC contexts. This lead to the decision of making Emotion Rush revolve around the promotion of ER in social interaction situations. Emotion identification, another skill also highlighted by the participants, was also included as a gamified challenge in Emotion Rush.

Once again supporting the literature, participants highlighted cognitive reappraisal and expressive suppression as the main ER strategies to teach these adolescents, something that was already being considered since the initial research process but was further incentivized by the insight of the healthcare professionals in this phase.

The most suggested and discussed game genre was RPG, which was also one of the most prominent genres both between SG's for promoting adolescent ER and SG's for other purposes regarding adolescent health.

A strong emphasis on choice-based mechanics was expectable, as they are a key aspect of RPG's, but participants also revealed interest in reward and scoring systems, believing that positive reinforcement would be beneficial in a single player game. Considering the fact that participants considered replayability an important aspect for Emotion Rush, the game ended up being designed as an arcade RPG, scoring, rewards and replayability are key features of the genre, and the literature on SG's for adolescent health and adolescent ER also supported the genre choice.

Participants showed interest in having the game portray environments that are familiar to the day-to-day life of the adolescents, which ended up leading to the choice of school as the environment of the game, as it is the environment where they spend the most of their day and, consequently, where they live many of the emotionally triggering situations they go through. Following that logic, characters from their daily student lives were also adapted to be the NPC's of Emotion Rush, who interact with the player.

An implicit approach was supported by the majority of the participants and was chosen as the approach of the game, by presenting emotionally triggering scenarios and reaction options without presenting them through the lens of ER right away. However, considering the insights of one of the participants about speaking about things directly when it comes to adolescents, it was decided that the game would have specific moments where more explicit feedback would also be presented, moments after those interactions have already been concluded by the player.

Giving some freedom to the player was also highlighted as an important aspect, and was thus included in the game through the possibility of choosing where to go in school break moments inside the game. The non-linear structure of the game, supporting the replayability aspect already mentioned above, was achieved through randomizing the order of scenarios that the players are presented with, while at the same allowing them to choose multiple paths with different outcomes they can explore. The importance of the narrative was also considered, and a narrative context to support the game's objectives and mechanics was presented: a school competition between classes, to see who are the more emotionally regulated students.

The interviews made it clear that the game should be developed for mobile devices, as they are the most accessible to adolescents in RC, and also allow them to play the game more frequently.

Healthcare professionals based their perception of how much should an Emotion Rush's session take by comparing it with the time their group dynamics with adolescents in RC usually take. As such, Emotion Rush was designed to allow players to save the game at specific points they can reach in less than an hour, to allow for short gaming sessions, when that is desired, but also allow for longer gameplay, when the adolescent wishes so or there is more time available to work on ER.

Finally, regarding the age gap, Emotion Rush focused a bit more on older adolescents (16-to-18-year-olds), as it relayed a bit more on narrative presented through text, but does not contain any content that can't be presented to younger adolescents that may also take interest in the game.

Table 6.2 summarizes the contributions of this interview process towards the conceptualization process of Emotion Rush.

Table 6.2: Contributions of the Interview Process towards the Conceptualization of Emotion Rush

Insight from Interviews	Impact on Game Concept
Empathy, Communication, Emotion Identification and Expression and ER in Social Interaction and Relationships	Emotion Rush was designed around the idea of simulating social interactions for the player to practice these skills.
Cognitive Reappraisal and Expressive Suppression	Situations presented in Emotion Rush were designed to be solved using these ER strategies.
Appeal of the RPG genre	Emotion Rush borrowed many RPG elements in its conceptualization and development, such as choice-based mechanics and NPC interaction.
Effectivity of Positive Reinforcement	Emotion Rush borrowed mechanics from the Arcade genre such as scores show to the player, rewarding positive in-game behavior through points and coins to unlock upgrades and an endless game cycle.
Importance of Replayability	Emotion Rush borrowed Arcade elements like an endless game cycle and a non-linear structure, offering different ways to conclude each situation presented to the player and randomizing situations each time, ensuring different things happen everytime the player restarts the game.
Portrayal of Day-to-Day Environments and Characters	School was chosen as the game environment, as it is an environment where adolescents spend the most of their day and where they live many emotionally triggering situations. Emotion Rush characters consist on teachers, classmates and school staff, that adolescents would normally find on their school.
Implicit Approach	Emotion Rush was designed to present opportunities for applying ER strategies implicitly, in order for adolescents to learn at their own pace, without feeling pressured or forced to follow a certain path.
Moments of Explicit Feedback	Emotion Rush was designed to provide explicit feedback at the end of each in-game day, to guide players that are having trouble in scoring.
Freedom of Choice	Emotion Rush offers freedom of choice through School Breaks, where the player chooses where to go, achieving a non-linear game structure.
Narrative Context	Emotion Rush presents the player with a narrative revolving around a contest that tests the ER strategies of students.
Mobile Devices as the Most Accessible	Emotion Rush was designed to be developed for mobile devices.
Gameplay Session Duration	Emotion Rush was designed to allow for gameplay sessions lasting an hour or less before the player reaches a point where they can save their progress, at the end of an in-game day. However, the game also allows playing for longer periods, if desired, as saving points are frequent.
Restricting Age Gap	Emotion Rush was designed mainly thinking in 16-to-18-year-olds.

Chapter 7

Emotion Rush

This chapter presents Emotion Rush in more detail, as well as the process through which the game was developed.

The first section presents an overview of Emotion Rush, including its gameplay flow, its mechanics and features and the overall experience it provides to players through its Graphical User Interface (GUI) elements.

The second section presents the tools used to develop Emotion Rush and how they were used to achieve the final game version.

The third section details how Emotion Rush's assets were obtained throughout the development process and how were they used in the project.

The last section describes the technical aspects surrounding the development of Emotion Rush, such as its architecture.

7.1 Game Overview

Emotion Rush is a mobile game combining arcade and RPG elements that puts players in control of a student in a new school, where they are presented with a school contest between classes that aims to test and train their ER skills while allowing them to explore how different reactions to different scenarios may lead to different outcomes, including how some ER strategies may be more adaptive than others depending on the situation. Emotion Rush is heavily based in two the two theoretical models presented in **Chapter 2: Background**: Paul Ekman's Model of Emotions [1] [40] and James Gross' ER Process Model [11] [11].

7.1.1 Gameplay Flow

In Emotion Rush, players live the daily life of a student in this new school, where new opportunities for using ER strategies to solve problems are constantly appearing during classes and school breaks. The gameplay flow is pretty simple, as illustrated in **Figure 7.1**.

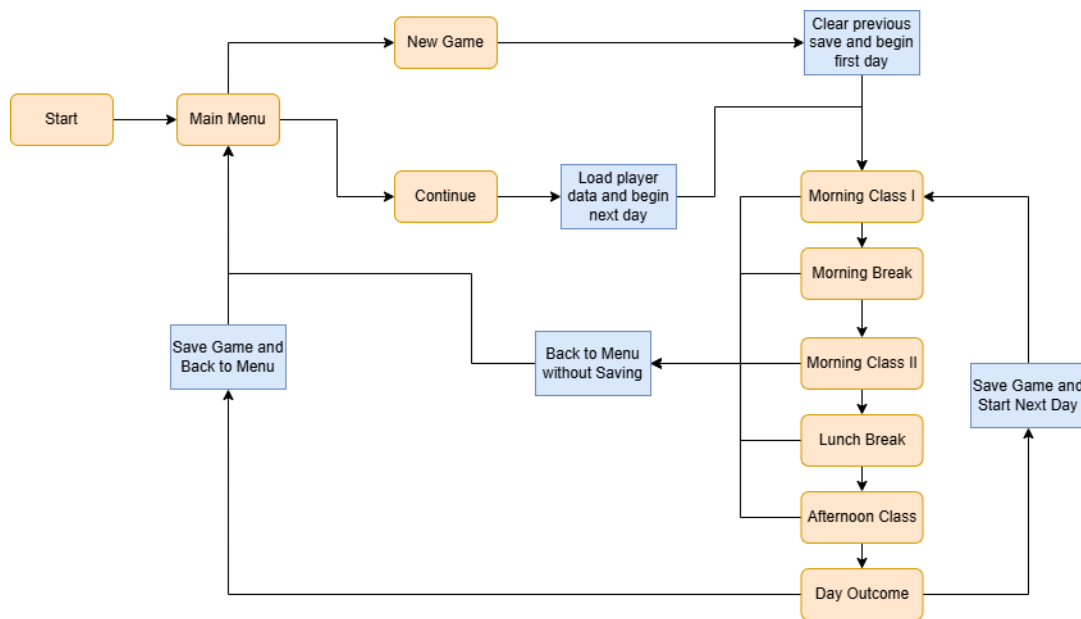


Figure 7.1: Emotion Rush Gameplay Flow Diagram

When the player starts the game, they start a new day of school. All five week days are composed of the same five segments:

- **Morning Class 1:** This class can happen in a Classroom, in the Lab, in the Auditorium or in the Gym. The place, as well as the situation presented, is randomly chosen when the player initiates this segment. During this class, the player goes through a situation where they can train their ER skills to solve a problem involving their own emotions or the emotions of characters around them, observing the direct consequences of their choices during the scene.
- **Morning Break:** After the class ends, the player has a 5 minute time period where they can explore the school and decide between going towards the Playground or the Library to participate in an additional randomized scenario in one of those places, or go towards the school store, where they can upgrade their character using coins obtained throughout the game.
- **Morning Class 2:** Similar to **Morning Class 1**, another scenario is randomly picked, as well as one place for the class to happen.
- **Lunch Break:** Similar to **Morning Break**, the player gets another break of 5 minutes where they can either play a new scenario in the playground or the library, or go to the school store and buy upgrades.
- **Afternoon Class:** Similar to **Morning Class 1** and **Morning Class 2**.

At the end of the day, after the Afternoon Class, the player is shown a synthesis of the achieved outcomes in the last in-game day, where they are shown the score they achieved through their

actions on this day, as well as how many coins they were rewarded with, some tips on what they did right or wrong and how many emotions were correctly identified throughout the day. After concluding an in-game day, the player is able to save their progress and either leave to the main menu or continue playing through another day that repeats the same cycle with new interactions.

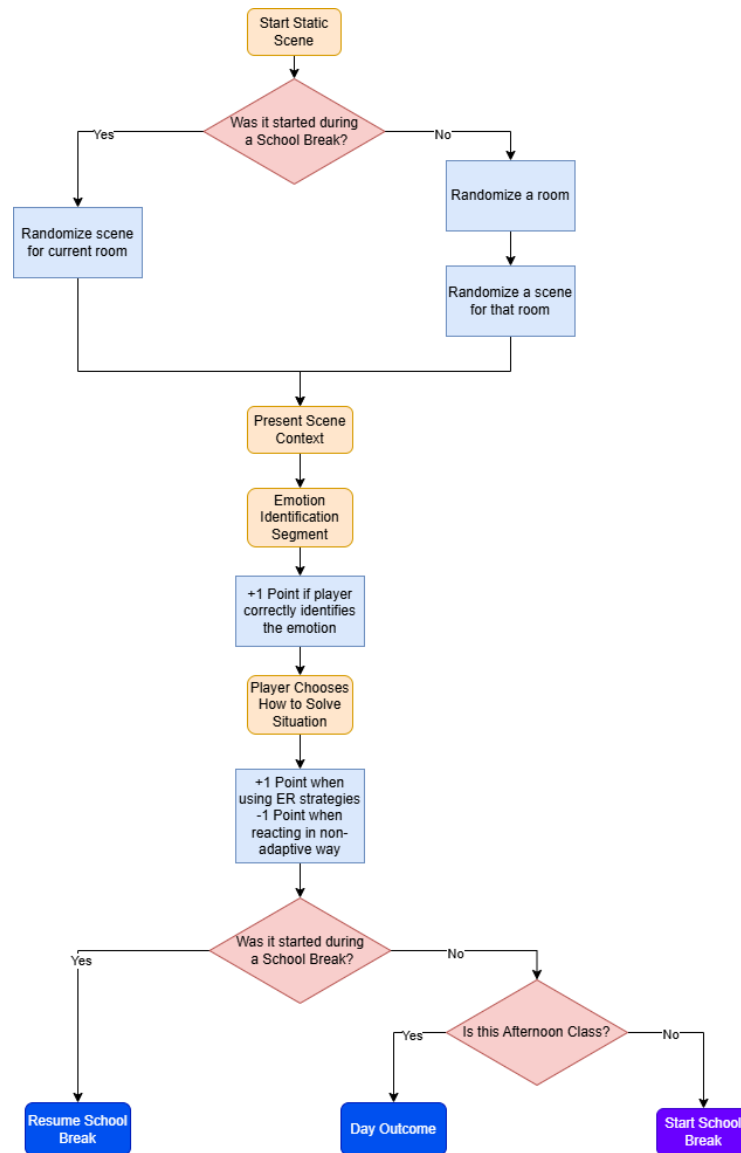


Figure 7.2: Static Scene Flow Diagram

Essentially, the gameplay flow is divided into two types of interactive scenes:

- **Static Scenes:** Scenes where the player cannot move around and is presented an Interaction Sequence to solve. These include classes and any interactions triggered by entering a location during School Break Scenes. Illustrated in **Figure 7.2**.
- **School Break Scenes:** Scenes where the player can move around the school for a limited time period and visit certain places, triggering a Static Scene by entering in any available

school location, resuming the School Break Scene once the Static Scene is concluded, while there is time available. Illustrated in **Figure 7.3**.

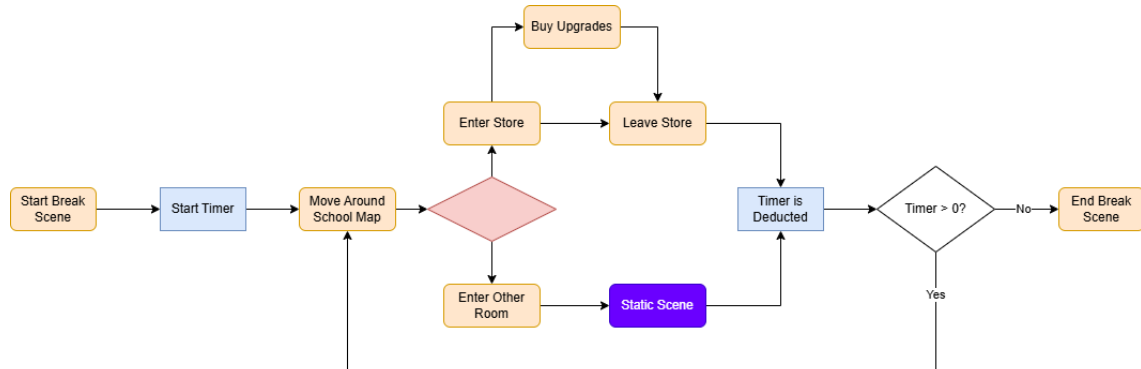


Figure 7.3: School Break Scene Flow Diagram

7.1.2 Features and Mechanics

To achieve the experience briefly described above, different mechanics and features were combined in order to translate the important aspects found in the literature and discussed in the interviews with healthcare professionals. They are described below in bigger detail.

7.1.2.1 Interaction Sequences

Interaction Sequences are the main gameplay mechanic of Emotion Rush, where players are trained into identifying and regulating emotions. In these scenes, the player is presented with a situation happening in a specific part of the school, involving them and other characters from the school and is given options to choose from in order to try and solve said situation.

Each of the three daily classes consists in an Interaction Sequence. During School Break scenes, the player is also able to explore the school and enter some places where additional interactions may be presented to them.

Everytime an Interaction Sequence starts in a given location of the school, that sequence is chosen randomly from the set of interactions that can happen at that place.

There are two kinds of situations where players are able to choose from different options during these sequences:

- **Emotion Identification Segments:** After being presented with a situation and a description of what they are feeling or what another character seems to be feeling, players are prompted to try and identify what emotion was described, like shown in **Figure 7.4**. Players are rewarded for choosing the correct emotion, as explained further in this chapter.
- **Situation Choice Segments:** After being presented with a situation, the player has multiple points where they can choose how to react in order to progress the scene. Some of them

consist in ways to apply cognitive reappraisal or expressive suppression, resulting in rewards for the player when picked. Others either consist in dysregulated reactions, that result in penalties, or neutral reactions.

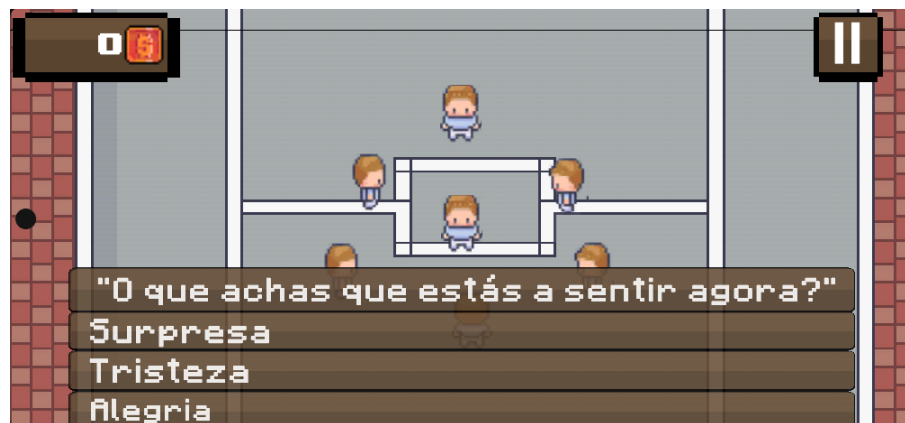


Figure 7.4: Emotion Identification Segment

These Interaction Sequences were written and designed based on Paul Ekman's Model of Emotions [1] [40] - regarding the sensations and signals described, the emotions portrayed and the emotions given as options in Emotion Identification Segments, as well as given feedback regarding emotion identification - and James Gross' Process Model of ER [2] [11] - regarding the ER strategies used and the feedback given about them.

7.1.2.2 School Environment

The whole game takes place in the school the player character is enrolling. Throughout the game, the player visits multiple locations inside the school. In most of them, this will trigger an Interaction Sequence, but this may not always be the case.

During Classes, the player can find themselves in the following locations:

- **Class A Classroom:** A common classroom where the player's school class sometimes has classes where Interaction Sequences about events in regular classes are presented.
- **Auditorium:** A room where the player goes to during some classes, when there are events in the school. Interaction Sequences here revolve around those events.
- **Sports Field:** The sports field in the playground is where Interaction Sequences involving Physical Education classes and sports competitions take place.
- **Lab:** The lab is a room where Interaction Sequences during science, chemistry and physics classes of the player take place.

Meanwhile, in School Breaks, the player has the following locations available to explore:

- **Hallways:** The hallways that interconnect the rooms in the school. The player goes through them every school break, to visit other available rooms during these scenes. Interaction Sequences do not happen here.
- **Library:** The library is where Interaction Sequences about the use of its services take place, such as situations that arise while ordering or returning books or using the library's computers.
- **Playground:** The playground is an open space with a sports field where Interaction Sequences about interactions between students take place.
- **School Store:** The school store is a location where the player can buy upgrades for their character, as explained further down this chapter. Interaction Sequences do not happen here.

7.1.2.3 Reward System

Emotion Rush's Reward System is the way the game rewards players for developing ER skills regarding their capability of identifying and understanding emotions in themselves or others and applying ER strategies to help regulate those emotions.

Rewards are given to the player in the form of Points and Coins at the end of each in-game day, that represent different things inside the game, but are fairly interconnected.

Points are associated with the player's school class score and are used to compare their class position with the randomly generated score of the other three classes, in order to determine the position of each class. Players receive 1 point every time they identify an emotion correctly in an Emotion Identification Segment or apply cognitive reappraisal or expressive suppression to a situation. Players also lose 1 point every time they react in a dysregulated way. Wrongly identifying an emotion or making a choice that does not apply adaptive ER strategies but is also not considered dysregulated does not award any points but it doesn't take any away either. At the end of every day, in the same moment that the player is presented with the points they gained that day, the points of classes B, C and D are all randomly generated, using a function that generates a number between -3 and 6, which is a reasonably possible range of scores for the player themselves to achieve in an in-game day.

Coins can be used to upgrade character abilities that help the player get more coins and points each day. The amount of coins gained at the end of a day is determined by the position of the player's class in the leaderboard, as well as the number of points the player has obtained in that day. Additionally, players get a prize every Friday, depending on the position their class ends up at the end of the week. A player cannot lose coins they won previously without spending them, so the game will award no coins to a player in situations where the coin calculation would go below zero.

$$dailyCoins(p, pos, l) = \max(0; p(5 - pos) + 10l)$$

$$fridayPrize(pos, l) = 10(4 - pos) + 10l$$

$$pos \in [1, 4], l \in [0, 10]$$

where p is the amount of points gained in that day, pos is the player's class position and l is the level of the Increase Prize upgrade.

Figure 7.5: Daily Rewarded Coins and Friday Prize Coins functions.

At the end of each week, after players receive their prize and continue to the following Monday, points are reset, but all coins gathered are kept by the player.

7.1.2.4 Upgrade Store

During school breaks, players can choose to visit the school store, in order to use their coins to buy upgrades for their character. There are four different upgrades for the player to choose from:

- **Increase Break Time:** Increases the time school breaks take by 30 seconds. At level 10, this means school breaks last 10 minutes instead of 5 minutes.
- **Accelerate Interaction:** Decreases the time an interaction sequence during a school break takes away from the available break time by 20 seconds. At level 10, this means interactions during school breaks decrease 1:40 minutes from the timer instead of 5 minutes.
- **Fast Runner:** Raises the movement speed of the player character during school breaks. At level 10, the movement speed is the double of what it was at level 1.
- **Increase Prize:** Increases the amount of coins daily and the Friday prize bonus, as explained previously.

The higher the level of an upgrade, the higher the cost for upgrading it again, as illustrated by **Figure 7.6**.

$$upgradeCost(l) = 50(l + 1)$$

$$l \in [0, 10]$$

where l is the current level of the upgrade.

Figure 7.6: Upgrade Cost Function.

7.1.2.5 Interaction Storage and Loading

The integration of multiple Interaction Scenes in Emotion Rush required a way of storing this data inside the game and efficiently loading it any time a Static Scene was initiated. The solution for this problem was storing each Interaction Scene as a .JSON file, with a structure designed specifically for these interactions.

In this structure, Interaction Scenes are divided in dialogue lines, where each line is each segment that appears at once on screen. Each line has the following attributes:

- **Text:** The content of the line.
- **Type:** Defines the type of the line. Linear lines do not offer options to choose from. *TwoOption* and *ThreeOption* lines offer two options and three options. *EmotionOption* lines represent emotion identification segments. Lastly, *DialogueOption* lines are used for representing options the player can select in *TwoOption* and *ThreeOption* lines.
- **Children:** Linear, *EmotionOption* and *DialogueOption* lines have one child, which represents the following line, or none, if the dialogue ends immediately after them. *TwoOption* have two *DialogueOption* children, that represent its options. *ThreeOption* are the same, but having three children instead of two.
- **Score:** Used only in *DialogueOption* lines, indicating how much points the player wins or loses by choosing this option.
- **Answer:** Used only in *EmotionOption* to indicate what emotion should be the one the player identifies to get points.

These interaction files are saved inside the *StreamingAssets* folder (to ensure compatibility with mobile devices), separated in folders according to the school rooms where they happen. Each folder also contains a file named *filelist.json*, containing the list of files on the folder.

Everytime a new Static Scene starts, Emotion Rush checks the folder associated with the room of said scene, reads the file list and randomly selects a JSON file to parse, converting it into a game object that can then be processed to be displayed to the player throughout the Dialogue GUI.

This feature not only allows to easily separate the interactions from the rest of the game's architecture, but it also makes it easier to add interactions to the game, remove them or edit them from a developer point of view.

7.1.2.6 Saving Progress

As there are a lot of scene transitions involved in Emotion Rush, Unity's *PlayerPrefs* were used to store multiple variables that are important to keep during gameplay and throughout scenes. These variables include data regarding the game state, the phases of the day cycle, the day of the in-game week, the time left on the ongoing School Break Scene, the scores of each class, player coins,

upgrade levels and emotion identification and choice feedback to be shown at each Day Outcome screen.

As the player is only able to save the game progress at the end of each in-game day, the majority of these variables follow one of three approaches. In the case of variables that are to be discarded after the end of a day, such as that day's feedback and identified emotions, they are saved in specific variables that are emptied after a new day starts. In cases where a variable is a numerical value that can be incremented or decremented directly or indirectly by the player through their actions, like the amount of coins a player has or the level of each upgrade, Emotion Rush saves separately the value of the variable and its variation throughout the current day, only applying said variation when the game is saved, switching the variation variable back to zero, avoiding changes persisting after the player leaves the game in the middle of a day. Lastly, for variables that keep track of time passing or room changes, they are updated as soon as scenes transition and are reset if, at any time the player leaves the game and starts it back from the Main Menu.

7.1.3 Graphical User Interface

Throughout Emotion Rush, there are multiple instances of GUI elements to inform the user and for the user to interact with.

7.1.3.1 Main Menu

As soon as Emotion Rush is open, this is the first page that the player will see. The Main Menu was thus designed to be simple and intuitive, presenting only the game's title and logo at the top of the screen and a button panel.

The panel, shown in **Figure 7.7** can have one or two buttons. If the player has a saved game on the device, they will have two options available: start a new game and delete their previous progress or continue playing from their last save point. Otherwise, their only option will be to start a new game.

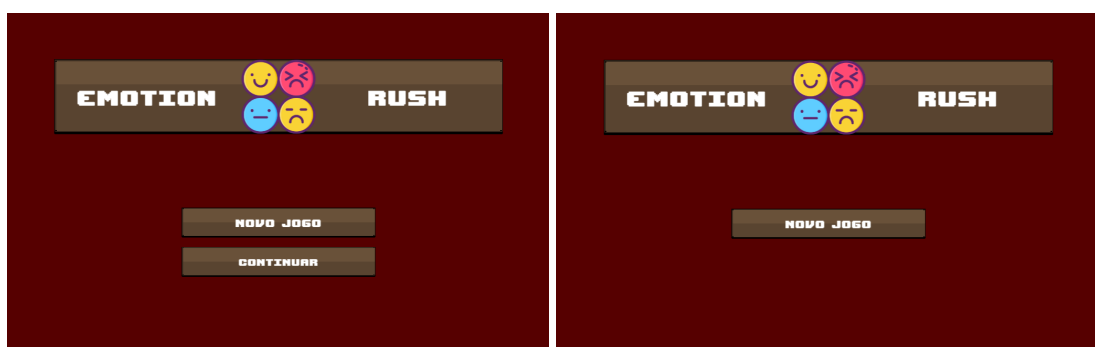


Figure 7.7: Main Menu GUI with Saved Game in the Device vs Without a Saved Game in the Device

To ensure clarity and transparency, everytime a user pushes the "New Game" button while having the option to continue playing their saved game, a prompt appears, informing them that their

previous progress will be overwritten by this new game, allowing them to cancel their decision if they don't intend to lose their progress or go through with it if that's what they wish.



Figure 7.8: Main Menu Prompt when Selecting "New Game" while having a Saved Game

7.1.3.2 Pause Menu

Any time the player is outside of the Main Menu or the Day Outcome interfaces, the player is able to pause the game by pressing the pause button, visible in **Figure 7.9** in the top right corner of the screen.



Figure 7.9: Pause Button in a School Break Scene

When pressed, the pause button stops the timer of School Break Scenes, all character animations and dialogues. It also opens a menu with three pretty straightforward buttons, like shown in **Figure 7.10**: one to resume gameplay, another to get help regarding how to play and the last one to go back to the Main Menu.

By pressing help, the player gets instructions on how to interact with the current scene, in case they have any doubt on how to play the game, like illustrated in **Figure 7.11**. From that menu, the player can press a button to go back to the Pause Menu at any time.

When the player presses the button to return to the Main Menu, the player is notified that they will lose the progress of their current day like seen in **Figure 7.12**, as the game only saves their



Figure 7.10: Pause Menu during a Break Scene

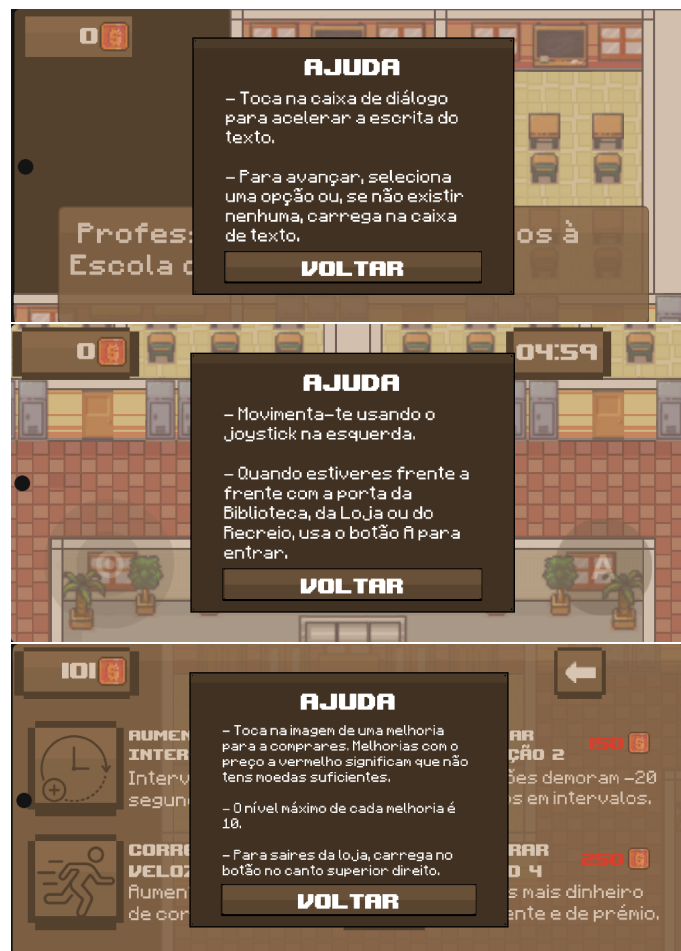


Figure 7.11: Help Menus for the Static Scenes, School Breaks and School Store

progress at each Day Outcome screen. The player can either choose to leave and lose the progress or stay in the game.

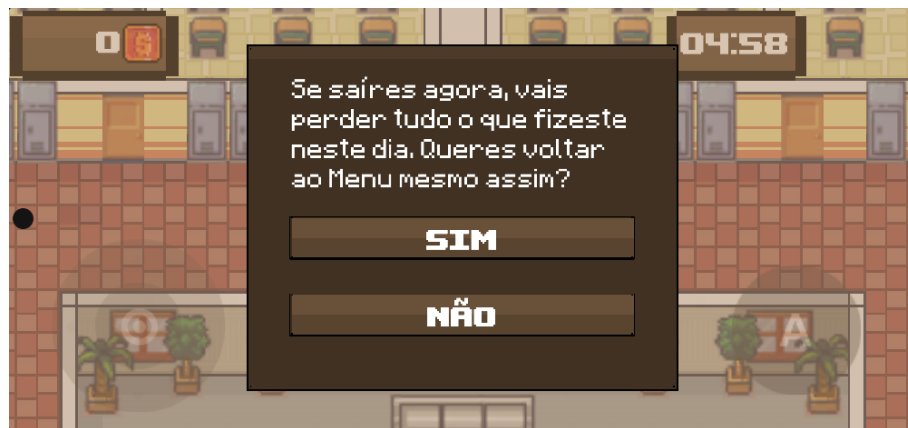


Figure 7.12: Warning about Returning to Main Menu in the middle of an in-game day

7.1.3.3 School Store

When players visit the School Store during the School Breaks, they are shown the interface in **Figure 7.13** with information regarding the four upgrades available, the current level of each one for their character, their current amount of coins and the current price of the next level of each upgrade. Additionally, any upgrades that exceed the current amount of coins of the player are marked in red, to indicate they cannot be purchased in that visit to the store.

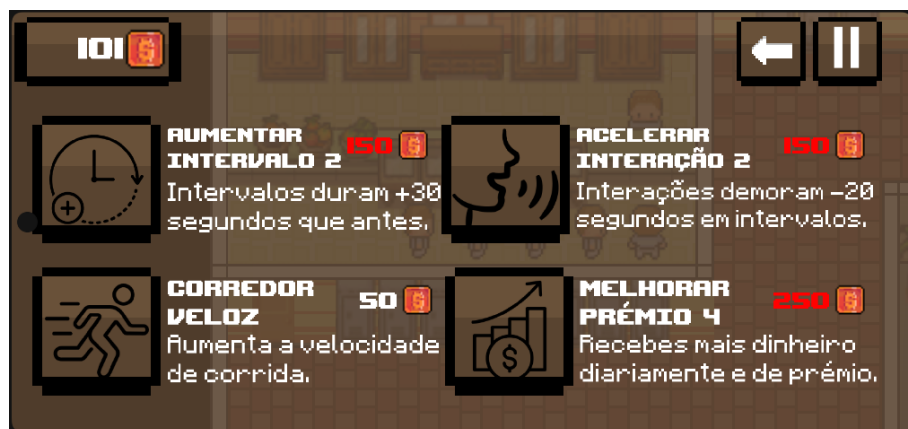


Figure 7.13: School Store GUI

It's worth mentioning that the coin counter in the top left corner of the screen is always visible throughout the day, so the player can know how many coins they have and decide when it's useful for them to visit the store.

7.1.3.4 Day Outcome

At the end of each in-game day, the player gets shown the Day Outcome screen, presented in **Figure 7.14**. In the left, the screen shows the School Class Leaderboard, with the yellow bar representing Class A, the player's class, while the other three bars represent Classes B, C and D,

which are the player's competitors. At the right of each bar, a number indicates the total number of points gained or lost in the current day.

Additionally, at the right side of the screen, the player can see which emotions they correctly identified through the day and also read some notes on possible good or bad decisions they might have made during this school day, that may help them understand how to make more points when situations that the advice applies to are presented to them.

From this menu, the player can either save their progress and return to the Main Menu or save it and continue to the next in-game day.



Figure 7.14: Day Outcome

7.1.3.5 School Exploration

During School Break scenes, players can move their character around by moving the joystick in any point of the left side of their screen, like shown in **Figure 7.15**. When they reach a door, they can press the A button while facing it to try and enter that room.



Figure 7.15: Player Controls

When interacting with the doors for the Store, the Library or the Playground, the players are shown a prompt like the one in **Figure 7.16** in order for them to decide if they really want to enter

that room and decrease the timer for that Interaction Scene or if they would rather do something else.

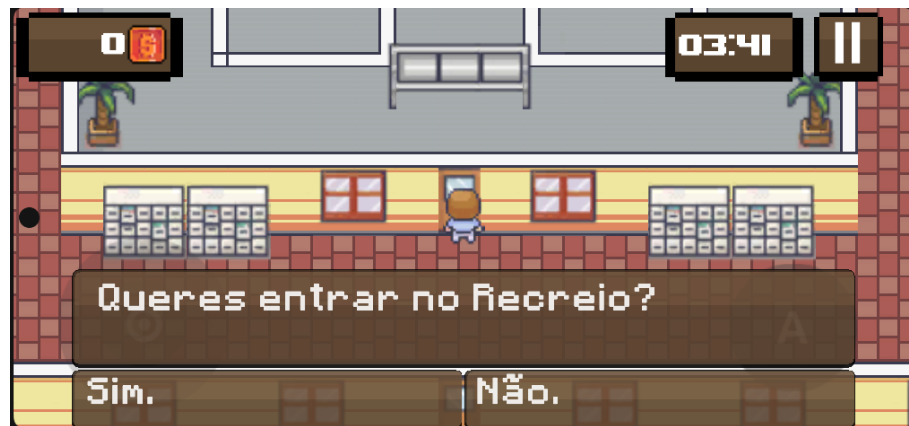


Figure 7.16: Door Interaction Prompt

However, not all rooms in the school are accessible during School Breaks. If the player tries to access a room they shouldn't enter during that moment, they will be shown a message like the one in **Figure 7.17**.

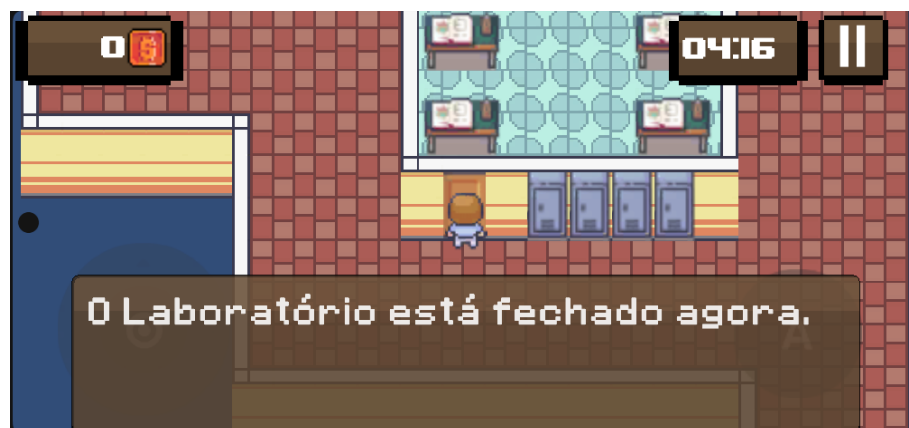


Figure 7.17: Closed/Inaccessible Room Prompt

During School Breaks, the timer in the top right corner helps players keep track of how many time left they have before classes start once again.

7.1.3.6 Dialogue

During Interaction Scenes, Dialogue is shown in three types of dialogue boxes: Linear, Two-Option and Three-Option Dialogue Boxes.

Linear Dialogue Boxes, like the one in **Figure 7.18** are presented when there is no option for the player to make at that point in the interaction. Two-Option (**Fig. 7.19**) and Three-Option (**Fig. 7.20**) Dialogue Boxes are used for option moments, depending on the number of options the player has available to choose from.

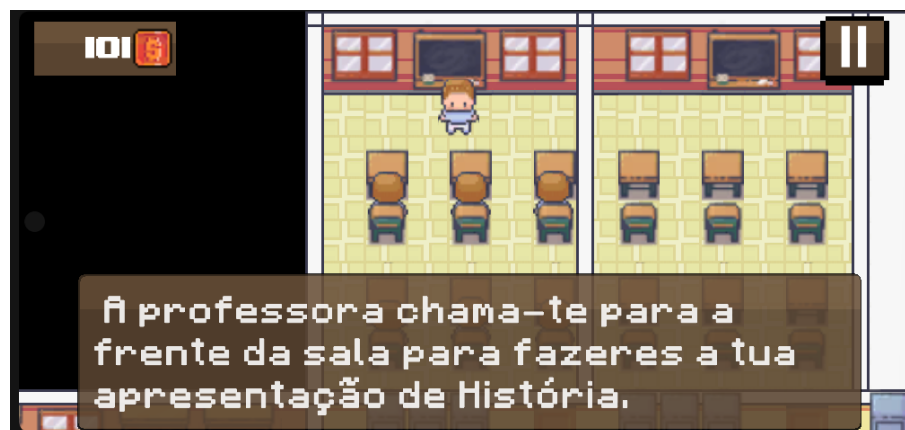


Figure 7.18: Linear Dialogue Box

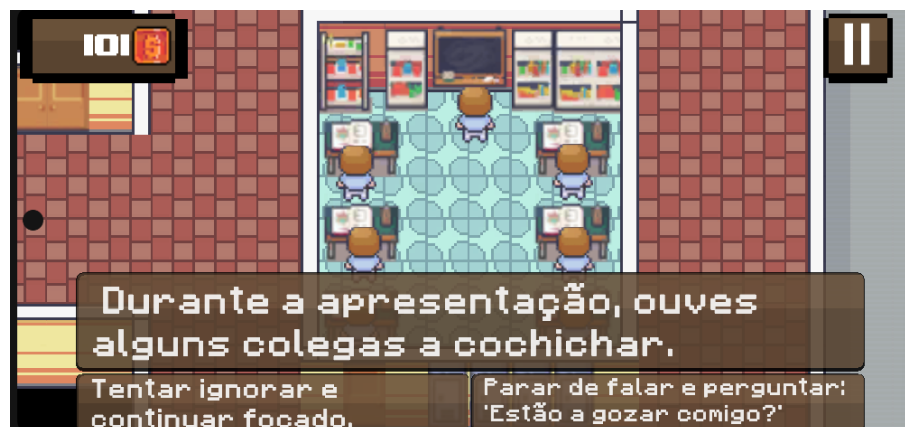


Figure 7.19: Two Option Dialogue Box

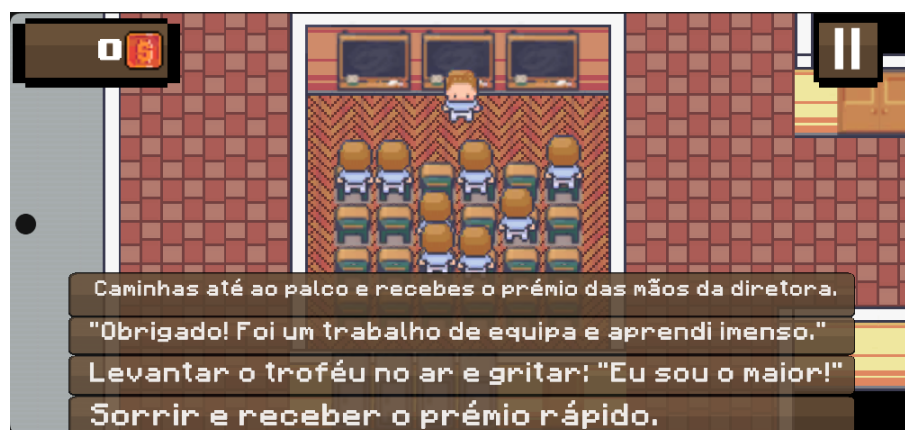


Figure 7.20: Three Option Dialogue Box

7.1.3.7 Schedule Transition

Everytime there is a scene transition from a moment in a day to another, like from a class to a break or from a break to the playground, Emotion Rush shortly shows the player information about the

current week day, the current phase of the school day and their current location, like shown in **Figure 7.21**.



Figure 7.21: Scene Transition GUI

7.2 Development Process

7.2.1 Toolkit and Framework

7.2.1.1 Engine - Unity 6

Gaming engines are environments for software development that offer multiple features, configurations and tools to optimize and simplify the development of video games. Through the use of gaming engines, game developers can speed up the development process and more easily make their games compatible with different platforms [75].

Unity is a multi-platform game engine that provides tools for developing augmented reality, virtual reality, 2D and 3D games, along with simulations and applications for other purposes and that has been widely adopted by companies in the industry. It is one of the most popular engines and is easily accessible and offers a big range of artist-friendly and developer-friendly tools [76].

For these reasons, the fact that it was already a familiar tool for the development and the fact that it was also used previously in serious game development as the literature points out, Unity was chosen for the development of Emotion Rush. More specifically, the most recent version, Unity 6, was the version picked for use.

7.2.1.2 Version Control - GitHub

GitHub is a version control platform that aids development by allowing to easily separate feature implementation in branches, planning sprints, tracking issues and tasks, saving the project remotely and reverting changes when they cause errors in the project.

Additionally, GitHub also offers a tool named GitHub Desktop that allows for easy visualization of recent changes that were not yet committed to the project, as well as allowing for easy visualization of an history of the local changes made to the project.

Throughout the development of Emotion Rush, these features allowed for easily tracking sprints, solving bugs and problems caused by changes in the code, keeping a backup of the project and overall making the development process easier to organize and keep track of.

7.2.1.3 Framework - SCRUM

SCRUM is a project management framework that consists in the incremental development of a project divided in multiple instances of short time periods, named Sprints. At the start of each Sprint, developers make the previous Sprint's Review, that is, they discuss what was achieved in that Sprint, before deciding what needs to be adjusted and what is going to be worked on in the following Sprint, creating the Definition of Done for the following Sprint. With SCRUM, each Sprint results in an refinement to the Product Backlog in the form of a new pre-release, that is, an experimental version for testing purposes which may be less stable, or a new release, a more stable version of the product, ready to be deployed and used as intended [77].

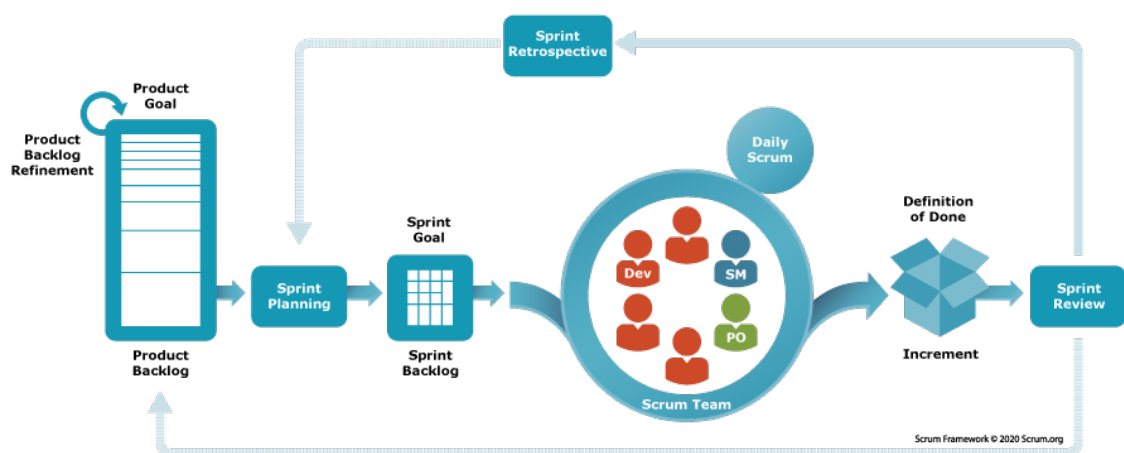


Figure 7.22: SCRUM Methodology Diagram

The development of Emotion Rush was based on an adaptation of this framework, as the literature supported iterative development. Sprints were defined as two-week periods, while also including a Sprint 0 of one week only for kicking off the project. This Sprint was used for configuring the project and making the first prototype, together with gathering and analyzing user requirements and planning development, as well as defining a Minimum Viable Product (MVP), that is, the simplest possible version of Emotion Rush that encompasses its core idea and concept, to allow for usability testing.

Regarding the additional sprints, Sprints 1 to 4 were used for achieving this MVP, in order to further usability test it, whereas Sprint 5 was used for code improvement and refactoring, as well as fixing any bugs detected after starting the testing phase and making any possible adjustments that were considered necessary. The outcomes and tasks carried out in each sprint are presented in more depth in the Development Log, further in this chapter.

7.2.2 Assets

The majority of assets used in Emotion Rush was not created from scratch, but obtained online. Below, there is more detail about each of the assets used.

7.2.2.1 Character and Environment Sprites

Character sprites, as well as furniture and other prop sprites and tiles for walls and ground belong to an asset pack named Modern Furniture, created by LimeZu [78]. It was selected because it provided basically all the props and decorations needed for creating an immersive enough school environment.

The asset pack contained a free version for testing and offered the possibility of using the assets in commercial or non-commercial projects by paying a license fee of 1.99\$, which was purchased throughout the development of the project.

7.2.2.2 Graphic User Interface Elements

The elements for building the GUI for Emotion Rush were obtained from a 2D GUI element pack in the Unity Asset Store [79]. This asset pack was totally free and included all kinds of materials such as icons, progress bars, text boxes and buttons used throughout the game. However, in certain occasions, additional resources were required.

The icons for the upgrade buttons were obtained from The Noun Project [80], a website containing free icons and stock photos.

Text fonts that allowed accentuation also had to be searched as the ones in the asset pack didn't allow for it. In the end, two different fonts were obtained from DaFont [81]: Minecraftia-Regular and Upheavtt.

7.2.2.3 Audio

Regarding music, Emotion Rush contains three music tracks: one for the main menu, another for the break scenes and another for the rest of the scenes.

Additionally, it also contains two sound effects: a school bell for transitioning between two school scenes and a 8-bit style button push sound effect.

All these audio files were obtained from Pixabay [82].

7.2.3 Development Log

The development of Emotion Rush was completely documented throughout its iterations, to allow for a full comprehension of the carried out work and the time it took since implementation kicked off until the final version obtained in this dissertation.

Throughout each Sprint, feature increments were tested both using Unity's Simulator on PC and on a smartphone.

7.2.3.1 Sprint 0 (03/04-10/04)

This initial sprint kicked off the project in the 3rd of April, with the objectives of configuring the Unity 6 project for 2D mobile development and testing the engine with the implementation of some initial and basic features for the game, like Player Movement Logic and GUI, Basic Animations and Object Detection, Interaction and Collisions. A small test scene was created while the game map was not yet built, to allow for testing the implemented features.

Throughout sprint 0, the following increments were achieved, with all planned tasks being accomplished:

- Player Movement for School Break Scenes
- Player Sprite Animations
- Movement Joystick and Interact Button GUI and Logic
- Basic Object Detection and Interaction
- Basic Collisions

Development in this sprint flowed quite quickly, as all these features were pretty straightforward and Unity tools for animation and tile map collisions sped up the implementation. It was also in this Sprint that issues were created and added to GitHub Projects, for Sprint organization purposes.

7.2.3.2 Sprint 1 (11/04-24/04)

After having a first base prototype developed, Sprint 1 focused on implementing one of the main mechanics of Emotion Rush: Dialogue. Therefore, this Sprint heavily focused on implementing the GUI for dialogue boxes and dialogue options, as well as the logic for displaying dialogue with a typing animation and creating data structures to represent dialogue lines and dialogue sequences. As it was foreseen that this feature would take some time, it was defined that any extra time available on this Sprint would be dedicated to working in the Main Menu GUI and, if possible, in the Pause Menu GUI.

Throughout Sprint 1, the following increments were achieved for pre-release v0.1:

- Data Structures for Saving and Handling Dialogue

- Linear, Two-Option and Three-Option Dialogue GUI
- Dialogue Logic for Typing Dialogue Animations, Skipping Dialog and Choice-Making
- Main Menu GUI

Despite Dialogue features taking a little bit more time to implement than initially planned, the only feature that was moved to Sprint 2's backlog was the Pause Menu.

7.2.3.3 Sprint 2 (25/04-08/05)

In Sprint 2, the plan was to work on incrementing the School Break Scenes that so far only had the Movement and Interaction Logic. As such, it was decided that, additionally to the Pause Menu coming from Sprint 1's backlog, this Sprint would focus on the School Break Timer, the School Map and start working towards the logic for transitioning between School Breaks and Static Scenes throughout the in-game day. Adjustments were also made to previously developed GUI, to improve Emotion Rush's aesthetic.

Throughout Sprint 2, the following increments were achieved for pre-release v0.2:

- Pause Menu GUI and Logic
- School Break Timer GUI and Logic
- School Breaks transition to Static Scenes when timer ends
- Static Scenes transition too School Breaks when interaction ends
- School Map
- Adjustments to Main Menu GUI and Dialogue GUI

In this phase of development, interactions were being written in parallel but were so far not added to the project. Instead, a placeholder interaction was created and added temporarily to the game for testing purposes.

7.2.3.4 Sprint 3 (09/05-22/05)

Following the improvements of Sprint 2, Sprint 3 focused once again on incrementing the logic around School Breaks and Static Scenes, integrating the logic for the day cycles and transitions.

During this Sprint, the following increments were achieved for pre-release v0.3:

- Created Unity Scenes for Static Scenes in each school room
- School Map Adjustments and Fixes
- Interactive Doors for accessing rooms during School Breaks
- Coin System GUI and Logic

- Day Outcome GUI and Logic
- School Store GUI and Logic
- Started Saving Variables in PlayerPrefs for keeping them between scenes
- Adjustments to Dialogue GUI and Logic Refactoring
- Created a JSON Parser for Reading Interactions and Converting them in Game Objects
- Added at least one interaction for each school room

Part of this Sprint was also dedicated to fixing some bugs and problems detected in early pre-release versions. New Interactions started being developed in parallel, but weren't added until later Sprints.

7.2.3.5 Sprint 4 (23/05-05/06)

The aim for Sprint 4 was finally achieving the MVP of Emotion Rush, by completing any mandatory features remaining in the product backlog in order to achieve the release *v1.0* of Emotion Rush, the first playable version of the game and the one initially used for demonstration with this dissertation's supervisors.

The increments of this Sprint towards *v1.0* were the following: - Emotion Identification Segments Scoring and Feedback Logic - Adjustments to Interaction Storage and Loading for Mobile Compatibility - Main Menu GUI Improvements

With about half of the Sprint remaining after finishing these increments, the remaining week was, as planned, spent on testing the game on both the Unity's mobile simulator and on mobile devices, to detect and solve as many bugs as possible before initiating usability testing with it, leading to release *v1.1*, a more stable and polished version. At this point, the Interactions in development were almost ready for being added to the game.

7.2.3.6 Sprint 5 (06/06-19/06)

Initially planned as a Sprint for refactoring and documenting code as much as possible, Sprint 5 started with some final adjustments to Emotion Rush before sending it for usability tests, culminating in release *v1.2.2*:

- Additional Bug Fixes for problems that were not detected previously
- Added the Help Button in Pause Menu GUI, for guiding new players
- Game Adjustments Regarding Feedback from Collaborators and Usability Testing Phase
- Code Refactoring and Polishing
- Code Documentation

7.2.4 Architecture

From a developmental point-of-view, Emotion Rush applied some design patterns and techniques that are presented below, in order to achieve a cleaner code base and facilitate updates and fixes to the project at any time.

Some patterns are also enforced by Unity 6's design, such as the Command pattern, enforced by its Input and Event Handling systems. However, this section will only detail patterns which were applied from the developer side, and not just enforced by the game engine.

7.2.4.1 Model-View-Controller Pattern

The concepts behind the Model-View-Controller pattern, pictured in **Figure 7.23**, were enforced in Emotion Rush when possible, dividing more complex components into separate parts that handle different aspects of the component, in order to simplify and organize code. This results in the separation of the game in three layers:

- **Model:** Handles logic regarding component data, communicating only with its component's controller.
- **View:** Handles what data is displayed to the player at any moment, communicating only with its component's controller.
- **Controller:** Handles game logic and commands received from the player. Communicates both with its component's model and view, as well as with the controllers of other components in the game.

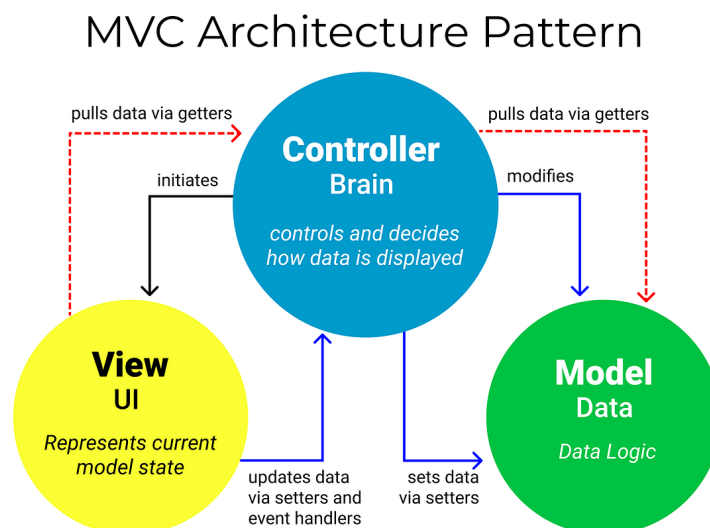


Figure 7.23: Model-View-Controller Diagram

This pattern was enforced throughout the code base, in order to ensure that component scripts were kept short, clear and simple, in order to facilitate code analysis and correction when necessary.

7.2.4.2 State Pattern

For managing the scene transitions between Static Scenes, School Break Scenes, the Day Outcome screen of each day and the Main Menu, the problem was approached with a state machine, as scattering scene transitions throughout several scripts would make debugging the transitions much more time spending.

Instead, a class named *Sequence* (divided in its Model-View-Controller components) was developed to keep track of the state of the game and handle scene transitions as the transitions of a finite state machine like the one illustrated in **Figure 7.24**, represented by methods developed in this class. This way, this class kept constant track of the state of the game, while also only allowing valid scene transitions from one state to another. After implemented, this class served as an abstract for the two types of scenes handlers (*StaticScene* and *Break*, also divided in layers) for managing specific characteristics of Static Scenes, such as requesting interactions to be loaded, and School Break Scenes, such as checking and updating the timer.

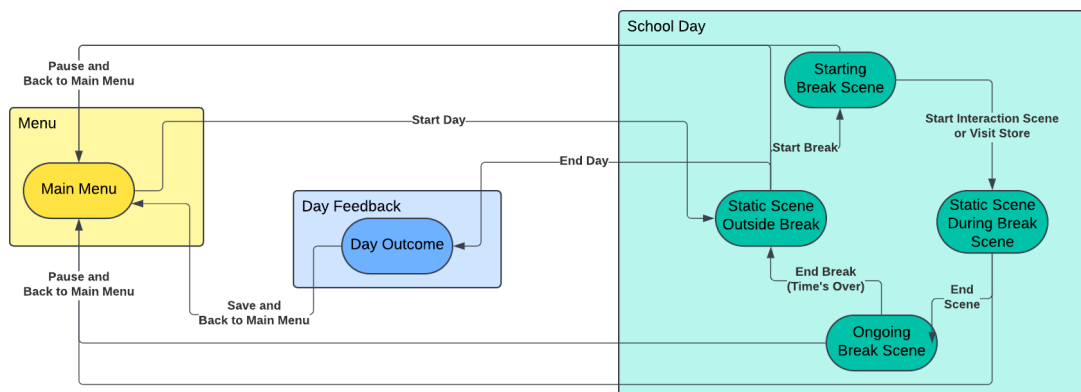


Figure 7.24: Emotion Rush State Machine for Scene Management

Chapter 8

Co-Design: Validation

This chapter provides details on the validation process of Emotion Rush, its outcomes and what improvements were made to the game after it was over.

The first section details the usability testing process carried out with healthcare professionals.

The second section details the feedback received from this project's collaborators, that are also taken into account for improving the game.

The third section presents a discussion on the main takeaways from the validation process.

The fourth and last section provides a description of what improvements were made to Emotion Rush based on the takeaways from the validation process.

8.1 Usability Testing

This section describes the procedures through which usability tests were carried out on Emotion Rush, as well as the gathered results. It also provides a discussion of these results and details on the improvements made to Emotion Rush after this study.

8.1.1 Procedure

Like previously done with the conceptualization phase, a convenience sample made of healthcare professionals that already collaborated with other LIACC projects was used for the usability testing of Emotion Rush. In order to validate the MVP, the game was made available to participants through Google Drive for Android devices as an Android Package file, as well as through a WebGL build on Unity Play, to allow for testing in iOS devices through a browser. This also allowed for testing it on a computer browser using a mouse, if it wasn't possible to test it on mobile. The links for accessing the Google Drive and the Unity Play build were sent via email to the healthcare professionals, together with a link for a questionnaire made in UPorto's survey platform. In the email sent, healthcare professionals were told to test the game for as much time as they wanted and then fill in the questionnaire. The participants were given 13 days to test the game and fill the questionnaire. The participants of the previously carried out interview process were also contacted to participate in this phase of the study.

8.1.1.1 Data Collection Methods

The questionnaire made available in UPorto Survey's platform included questions regarding their sociodemographic data, professional experience, experience with the game and insights towards its possible effects on adolescents in RC. Usability questionnaires such as the System Usability Scale (SUS), the Intrinsic Motivation Inventory (IMI) and the User Satisfaction Evaluation Questionnaire (USEQ) was initially planned, but was discarded because of the absence of an authorization from the ethics committee. Instead, the conducted questionnaires contained only open answer questions about their experience, used only as a way of gathering data on the feedback of the participants. The questionnaire was divided in four parts, detailed below. The questionnaires were written in portuguese and no question was mandatory.

Sociodemographic Data

Initially, participants were asked about their gender, age, nationality and their area of professional expertise. Additional information that could identify the participants was never asked, to ensure the anonymity of everyone that participated in the study.

Professional Experience

In the second part of the questionnaire, participants were asked two questions. First, they were asked if, in the past, they had used any modern technology in the context of the interventions they make, and, if yes, what technologies did they use. Then, participants were asked if, in the past, they had already used any digital game or tool for promoting ER in their interventions and, if yes, what tools did they use.

Experience with Emotion Rush

Following the Professional Experience segment, the participants were asked to answer some questions regarding their experience with the game, listed below:

- For how many hours have you played Emotion Rush?
- Would you like to have played for longer? Why?
- Did you like Emotion Rush? Why?
- What positive aspects would you highlight in Emotion Rush? Justify each of the aspects mentioned.
- What aspects to improve would you highlight in Emotion Rush? Justify each of the aspects mentioned.
- What type(s) of device(s) have you used to test Emotion Rush? (Participants were given the options: "Android Smartphone", "iPad", "iPhone" and "Other")
- Have you found any problem(s) while testing Emotion Rush? If yes, describe them.
- Do you think Emotion Rush should be changed in some way? If yes, what would you change?

- Which method did you use to test Emotion Rush? (Participants were given the options: "Installation in Android Device" and "Through Browser")

Emotion Rush and Adolescents in Residential Care

Lastly, participants were inquired about their insights regarding what they think the impact of Emotion Rush would be on the target audience, through the questions listed below:

- Do you think Emotion Rush could have a positive impact on the ER skills of adolescents in RC? What benefits do you foresee?
- Would you recommend Emotion Rush to adolescents in RC? Why?
- Do you think adolescents in RC would like to play Emotion Rush? Why?
- Do you think Emotion Rush incentivizes adolescents to replay it? Why?
- Do you think Emotion Rush's replayability incentive would have a positive impact in promoting ER in adolescents in RC? Why?
- How frequently and for how many time do you think adolescents in RC should play Emotion Rush? Justify your answer.
- Do you think Emotion Rush in its current version can positively impact the ER skills of adolescents in RC? Why?

8.1.2 Results

This section presents the results of the usability testing process carried out between the 9th of June and the 22nd of June, obtained from the questionnaires described above. Throughout this period, participants were able to test and explore the game freely and the questionnaire was made available for them right away.

8.1.2.1 Participants

As illustrated in **Table 8.1**, the sample contained 2 participants with ages ranging from 29 to 37-years-old, all of them female, Portuguese and working in areas of psychology. All of them declared having used modern technologies in the context of interventions they have made in the past, naming technologies like VR and Digital Games while also naming some examples such as *Cogweb*, *Cogmed*, *NeuronUP* and *CogniFit*.

8.1.2.2 Experience with Emotion Rush and Feedback

As shown in **Table 8.2**, participants tested the game for about 45 minutes on average, either on an iPhone ($n = 1$) or on a PC ($n = 1$).

Table 8.1: Participants' Sociodemographic Data

		<i>n</i>	%	$\bar{X}$
<i>Professionals</i>	Gender			
	Female	2	100%	
	Male	0	0%	
	Age (range)			33 (29–37)
	Area of Expertise			
	Psychology	2	100%	
	Nationality			
	Portuguese	2	100%	
	Past use of technology in ER promotion			
	Yes	2	100%	
	No	0	0%	
	Past use of SG's or digital tools in ER promotion			
	Yes	1	50%	
	No	0	0%	

Table 8.2: Participants' Testing Context

		<i>n</i>	%	$\bar{X}$
<i>Professionals</i>	Hours Played(range)			0.75 (0.5–1.0)
	Devices Used			
	<i>iPhone</i>	1	50%	
	Other (PC)	1	50%	
	Testing Method			
	Installing on Android	0	0%	
	Running on Browser	2	100%	

One participant reported a desire to be able to play and test Emotion Rush for more time, stating they found it interesting but were able to play it just enough to be able to explore it ($n = 1$). The other declared feeling like they didn't need to play it for more time ($n = 1$).

All participants expressed a positive view on Emotion Rush, declaring they liked the game ($n = 2$) and, when asked why, described it as highly interactive and diversified ($n = 1$), highlighting features such as being able to move the character around and dialogue choices ($n = 1$).

Participants pointed out many positive points regarding Emotion Rush. One of the participants described the game as having simple and direct mechanics and gameplay that incentives player engagement, including younger adolescents and people that are not used to playing videogames ($n = 1$). One participant also highlighted the quality of the sound effects and music on the game ($n = 1$).

As aspects to improve on Emotion Rush, participants picked the amount of text presented to the player at once, that they believe should be reduced and presented on a more easily readable

font ($n = 1$), as well as presenting more context and reflection on why the player should work on regulating certain emotions and certain contexts ($n = 1$), as well as offering information regarding the usefulness of each emotion ($n = 1$). Lastly, participants also suggested adding some kind of progressive difficulty and a bigger diversity of scenarios and emotions, so the game doesn't become repetitive after some time ($n = 1$).

None of the participants reported any technical problems accessing and testing Emotion Rush.

All participants considered that Emotion Rush could have a positive impact in the ER skills of adolescents in RC, with one of the participants adding that the game could reinforce emotion identification which is one of the main difficulties of these adolescents, while also adding that the SG format makes it a more appealing approach than verbal interventions, making Emotion Rush particularly useful for training adolescents that may show resistance to psychotherapy or that have trouble expressing their emotions.

All participants stated they would recommend Emotion Rush to adolescents in RC, with one of them adding that, while they believe the game would have a limited impact that could be increased by framing it in a structured program with oriented reflection moments and player supervision ($n = 1$).

All participants declared believing that adolescents in RC would like playing Emotion Rush, with one of them adding that while obviously not all adolescents will take interest into playing it, it is probable that many will be captivated to play it, especially if it is adapted to their profile and well introduced ($n = 1$).

When asked if they believe the game incentivizes replayability in the way it is designed, both participants answered positively, but one of them declared that while they believe the game contains elements that incentivize adolescents to replay it once or twice, it might not have strong enough components to incentive continuous replayability, as these adolescents have different motivation, attention and frustration tolerance levels.

All participants stated they believe that the way Emotion Rush incentivizes replayability would positively impact the ER skills of adolescents in RC ($n = 2$), as repetition would further improve skills of emotion identification and impulsive reaction regulation, but, as stated above, Emotion Rush could still improve regarding the way the replayability is incentivized.

One participant suggested that Emotion Rush should be played once per week for about four to six weeks.

Participants stated they believe that, even in its current version, Emotion Rush can already have positive impacts in the ER skills of adolescents in RC ($n = 2$), especially regarding emotion identification and dealing with impulsive reactions ($n = 1$).

8.1.3 Discussion

The feedback obtained in this study was overall positive. While interest in testing Emotion Rush for a longer period was shown by some participants, all participants expressed their approval of Emotion Rush in its current state, highlighting its characteristics such as freedom of choice, diversity of scenarios and outcomes, simple and direct mechanics and replayable non-linear structure.

This study pointed out that Emotion Rush adequately promotes emotion recognition and could be an effective approach with psychotherapy resistant adolescents in RC. The integration of Emotion Rush in structured intervention programs involving supervision and oriented reflection is a possibility to be thought of for the future of the project.

Overall, psychologists described Emotion Rush as adequate and even recommended for use with adolescents in RC, especially if the game is further tailored to their profile and adequately introduced to them.

This study also lead to identifying improvements for the current version of the SG, specified below:

- Reviewing dialogues and reducing the amount of text presented to the player at once.
- Change the dialogue text font to a more easily readable font.
- Portraying the usefulness of each emotion, as well as more clearly showing the motivation for regulating them during interaction scenes.
- Increasing the diversity of interaction scenes.
- Adding some kind of progressive difficulty to the game.
- Further incentivizing long-term replayability through additional mechanics.

No technical problems were reported by the participants. While this is positive, the reduced sample size does not allow for taking many conclusions regarding its reliability as a software.

Overall, while the study provides limited conclusions because of the limited size of the analyzed sample, the received feedback points towards the adequateness of Emotion Rush as an SG for promoting adolescent ER in RC, which can be interpreted as a sign that it is more than ready to be tested with adolescents in RC now.

8.2 Designer Feedback

Adding to the results obtained from the Usability Testing questionnaires, Emotion Rush was also sent to a graphic designer that provided insight on the current state of the game and suggested changes and adjustments that were taken into consideration.

The graphic designer pointed out some important adjustments mainly regarding the GUI, that are listed below:

- Adding instructions on how to play Emotion Rush to the Main Menu, additionally to having them on the Pause Menu and on the tutorial at the beginning of a new save.
- Creating consistency on the text font size, as some dialogues adjust the font size according to the amount of text in the current line.

- Being more clear regarding how the players can save the game, as it may appear that the player is unable to do so at the end of each in-game day.
- Creating visual consistency by keeping the same button spacing for different button panels in the GUI.

8.2.1 Discussion

The additional feedback added some possibilities of improvement for the current version of Emotion Rush.

The suggestions revolve around adjustments regarding visual aspects of the game, like the text font size, adding additional guidance through GUI elements for unexperienced players and ensuring visual consistency.

As these suggestions do not reflect big reworks of Emotion Rush's concept, instead providing ways for the game's concept and current version to improve, it can be concluded that Emotion Rush's concept and current version are adequate for promoting ER with this target audience, despite still clearly having room for improvements, which is also supported by the carried out usability tests.

8.3 Improvements After Validation

This section details the improvements that were still achieved after the Usability Testing and applied to the latest release of Emotion Rush.

8.3.1 Usability Testing

As the usability testing study finished with little time available for further adjustments, the suggested improvements had to be moved to future work, as they involved complete revisions of interaction scenes (reducing amount of text and portraying usefulness of each emotion and motivations for regulating them) or adding new content (more interaction scenes and mechanics for progressive difficulty and long-term replayability), that should be accompanied by new usability testing studies with healthcare professionals and adolescents in RC.

As for the text font adjustment suggested by one of the participants of the study, the effectiveness of the text font (and possible replacements) would need to be evaluated through studies with adolescents in RC, so this adjustment was also moved to future work.

8.3.2 Designer Feedback

Regarding the additional feedback from the collaborators, some adjustments were made to Emotion Rush's GUI to accommodate their suggestions.

First, an "How to Play" button was added to the Main Menu, as illustrated in [8.1](#) in order for the players to be able to check the game instructions before starting or resuming their gameplay.

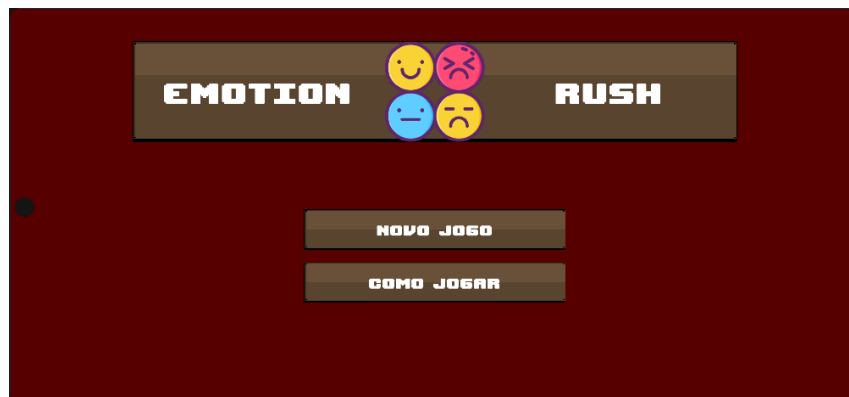


Figure 8.1: New Main Menu GUI with How to Play Button

The How to Play section contains five pages of information, like shown in **Figure 8.2**, regarding the contents explained in the tutorial and in the Help section of the Pause Menu. Information was also added regarding how to save the game progress.

To ensure visual consistency, button spacing was also adjusted, as suggested by the collaborator designer.

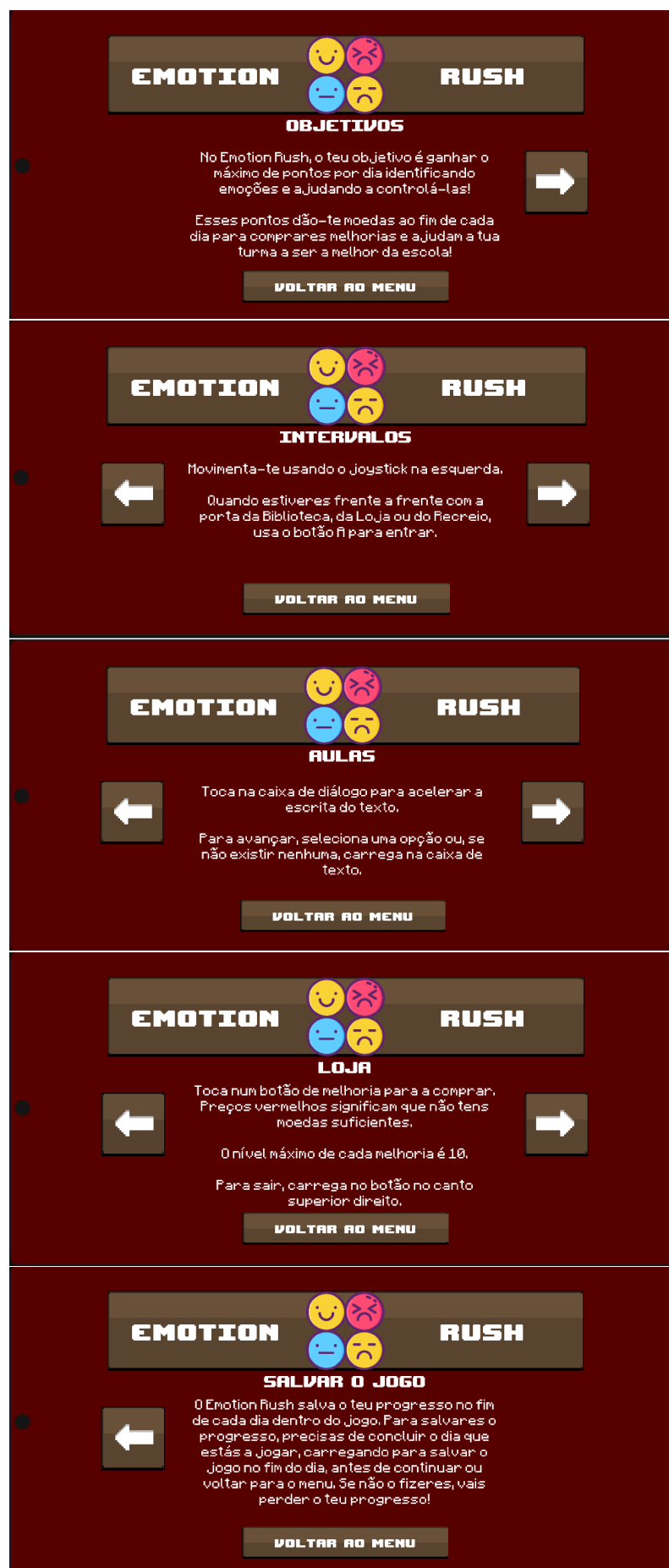


Figure 8.2: How to Play Info Pages

Chapter 9

Conclusion and Future Work

This final chapter summarizes the all of the work carried out during the course of this dissertation, while at the same detailing what remains to be done.

The first section presents a summary of the project, detailing its scientific divulgation, contributions and limitations.

The second section presents the next steps to be carried out regarding Emotion Rush and its development.

9.1 Conclusion

This dissertation's main goal was the co-design and development of an SG for promoting ER in non-clinical 12-to-18-year-old individuals in RC contexts. For it to be achieved, this dissertation also had as objectives the research on adolescent ER, RC contexts and SG development, as well as the full documentation of the process through this document and the assessment of acceptance of the SG through usability testing with stakeholders.

From this project resulted Emotion Rush, the first SG for promoting ER in adolescents in RC contexts, developed in co-design with healthcare professionals and designers. The co-design approach allowed the team to see these objectives through multiple lens beside the developer lens, in order to understand the requirements of the game that was developed.

Based on three research phases and two phases of co-design, this study widened the research for adolescent ER promotion by targeting a specific group of adolescents for which there were no digital games for promoting ER developed so far. Given their particular life situation and how it makes them more vulnerable to ER difficulties, having a game specifically developed to be appealing for them and answer their needs regarding ER development is highly beneficial for their psycho-social development.

Based on other games developed for adolescents, either for promoting ER or for promoting other aspects of adolescent health, Emotion Rush combined the insight of what is appealing for adolescents from other already developed SG's, the theories of James Gross and Paul Ekman regarding emotions and ER and the data on current RC contexts with the insights of healthcare

professionals specifically focused on tailoring this game for adolescents in RC contexts, creating a game that combines multiple elements that appeal to the members of this vulnerable group, leading them to take interest in trying out Emotion Rush. The game then incentivizes its replayability through its endless game cycle and non-linear structure, as well as randomized order of content presented, which makes players learn from repetition.

9.1.1 Summary

For meeting the objectives of this dissertation, this project kicked off with a thorough research on the topics of ER, RC contexts and SG Development, in order to better understand these key concepts and use the insights of the available literature on them as a reference for the rest of the dissertation. From this initial research resulted a better comprehension of the three dimensions of this dissertation, as well as a better understanding of Paul Ekman's Model of Emotions and James Gross' ER Model, two theoretic models selected for the Theory-Driven approach later applied for development.

After this, a systematic review about Serious Games for Adolescent ER was carried out, in order to understand what approaches were previously used for ER promotion in this age group. This systematic review allowed for understanding common methodologies, tools and characteristics between previously developed digital games for adolescent ER, as well as finding out what has already been done in this area and what contributions could Emotion Rush make towards it.

To further increase the research base regarding SG Development, an additional scoping review was carried out in order to research other SG's for promoting adolescent health, regarding aspects other than ER. This review added to the understanding about which approaches are more appealing for adolescents regarding SG's for health promotion, complementing the previously carried out systematic review.

While the project's research was carried out, the co-design process for the involvement of adolescents in RC and healthcare professionals was also prepared. Once research was over, an interview process with healthcare professionals that accepted to collaborate with the project was carried out, in order to obtain their insights and combine them with the carried out research when designing and developing Emotion Rush.

After the interview process was done and the results were properly analyzed, Emotion Rush's iterative development kicked off after a brief period of conceptualization.

After the MVP was achieved, it was made available to healthcare professionals that accepted to take part in usability testing Emotion Rush. At the same time, the game was also tested by a designer, that gave her own insights regarding the GUI and other design choices regarding this version of the game.

Considering the feedback from both the usability tests and the designer collaborator, adjustments were made to Emotion Rush, either to fix bugs or make improvements to the experience. Additionally, Emotion Rush underwent some additional refactoring and testing, in order to detect and fix any additional problems, as well as make sure Emotion Rush's code base is well organized, documented and easy to update and maintain.

9.1.2 Limitations

While the objectives of this dissertation were mostly achieved, the project suffered from a significant limitation, already mentioned previously: the impossibility of carrying out the planned co-design process with adolescents in both the conceptualization and testing phases, due to the absence of a response from the ethics committee since early December of 2024, when all documentation was sent for obtaining authorization for the co-design process to be carried out.

This major limitation ended up causing some slight delays on the project, that eventually lead to postponing contact with adolescents in RC contexts to future work, in order to not delay the project any further. While this means that Emotion Rush couldn't yet be validated by the target audience, the outcomes from the usability tests with healthcare professionals revealed a very positive acceptance of the game and allowed for an initial adjustment phase, before testing the game with the target audience in the future.

9.1.3 Scientific Divulcation

Throughout the work carried out on this dissertation, the team participated in multiple conferences through the submission of papers regarding this project. More detail on these conferences is presented below.

- **IJUP - Investigação Jovem da Universidade do Porto:** The University of Porto's Young Researchers Meeting is an annual event where University of Porto's students are able to present and discuss projects they have been involved in. This year's edition happened between the 7th and 9th of May. For attending the conference, an initial abstract was submitted, describing this dissertation's project, and then, after the project was selected for the conference, a poster was developed and presented in person. After presentation, this project was chosen to be distinguished with an award for Best Poster Presentation by the conference's jury, on the 26th of June.
- **EUGLOH Annual Summit - European University Alliance for Global Health:** The European University Alliance for Global Health Annual Summit will happen in Porto between the 13th and the 15th of October. For participating this conference, a submission containing an updated curriculum, a letter of motivation, an abstract of the work carried out for IJUP and a certificate of enrollment on FEUP was made, after the conference was suggested by the IJUP jury as a way to further divulge the work presented at IJUP. The submission was not accepted, due to the fact that an enrollment on University of Porto in the first semester of 2025/2026 would be necessary, as it is the moment where the conference will occur.
- **IEEE Conference on Games 2025:** IEEE's Conference on Games is an annual event for presenting and discussing technical, engineering and scientific work on video games, board games and other types of games that will take place from August 26th to 29th. For this conference, a short paper was written and submitted on the 30th of May regarding the development state of Emotion Rush. This paper was rejected on the 29th of June.

9.1.4 Contributions

After the development of this dissertation, this section addresses the research question of this dissertation, defined in **Chapter 1 : Introduction**, showing the contributions of this project towards answering it:

Is it possible to co-design and develop a theory-driven serious game for promoting and developing ER competences in 12-to-18-year-old adolescents living in RC contexts?

9.1.4.1 Co-Design

Regarding the co-design process, it is important to mention how it heavily contributed towards guiding the conceptualization process prior to development. While the carried out research provided many important insights regarding SG development, adolescent ER and RC contexts, no games for promoting adolescent ER in RC contexts were found in the literature. Thus, being able to directly question professionals that work with these adolescents and know about their needs and preferences was crucial to understanding the requirements of this project and tailor Emotion Rush to them. Additionally, the interview process also allowed for confronting the literature with current situations regarding RC contexts and ER promotion through SG's, which made some decisions about Emotion Rush's design easier to make.

At the same time, usability tests allowed for Emotion Rush to be tested through multiple optics other than the developer's, which made it easier to detect problems and aspects to improve that could go unnoticed if the game was only tested from a developer's point of view.

Despite the limitations encountered in carrying out the co-design process with adolescents in RC, detailed in the next section, Emotion Rush not only proves it is possible to co-design an SG for adolescent ER in RC contexts, as it is also recommended to do so, to ensure adequateness and increase the acceptance of the game.

9.1.4.2 Theory-Driven Development

While Co-Design was key for achieving the current state of Emotion Rush, the previously carried out research detailed in **Chapters 2 : Background** to **4 : Other Serious Games for Adolescent Mental Health** was also fundamental for achieving the results of this dissertation, as Emotion Rush heavily relied in the Paul Ekman's Model of Emotions and James Gross' ER Model.

Without this initial research process and the carried out literature reviews, not only would the co-design process be much harder to plan and carry out, but there wouldn't be any basis for making decisions for developing Emotion Rush.

Therefore, for the success of this dissertation, Co-Design and Theory-Driven Development were complementary, as Emotion Rush couldn't have been achieved without one or the other.

9.1.4.3 Target Audience Age

Throughout this dissertation, following the carried out research and the interview process, it was concluded that, as a target audience, "12-to-18-year-old adolescents in RC contexts" is a very broad group in terms of cognitive development, needs and preferences. Therefore, Emotion Rush was developed having 16-to-18-year-old adolescents in mind, despite not containing any content that can't be presented to younger adolescents if they take interest in the game.

9.1.4.4 Acceptance in Residential Care Contexts

Considering the outcomes from the usability tests, Emotion Rush was positively evaluated by healthcare professionals, that provided insights regarding possible improvements, adjustments and corrections that could be done to Emotion Rush. This feedback allowed for understanding how to further improve and adjust the game before following with usability testing processes with adolescents in RC, increasing acceptance and adequateness of the game.

9.1.4.5 Final Answer

The work carried out during this dissertation proves that not only is it possible to involve stakeholders in the design of a theory-driven SG for promoting adolescent ER in RC contexts, but it is also beneficial to do so, as the insights from stakeholders regarding target user needs and preferences, as well as their different optics and points of view regarding the aspects of the SG provide knowledge that complement the literature that serves as basis for the Theory-Driven development process. While 12-to-18-year-old adolescents are a broad group and SG's should, when possible, be directed to a smaller age group inside that interval, it is possible to co-design and develop a theory-driven SG for this target audience.

9.2 Future Work

During the development of Emotion Rush, there were many aspects that were thought of that ended up considered as secondary increments, that weren't crucial or necessary for the MVP and thus ended up not being implemented in the initial versions of Emotion Rush obtained at the end of this dissertation. However, now they acquire new importance, as the MVP has now been achieved and Emotion Rush can benefit from these ideas to increase its acceptance and effectiveness with its target audience. At the same time, while the feedback from the usability tests with healthcare professionals and from collaborators already resulted in many adjustments to the current version of Emotion Rush, there are some major improvements that Emotion Rush would also benefit from.

First, Emotion Rush would benefit a lot from carrying out usability tests with adolescents in RC contexts, as originally planned, which would allow for understanding how the game can be adjusted to be even more appealing and beneficial for the target audience. Additional usability tests with a larger sample of healthcare professionals would also be beneficial for further assessing the current state of Emotion Rush.

The addition of customization elements for adolescents is one of the main discussed aspects that ended up not being added to the MVP, such as allowing them to use coins they win in the game for purchasing options for visually customizing their character inside the game, customizing other characters such as classmates, teachers and school staff or even unlocking options of new environments to visit inside the school, such as school clubs, where new situations could be presented to them. This would only be possible after contacting with adolescents in RC contexts, to understand what customization elements and what themes would appeal to them the most. Customization would also include possibilities like defining the gender of the player controlled character and their name, to allow for the players to feel more immersed and closer to the character. This change towards a more player customizable game is supported by both the interviews and the feedback from professor Mariana Sousa in the usability testing phase.

Another improvement would be the possibility for adjusting the content that can be shown inside the game regarding Interaction Scenes, as some themes and topics may be sensitive or triggering for some adolescents. The way interactions are stored through JSON files in Emotion Rush would easily allow for developing a tool integrated inside the game to allow for therapists and caregivers to create new Interaction Scenes for adolescents and add them to their game, as well as editing or even blocking some Interaction Scenes from appearing for a specific player that may be triggered by them otherwise. This would also allow for the game to be more easily integrated in therapeutical interventions where players could be supervised while playing.

Emotion Rush would also obviously benefit from an increase in the amount of Interaction Scenes. The diversity of situations covered in the game, portraying different student life aspects and presenting different emotions and ER strategies in different contexts would improve the replayability aspect of the game, allowing for showing how similar situations may sometimes be caused by different emotions and how cognitive reappraisal and emotional suppression can be applied to different situations. It would also be beneficial to expand the game not only in terms of interactions but also in terms of environments, portraying events outside of school like school trips, hangouts with friends or even moments inside the RC institution. Through this, the game could also work with more topics around Emotion Regulation, such as Michael Lewis' self-conscious emotions [83] or providing more detail on the usefulness of each emotion and the motivation for regulating it in each situation. All of these would raise the amount of content the player would be shown inside the game, making it less repetitive, more replayable and thus more effective towards promoting ER for adolescents.

Accompanying the addition of new interaction scenes to the game, it would also be important to revise and adjust the current interactions present in the game together with healthcare professionals and adolescents, to ensure their adequateness, their appeal and their clarity regarding the ER promotion, but also to create visual consistence and keep a fixed text font size for every dialogue line, which would require revising the amount of characters in each line.

Emotion Rush's replayable structure also has room for improvement that should be studied in the future, through progressive difficulty and additional mechanics, to ensure players engage with it in long-term, increasing its effectiveness in ER promotion.

Finally, Emotion Rush would also benefit from frequent updates for fixing issues, improving performance and user experience and even for making the game compatible with other platforms in the future, such as PC or even consoles.

It is worth mentioning that all of these improvements would need to be accompanied with new phases of usability testing with both adolescents in RC and healthcare professionals, to ensure each of them would impact the game positively and increase its acceptance and effectiveness.

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