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Co-creating a gamified tool for cannabis and tobacco use monitoring: Participant-driven development

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ABSTRACT

Introduction: The growing use of cannabis, often alongside tobacco, presents challenges for substance use treatment programs (SUTPs), as it intensifies withdrawal symptoms. To address dual dependencies and improve engagement, we developed a gamified web app for individuals in SUTP who use cannabis to monitor their use. This paper describes the tool's co-creation process and and, findings that guided alignment with target needs.
Methods: Seventeen adults with current or past cannabis use were recruited from SUTPs in Catalonia (2021–2023). Using a qualitative, participatory design, the study involved reflexive thematic analysis and co-creation with researchers, clinicians, and gamification experts. Development followed four phases: (1) Discovering, expectations and motivations through interviews; (2) Deepening in Co-design, exploring needs and profiles; (3) Narrative Development, basing stories on real experiences; and (4) Technical Development, adapting features to goals.
Results: In Phase 1, two archetypes were identified: "socializers" and "explorers", along with core values, such as acceptance, social connection, and life control. Phase 2 revealed expectations for content on autonomy, stigma

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reduction, empathy, self-confidence, tranquility, and curiosity as key motivators. Phase 3 created three stories. Phase 4 produced a customized tracking app, integrating questionnaires.
Conclusion: This study highlights the value of co-creation in designing interventions for SUTPs and demonstrates usefulness of participatory approaches to create mHealth tools. These approaches informed the app's design to align with individuals' motivations and preferences, grounded in lived experiences. The resulting web app provides personalized support for substance use treatment. Future research should explore clinical and behavioral impacts.

1. Introduction

Cannabis has become the most used illicit psychoactive substance worldwide (European Monitoring Centre for Drugs and Drug Addiction, 2022). In Western countries, one of the most prevalent and problematic patterns of use among people who use cannabis is its concurrent use with tobacco. This co-use is common in many societies and introduces additional challenges, as dependence on both substances exacerbates withdrawal symptoms from one or both substances (Livne et al., 2019), complicates treatment adherence, and reduces cessation rates (Agrawal et al., 2012; Serre et al., 2018). Despite its high prevalence, current treatment frameworks often do not dullyaddress the intertwined nature of dependence on both substances (Schauer and Peters, 2018; Wray et al., 2013).

In Spain, cannabis consumption has notably increased over the past decade (Fernández-Artamendi et al., 2021). The latest available data show that 43.7 % of individuals have used cannabis at least once in their lifetime, continuing the upward trend that began in 2013 (30.4 %) and reaching the highest value in the historical series (Observatorio Español de las Drogas y las Adicciones, 2024). Among adults aged 15–64, 40.9 % have tried cannabis, with 8.6 % reporting use at least once in the past month. Moreover, 90.6 % of those who used cannabis in the past month reported consuming it mixed with tobacco (Observatorio Español de las Drogas y las Adicciones, 2023).

A concerning consequence of this trend is the increasing number of individuals seeking help to quit cannabis use through Substance Use Treatment Programs (SUTPs). Cannabis accounts for 20 % of new treatment admissions to drug treatment centers in Spain, with most individuals seeking help voluntarily or due to family pressure (Observatorio Español de las Drogas y las Adicciones, 2023). Research indicates that nearly half of the individuals who use cannabis experience withdrawal symptoms. A significant proportion of these individuals have substance use disorders (SUDs), often accompanied by psychiatric comorbidities(Gowin et al., 2025), highlighting the need for better characterization of dual use patterns (Bahji et al., 2020).

However, traditional treatment programs often struggle to engage individuals with dual substance use disorders, partly due to the lack of real-time personalized support (Nguyen et al., 2024). In response, mobile health (mHealth) technologies have gained attention for their potential to enhance treatment adherence through real-time monitoring and tailored feedback (Smiley et al., 2020). Specifically, Ecological Momentary Assessment (EMA), a data collection method integrated into mHealth applications, allows real-time tracking of substance use behaviors and withdrawal symptoms while minimizing recall bias (Amagai et al., 2022; Meyerowitz-Katz et al., 2020). Nevertheless, despite their potential, many of these tools struggle to effectively engage end participants due to insufficient personalization, lack of immediate feedback, limited perceived value, and high cognitive load (Baptista and Oliveira, 2019).

In this context, gamification and serious games have emerged as promising strategies. Although positive outcomes have been reported in tobacco cessation, these strategies remain underutilized in the context of the treatment for other substances (Bindoff et al., 2016; O'Connor et al., 2020; Staiger et al., 2020). Furthermore, participant perspectives are often overlooked in the design of gamified applications (Ambros-Antemate et al., 2023; Bindoff et al., 2016; Krebs et al., 2019), even though collaboration with end participants is crucial for achieving high levels of acceptability, usability, satisfaction, and success (Anderson et al., 2024). Some authors have used theoretical motivational models and general design principles to guide the development of gamified web or mobile applications (Ambros-Antemate et al., 2023; Anderson et al., 2024). Therefore, integrating participant perspectives is essential, particularly in interventions targeting substance use populations, to ensure relevance, reduce attrition rates, and promote sustainable, healthy behavior changes (Blok et al., 2019).

To overcome these obstacles, serious games and gamification techniques have been successfully introduced in both educational (Koelewijn et al., 2024) and clinical contexts, including tobacco cessation programs (Bindoff et al., 2016; Krebs et al., 2019). To date, only one observational study has examined the impact of gamification on self-efficacy and motivation to quit among individuals who smoke using mHealth platforms such as apps or web tools (Rajani et al., 2021). The study provided valuable insights into the effectiveness of gamified interventions in promoting behavior change and enhancing treatment outcomes (Rajani et al., 2021). However, the application of gamification for monitoring clinical symptoms, substance use patterns, and treatment adherence remains limited (Ambros-Antemate et al., 2023; Eichenberg and Schott, 2017). When effectively implemented, gamification can significantly enhance participant engagement and improve data quality (Bitrián et al., 2021), both of which are crucial in substance use treatment.

This study is part of the DuCATA_GAM-CaT project, which aims to explore patterns of cannabis and tobacco co-use, as well as withdrawal symptoms, among individuals seeking cannabis treatment at substance use treatment programs (SUTPs) in Catalonia (Saura et al., 2024). As part of this broader goal, the project developed a gamified web app tool (based on EMA) that could engage participants in the daily reporting of their behaviors and experiences related to substance use and cessation.

The web app was co-designed with participant involvement at every stage -from conception to testing -to ensure functionality, appeal, and participant-centered design. It is a dynamic browser-accessible platform equipped with a broad set of interactive features.

The objective of this article is to describe in detail the co-creation methodology used in the development of the gamified web app. We focus on how participant input informed the design process and guided the selection of the app's features and game elements, to foster sustained engagement in daily self-reporting of tobacco and cannabis use and their withdrawal symptoms.

2. Methodology

2.1. Overall study design

This is a qualitative, descriptive study based on the participatory design approach (Jull et al., 2017). Conducted in Catalonia (2021–2023), the study includes a diverse group of stakeholders who actively contributed to and co-generated insights and knowledge, ensuring that the web app's design is aligned with participant needs (Vargas et al., 2022). The development was structured into four primary phases, each building upon insights from the previous one (Table 1).

2.2. Participants

The research team was responsible for participant recruitment, facilitation of interviews and co-creation sessions, and all stages of analysis. It consisted of an interdisciplinary group including the principal investigator, a PhD candidate, a qualitative methods expert, five clinicians from SUTPs, and three stakeholders with expertise in gamification. The gamification experts were part of a specialized company with over 16 years of experience, a scientist and academic in gamification, a game engineer, a storytelling expert with an advertising background, and a technical project manager.

This study used a purposive sampling strategy, selecting participants with specific characteristics to align with the objectives of each research phase (Guest et al., 2006). This approach ensured that the data collected was rich, relevant, and reflective of diverse perspectives, allowing for a comprehensive exploration of participant behaviors and needs.

Inclusion criteria for participants were to be at least 18 years old, have no active psychiatric or gambling disorder, have low or no current cannabis use, and have previously attended SUTP centers. Recruitment was conducted in collaboration with clinicians, who screened potential participants to confirm the absence of severe cognitive impairments and ensure their ability to engage meaningfully in the study. Additionally, clinicians helped guarantee diversity across age groups, gender balance, and profiles of individuals either overcoming or having overcome cannabis addiction.

The sample included 17 individuals with current or past cannabis use, 7 were women and 10 men, aged between 29 and 55 years, with diverse educational backgrounds and varying patterns of cannabis and tobacco use. This diversity reflects the heterogeneity of the app's target population and enriched the co-design process by incorporating a wide range of perspectives. The final sample size varied across study phases and was determined inductively, with sampling continuing until theoretical saturation was reached (Guest et al., 2006) (Table 1).

2.3. Analysis

Interviews continued until data saturation was reached (Guest et al., 2020). Afterwards, we conducted a reflexive thematic analysis(Braun and Clarke, 2021), tailored to each phase of the study. This approach allowed us to explore the nuances of participants' experiences while aligning the analysis with the objectives of each phase. Each phase was underpinned by relevant theoretical frameworks, such as participant-centered design for co-creation and behavioral change theories for engagement strategies (Table 1). To ensure rigor in the analysis, we followed Lincoln and Guba's criteria: credibility, transferability, dependability, and confirmability (Lincoln and Guba, 1985). All sessions were recorded and transcribed.

2.4. Study phases description

The following sections present a detailed description of the main phases of the web app co-creation process. Table 1 provides an overview of the methodological roadmap, including timeline and specific methodological choices for each.

2.4.1. Discovering phase

This phase aimed to gather insights from clinicians and participants (individuals who currently and formerly used cannabis) through interviews and gamification activities designed to promote self-learning and collaborative knowledge generation. Insights from three clinicians were obtained with several in-depth interviews to explore key issues related to cannabis-tobacco co-use, characterization of prototype profiles of use, treatment adherence, and challenges in therapeutic management.

Insights from individuals were obtained with a tailored board game that represented real-life situations and encouraged participants to develop coping strategies for achieving intermediate objectives in their quitting process, such as dealing with boredom or cravings. The game

Table 1
Overview of methodology description across the four phases of the study.

Period	Objective	Theoretical approach used	Participants	Data collection Techniques	Format and duration
Phase 1: Discovering					
September 2021 - February 2022	Characterize player types and individuals' profiles through gameplay testing.	-Marczewski's taxonomy -Reiss's classification	6 individuals who currently or formerly used cannabis, contacted via clinicians	Gamification activities (Table 2A)	Face to face, 90 min
	Gain insight into clinicians' perceptions of cannabis use among participants		3 clinicians from a public SUTP center	In-depth interview	Face to face, 90 min
Phase 2: Deepening in the co-design					
February –April 2022	Characterize player types, leisure preferences, and action motivators, which help to design the gamified web app tailored to participant profiles	. Marczewski's taxonomy -ASE model	9 individuals who currently or formerly used cannabis, contacted via clinicians	2 focus groups (Table 2B)	Online via Teams, 60 min
			5 clinicians from a public SUTP center	1 focus group	Online via Teams, 60 min
Phase 3: Storytelling					
May-June 2022	Create authentic narratives that reflect personal growth.	Designing Memorable Experiences -MDA* model -Hero's journey model	4 individuals in recovery from cannabis use	In-depth interviews about personal experiences to create 3 characters based on these stories (Table 4a)	Online via Teams, 60 min
Phase 4: Technical development					
July 2022- February 2023	Integrate previous phases to develop the web app using the gathered information, then test it to validate usability.		Same participants from Phase 3 Clinicians validated the web app.	Feedback on game mechanics and a monitoring software Testing of the experience to ensure it was suitable for participants.	

Note: Between 2021 and 2023, all sessions were facilitated by an interdisciplinary team including a principal investigator, a PhD student, one qualitative expert, five clinicians from public SUTPs, and three gamification specialists

* MDA: Mechanics, Dynamics, and Aesthetics

featured a lifeline mechanism with limited rolls resembling joints, and penalty cards for unsuccessful strategies or maladaptive strategies. The objective was to reward effective and realistic strategies (e.g., healthy distractions or social support) and penalize inadequate ones. The winner was the player who consumed the fewest joints and provided the most positive strategies to resist consumption.

Before testing the board game with the participants, the clinicians and the researcher group conducted two sessions to refine the game dynamics and the gamification methodology. Following this, a session was held with participants who had overcome cannabis use and individuals who had significantly reduced their consumption. Participants were briefed on the game mechanics, and the session was conducted by three researchers and one gamification expert. A total of six individuals participated (two women and four men, average age 43 years). Half of the participants were still using cannabis, and one had quit tobacco (Table 2a).

Findings from this phase helped to initially characterize player profiles, guiding the subsequent web app co-creation phase. In addition, insights into participant profiles were further analyzed using Marczewski's taxonomy (Marczewski, 2015), and motivators from Reiss's classification (Reiss, 2005), which were further explored in the subsequent phase.

2.4.2. Deepening in the co-design phase

This phase aimed to explore in-depth player profiles, leisure preferences, and action motivators, to inform the creation of the gamified web app. To gather the insights, the research team employed a collaborative methodology, using an adapted Serious Games Canvas tailored to the project's needs. Serious games combine entertainment and learning, often promoting lasting behavioral change, particularly in health contexts (Quintana and Garcia, 2017).

The Serious Games Canvas helped integrate motivational elements and reward mechanisms to provide engaging content and feedback. The design incorporates a shared care plan, integrating patient data, alerts, and goal setting, which activate intrinsic motivations like mastery, autonomy, social connection, and knowledge sharing. The game focuses on behavioral insights to deliver a comprehensive, motivational segmentation (Quintana and Garcia, 2017) and was grounded in the Attitudes, Social Influence, and Self-Efficacy (ASE) model (de Vries et al., 1988), which predicts health behaviors by subtly guiding players through scenarios involving refusal and trigger management.

The game involved exercises on briefings, behavioral expectations, skill training, and participant analysis. We applied Marczewski's player type taxonomy (2015), Reiss's intrinsic motivators (2005), and Radoff's game mechanics to refine elements relevant to patients and the clinical context. Participatory activities with individuals who formerly used cannabis, as well as clinicians, further shaped these elements.

The main objectives of this phase were to define the game's structure, identify player motivators, establish the narrative, and align expectations. This culminated in three online discussion groups with nine individuals (average age: 41 years; one-third continued using cannabis, one had quit tobacco) and five clinicians. Sociodemographic data are detailed in Table 2b. Their insights were essential for shaping the game's narrative, refining its design, and creating character profiles, enriched by the perspectives of both individual service users and clinicians.

Table 2
Participants' characteristics in phases 1 and 2.

A. **Characteristics of participants from phase 1: Discovering**

Sex	Age	Educational level	Current cannabis use	Current tobacco use
Woman	45	University	Yes	Yes
Man	44	Secondary	Yes	Yes
Man	48	Primary	Yes	Yes
Woman	50	University	No	Yes
Man	42	University	No	No
Man	30	Secondary	No	Yes

B. **Characteristics of participants characteristics from phase 2: Deepening in the co-design**

Sex	Age	Educational level	Current cannabis use	Current tobacco use
Woman	45	University	Yes	Yes
Woman	55	Secondary	Yes	Yes
Man	32	University	Yes	No
Man	29	University	Yes	Yes
Man	35	Secondary	Yes	Yes
Woman	50	University	No	Yes
Man	42	University	No	No
Man	44	Primary	Yes	Yes
Man	36	University	No	Yes

2.4.3. Storytelling phase

Our approach to gamification was anchored in four key elements of Designing Memorable Experiences: establishing aesthetic criteria, creating game mechanics, developing a relevant story, and selecting an appropriate technological platform (Schell, 2008). Additionally, we adhered to the MDA model (Mechanics, Dynamics, and Aesthetics), which formalizes the understanding of games and outlines several aesthetic dimensions, including storytelling (game as an unfolding narrative) as a central component of effective gamification (Hunicke et al., 2004; Limantara et al., 2020). These models emphasize narrative as a core component of engagement.

We conducted in-depth individual interviews with four participants who had successfully overcome cannabis addiction and who had previously participated in earlier phases of the study. (Table 3a). Drawing on Joseph Campbell's "Hero's Journey" model (Campbell, 1968), which outlines 17 narrative stages, we explored participants' personal journeys in overcoming cannabis addiction. The interview script was based on Christopher Vogler's (2007) adapted 12-step model, derived from Campbell's 17-step Hero's Journey (Vogler, 2007). Core principles such as hope, awareness, persistence, self-confidence, tranquility, and self-control were identified as crucial for the transformative journey to overcome addiction and guided the development of the game.

2.4.4. Technical development of the web app

This final phase integrated all previously gathered information and focused on the technical development of the web app, which was conducted by a specialized company. The main objectives were to implement the game design and storytelling elements, ensuring the web app reflected participants' real experiences while providing robust content and functionality, and integrating key research variables to pilot the web app.

During this phase, qualitative feedback was collected from participants and clinicians involved in earlier stages to ensure the web app's content and narrative aligned with their experiences and clinical needs. This iterative process involved continuous communication between the research team, clinicians, and developers.

However, due to constraints within the subcontracted web app framework, which did not support all the study's questionnaire items, we developed an additional software tool. This secondary tool allowed sending short questionnaires through a popular instant messaging service (WhatsApp) every six days. This software collected sociodemographic data, substance use, mental health, and consumption context. It was validated by clinicians and tested with individuals who formerly used cannabis.

Throughout this phase, both the web app and the additional software tool were reviewed and qualitatively validated by all stakeholders involved—including participants from earlier phases, clinicians, and researchers—to ensure that the narratives, character profiles, rewards, and collected information were coherent, representative, appropriate, and clearly understood.

2.4.5. Cross-phase synthesis

Insights from these four phases were crucial for shaping the game's

Table 3a
Characteristics of the interviewed participants in the storytelling phase used to create the profiles of the three game characters.

Participant	Sex	Age	Data collection technique	Interview Date	Duration	Profile substance individuals	Average years of consumption
1	Men	43	Online individual interview	2 May 2022	60 min	Cannabis and tobacco	20 years
2	Women	50	Online individual interview	2 May 2022	40 min	Alcohol and cannabis	15 years
3	Men	44	Online group interview	2 May 2022	70 min	Cannabis and tobacco (occasionally other substance use)	30 years
4	Men	30				Cannabis, tobacco (occasionally other substance use)	15 years

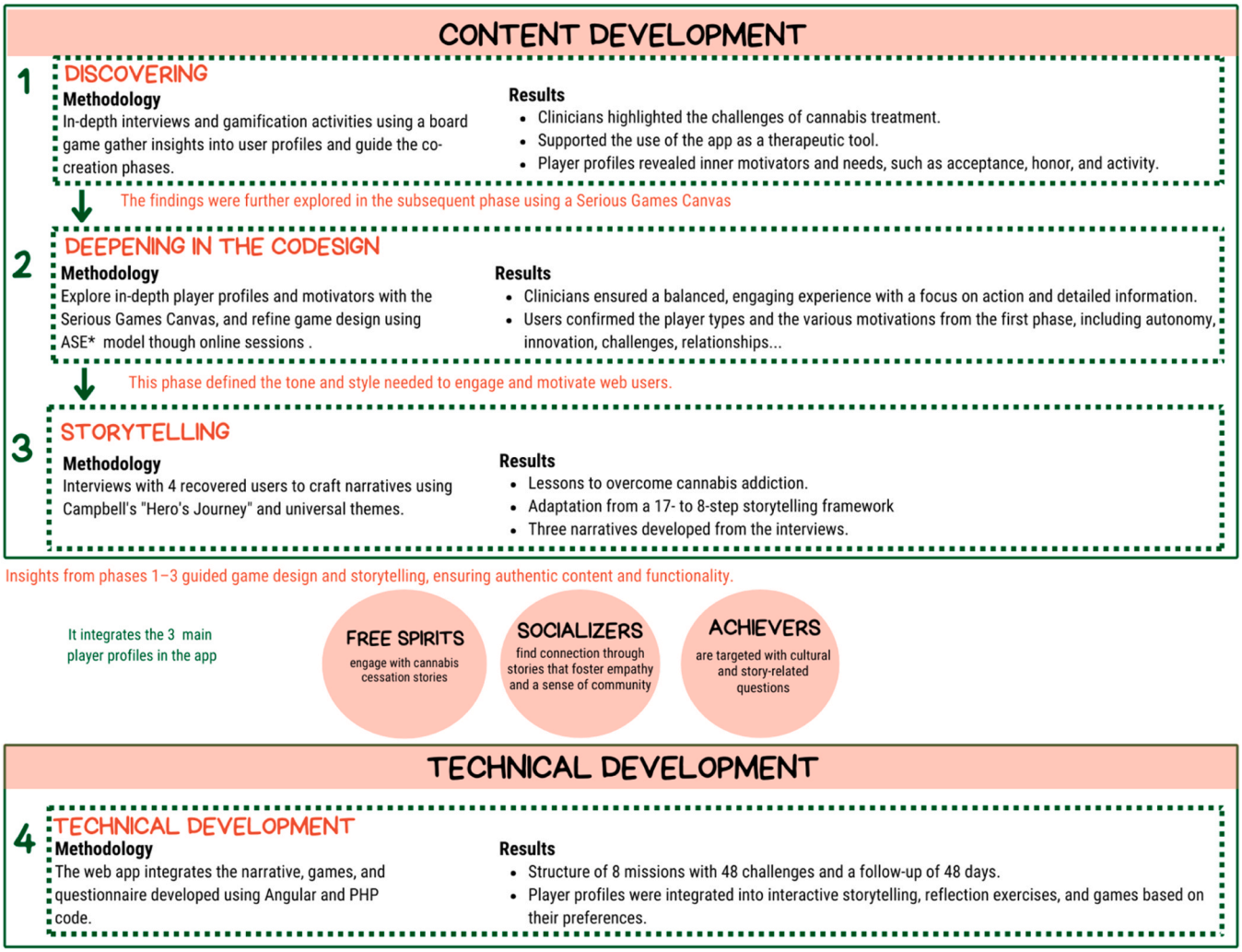

Fig. 1. Overview of the Methodology and results. Footnote: This figure outlines the co-creation process of the gamified web app across four phases: Discovering, Co-Design, Storytelling, and Technical Development, shown in steps 1–4. It highlights methodologies, results, and the integration of player profiles (*Free Spirits*, *Achievers*, *Socializers*), which informed the app's gamified features.

narrative, refining its design, guiding development, and creating character profiles (Fig. 1). The findings also highlighted the diverse perspectives of both participants and clinical professionals, enriching the application with elements from these distinct viewpoints. To ensure the rigor of the research, we adhered to the criteria outlined by Lincoln and Guba (1985) for credibility, transferability, dependability, and confirmability (Lincoln and Guba, 1985).

2.5. Ethical considerations

The study protocol of the DuCATA_GAM-CaT project was reviewed and approved by the Hospital Universitari de Bellvitge Ethics Committee (Ref. PR328/19) and registered on Clinical Trials [NCT05512091]. All participants in the qualitative study presented here provided written informed consent for each of the activities described above. All sessions were audio-recorded, securely stored, and anonymized for content review and analysis. To minimize attrition, participants received a compensation (€25 gift card), aligned with standard research practices for time spent in research activities. Participation was entirely voluntary, and participants were informed that they could withdraw at any time without penalty or loss of compensation.

3. Results

The findings have been structured according to the previously mentioned phases.

3.1. Discovering phase

Insights from clinicians: In-depth interviews with clinicians revealed key insights into cannabis-related issues and treatment adherence challenges, emphasizing the app's potential as a participant-care tool rather than merely a game. The significant adherence challenges faced by the population due to easy distraction supported the idea that gamification could serve as an effective and engaging method to gather valuable information and support treatment efforts.

From the board game, we captured valuable insights into participants' leisure and social activities. Leisure activities included watching comedy movies and series, listening to music, video gaming, taking online courses, playing with pets, and shopping: "*Well, given the stressful situation, I decide to go for a walk with my dog.*" (participant 5, male, former cannabis-using individual). Social activities involved cooking, partying, socializing with friends and family: "*So I decide to call my best friend to get rid of it.*" (participant 4, female, former cannabis individual) and engaging in sports like walking, running, yoga, or other physical exercise.

Participants who formerly consumed cannabis preferred social activities away from home to avoid consumption situations, demonstrating high self-awareness and responsibility, while participants who were current individual used digital contents and consumed cannabis individually: *"For me, it's important to leave home to escape the situation of substance use and arguments with my partner and my child… If I feel anxious, I run, I exercise"*. (participant 1, female, currently using cannabis).

Initial findings identified player profiles as socializers and explorers, with inner motivators including the demand for acceptance (seeking societal approval), social contact (important despite recurrence risk), need for order (regaining life control), independence, tranquility, and physical activity, the need for honor (boosting self-esteem), and trust from family members, as core values.

3.2. Deepening in the co-design phase

This phase generated results in three areas: participant expectations, intrinsic motivations, and players' profiles for the gamified application (see Table 4).

3.2.1. Participant expectations and needs phase

Participants emphasized the importance of the web app containing features that promote hope, educate about cannabis effects, and foster self-acceptance. They also sought tools to set and track personal and professional goals to empower their recovery process. Additionally, ensuring ongoing participant engagement and commitment to therapy was identified as crucial for the web app's design. They requested educational resources to deepen participants' understanding of cannabis use and its effects, encouraging self-reflection. They also highlighted the need to avoid stigmatizing negative emotions such as anxiety, anger, and frustration, advocating for a supportive environment instead. Participants' perspectives differed from those of clinicians, as they associated positive moments with social experiences—such as family, friends, work, and hobbies—emphasizing a holistic approach beyond just the effects of the drug.

Participants also wanted the web app to foster community support and reconnection with their social environment.

3.2.2. Intrinsic motivators for the gamified application

Key motivators included self-confidence, tranquility, and curiosity, supporting engagement and therapeutic effect.

Participants and clinicians saw freedom and fun as important recovery concepts, helping participants regain control and a positive perspective on their lives after overcoming their addiction and this was used later in the development of the storytelling script.

To promote consistent engagement, participants indicated that the gamified application should encourage ongoing interaction and reflection on usage habits. They emphasized the importance of understanding participants' evolving moods and motivations to adapt the app and support therapeutic change. Suggested strategies included offering alternatives to habitual cannabis use, emphasizing hobbies, incorporating humor, assertiveness, sharing authentic testimonials and normalizing experiences were seen as effective ways to build empathy.

3.2.3. Player profiles to shape the development of the gamified application

Participants identified three main player types for the gamified application: free spirits who value autonomy and innovation, and embodying entrepreneurial qualities; achievers who enjoy challenges, strive for excellence, and actively pursue success; and socializers, seeking to expand their networks to build relationships and engage with others.

Clinicians' insights shaped a balanced and participants-centered design focused on an engaging, practical, community experience. They emphasize maintaining formality while ensuring enjoyment, prioritizing action over mere reflection, and highlighting the importance of detailed and precise information throughout the participant treatment process.

This phase helped us to learn the tone and communication style required to engage and motivate potential web app participants.

3.3. Storytelling phase

Based on the insights from earlier stages, it was essential to ground the narratives of the Serious Game characters in real experiences related to cannabis use and abstinence (Table 3a). Participants emphasized the importance of normalizing experiences, dispelling misconceptions without judgment, and sharing personal stories as key elements for effective communication about addiction and recovery. These insights were instrumental in creating a compelling storytelling framework for the gamified web app.

Consequently, three narratives were created based on the information obtained from the interviews, each featuring two male and one female character to reflect the social and demographic profiles of participants (Table 3b). These narratives, which focus on overcoming cannabis addiction, were adapted into an eight-step storytelling framework for integration into the game (Fig. 2).

3.4. Technical development of the web app phase

Based on findings from the previous stages, the web app's development was closely aligned with the project DuCATA_GAM-CaT study's objectives and the co-creation findings. The resulting web app integrates features to enable real-time self-monitoring via EMA prompts, daily tracking of withdrawal symptoms, and elements that promote participant adherence through gamified engagement. Each design choice was informed by participant input and tailored to the target population. (see Table S1).

The technical implementation was carried out using Angular for the frontend and PHP (Hypertext preprocessor) with TypeScript for the backend. It supports daily tracking of cannabis and tobacco use through a five to seven-minute daily reporting process. The Serious Game includes an onboarding tutorial, eight missions with six challenges each, and a final recognition event (Fig. 2). Each challenge includes narrative segments about the three characters, enhanced with multimedia (Table 3b). Participants engage in rotating interactions—cultural questions, reflections on the story, and questions about substance use—and contextual questions at the end of each mission.

Player profiles shaped the game content: "Free Spirits" engage

Table 3b
Profiles of the three characters created, based on the participants' archetypes.

Characters names[a]	Sex	Age	Age at cannabis initiation	Average years of consumption	Cannabis type	The turning point	Personal circumstances
Anna	Woman	48	30	15	Hashish and marijuana	The threat of losing custody of her daughters	Divorced with 2 daughters
Alex	Man	44	12	29	Hashish	Psychotic episodes	He broke up with his girlfriend and grew apart from his friends
Manu	Man	35	14	20	Marijuana	His father's death	He inherited an old flat that he needed to renovate

[a] These names are common and cultural appropriate in the region of the study.

through story reflections, "Achievers" with cultural and story-related questions, and "Socializers" find connection through stories that foster empathy and a sense of community. The gamified aspects of the web app include easy puzzles, riddles, and other simple entertainment that do not require specialized skills to complete.

Stakeholder input during the pilot was used to iteratively refine the web app's content, focusing on qualitative insights rather than standardized usability or acceptability metrics.

4. Discussion

Our results highlight the relevance of adopting a systematic and inductive co-design approach when developing digital interventions for individuals seeking cannabis treatment and presenting co-use of tobacco. By involving substance-using individuals and clinicians across multiple phases, we were able to capture complex motivational, emotional, and social dynamics, echoing recent calls for more personalized and theory-informed digital health tools (Ambros-Antemate et al., 2023; Groos et al., 2024).

Our co-creation approach emphasized shared goals and collaborative knowledge generation, consistent with calls to involve key stakeholders in health innovation (Zhang et al., 2022). Our multidisciplinary team—gamification experts, researchers, clinicians, and current/former cannabis-using individuals—ensured the design was both effective and grounded in real-world experience (Vargas et al., 2022). Despite its value, co-creation is rarely applied in substance use interventions, especially among vulnerable populations. Our study addresses this gap by prioritizing co-creation to better serve the needs of this population. These insights informed storytelling, game flow, types of challenges, and reward systems. Notably, only 47 % of studies in serious game development explore storytelling in early stages, underscoring the novelty of our approach (Ambros-Antemate et al., 2023).

Applying participatory action research, we identified three key player typologies in this population (Marczewski, 2015; Vargas et al., 2022). Each typology guided the inclusion of features aligned with curiosity, freedom, and enjoyment. Participants also stressed the value of alternatives to cannabis use, like humor, hobbies, and authentic testimonials—which were incorporated into the narrative to foster empathy and support. Gamification in health is increasingly used to motivate and engage individuals in specific activities, such as in this case reporting their daily consumption of cannabis-tobacco (King et al., 2013). While gamification can enhance engagement, its effectiveness is significantly heightened when the games are grounded in robust theories and tailored to the preferences of the target individuals (Sardi et al., 2017). Our approach to gamification integrates the four key elements of Designing Memorable Experiences by Schell and incorporates the MDA model (Mechanics, Dynamics, and Aesthetics). We designed various games with careful consideration not to overwhelm participants, allowing them to concentrate on specific tasks. These games include elements that encourage them to empathize with the main characters and see themselves reflected in others' experiences through the storytelling in each mission (Bachen et al., 2016; Schell, 2008). This approach is particularly crucial for vulnerable populations, such as individuals who use cannabis and are seeking treatment at SUTP, who may experience cognitive impairment, slowed processing speed, and anhedonia due to prolonged cannabis use (Blum et al., 2021). Therefore, the gamified aspects of the app include easy puzzles, riddles, and other simple entertainment that do not require specialized skills to complete.

Regarding the storytelling, which was crafted using the "Hero's Journey" (Campbell, 1968), we employed that story for its potential to emotionally impact participants while mapping knowledge onto their existing mindsets, reinforcing it with rational arguments. The balance between empathy with the characters and the metaphor of the Hero that overcomes addictions is crucial for understanding, and this combination has been described as an ideal platform to engage in experiences (Quintana and Garcia, 2017).

Previous research using apps for substance use prevention has utilized gamification, yet many of these apps primarily target youth in preventing the use of alcohol or other drugs (Martínez-Miranda and Espinosa-Curiel, 2022) or focus on substances that carry less stigma than cannabis, such as alcohol (Staiger et al., 2020). To date, only one study has explored the use of an app with individuals who use cannabis, aiming to assess whether a cannabis cessation app could reach a broader population compared to community-based programs. Results indicated that app-based interventions may attract individuals who use cannabis with distinct profiles (Vederhus et al., 2020). Unlike this previous app, however, our approach represents an innovative, participants-centered model for mHealth tool development, involving co-creation with participants, clinicians, researchers, and technicians to ensure relevance, usability, and effectiveness.

The potential of mHealth interventions for individuals who use cannabis, though, extends beyond traditional program limitations by enhancing engagement and adherence. Research indicates that mHealth apps can increase participant retention by up to four times, particularly for those with clinical conditions (Amagai et al., 2022). The co-creation process followed in the DuCATA_GAM-CaT project illustrates how participatory design can inform the development of engaging and participants-centered digital tools for individuals seeking treatment for cannabis use. By involving participants throughout all stages of development, the resulting web app integrates features that are both functionally relevant and tailored to individuals preferences and needs. This aligns with prior evidence highlighting the value of participatory approaches in mHealth development to improve acceptability and usability (Gibson et al., 2024).

4.1. Limitations and strengths

While our study provides valuable insights into developing a co-created gamified app, it has some limitations. First, the sample may not be representative of the broader population of individuals who use both cannabis and tobacco. However, statistical representativeness is not applicable in qualitative methodology, which aims to achieve in-depth understanding of specific phenomena through purposive sampling rather than numerical generalization. Our focus was on identifying nuanced patterns and themes relevant to our target population.

To ensure the robustness of our findings, we employed purposive

Table 4
Selection of participant quotes to illustrate the information obtained from in-depth interviews, providing direct insights into their experiences, expectations, intrinsic motivations, and player profiles (Phase 2).

Sub-categories	Participants' Thoughts and Reflections about the application
2.1. Participant expectations and needs	
Support autonomy	"I picture myself being fine without using [substances] … managing to live without them… and finding other ways to handle problems, because we all have challenges, but you need to find ways to overcome them—whether through therapy, hard work (…). I see myself pursuing my goals, becoming healthier, and taking better care of myself. Quitting smoking is already a step towards self-care. I imagine continuing to take care of myself… finding a job… and rebuilding my life. I have hope for the future." (participant 1, female, cannabis-tobacco user)." "I want to see myself as I was not long ago stable and at peace, fully enjoying the moments of happiness, which pass by so quickly. When you're stable and calm, everything becomes easier to handle." (participant 8, male, cannabis- and tobacco-using individual). "Identifying some of the experiences people go through when they quit smoking. This allows us to better support them during withdrawal and provide effective help by detecting and understanding the symptoms." (participant 2, female, professional).
Avoid stigmatization	When I'm with my children, those are the best moments of my week. It's those times with them that bring me my greatest joy." (participant 8, male, cannabis- and tobacco-using individual). "For the past few months, I've started exercising. I used to be quite sedentary, but now, after I finish working out, I feel really good." (participant 6, male, cannabis- and tobacco-using individual). "Spending a day with my daughters really helps me." (participant 1, female, cannabis- and tobacco-using individual). "Some individuals also show a notable sense of apathy toward abstinence, suggesting that quitting smoking doesn't provide the benefits [to individuals] they had anticipated." (participant 4, male, professional).
Enhance empathy	"When you feel compassion, you experience much less frustration with yourself and others. You gain a better understanding of people, and during discussions, you can empathize more deeply if you have compassion." (participant 1, female, cannabis- and tobacco-using individual). "One thing that helps me a lot is that, due to my circumstances, I was in a centre where it was beneficial to take part in group sessions with different people. Hearing the external perspectives of others and their diverse viewpoints on the problem, as well as what they think of me, was valuable." (participant 4, male, cannabis- and tobacco-using individual).
2.2 Intrinsic motivators	
Self-Confidence, Physical Activities, and Tranquility	"Reducing anxiety, stress, and anger is crucial. Personally, I've worked extensively with breathing techniques, and when you find the right one, it's truly wonderful. I've also practiced mindfulness and any other relaxation techniques that work well for you can be very effective." (participant 6, male, cannabis- and tobacco-using individual). "A key idea is tranquility, especially because it calms anxiety before sleeping and helps induce sleep. When I smoke cannabis, I can stop thinking and feel calm. Similarly, when I smoke, things seem to go better. Although this is a mistaken feeling, that's how it is perceived." (participant 1, male, professional). "Living consciously and being aware of my actions at every moment leads to clearer thoughts. Peace means being calm and not depending on anything. This helps me manage the difficult moments that we all experience." (participant 7, male, cannabis- and tobacco-using individual).
Freedom and Identity.	"They feel trapped and heavily tied to their consumption. There is a lot of frustration, and some people experience anger. They want to change, but they don't know where to go. They feel lost and hopeless, often struggling with financial issues." (participant 1, male, professional). "Patients have been smoking for many years; it is part of their identity, and quitting cannabis means giving up an important aspect of their identity and their life." (participant 2, female, professional). "The feeling of being high is enjoyable if you like it; it provides relief. However, after a while, this sense of calm from cannabis turns into anxiety." (participant 6, male, cannabis- and tobacco-using individual).
Empathy-Driven Engagement	"What doesn't sit well with me is when someone comes to explain how drugs work, especially if they're simply reading from a manual (…) I don't think it's effective when someone without experience tries to describe what we've lived through. However, it is helpful to listen to someone who has gone through what we have—someone who can explain the beginning, the middle, and the end." (participant 6, male, cannabis- and tobacco-using individual). "Helping to identify some of the experiences people go through when they quit smoking allows us to better support them through withdrawal symptoms and assist them effectively. It involves detecting and understanding these symptoms." (participant 2, female, professional).
2.3. Player profiles	Participants defined themselves as primary players (in order of preference). 1. **Free Spirit**: Prefers to make choices, values autonomy, and enjoys exploring alternatives. They are entrepreneurial. 2. **Achiever**: Aims to excel, enjoys challenges, participates in optional activities, and strives for gold medals. 3. **Socializer**: Seeks to expand their network of contacts and friends, meet new people, engage in conversation, and socialize.

sampling to capture diverse participant profiles. Data collection and analysis followed an iterative process, continuing until theoretical saturation was reached, when no new themes emerged. Triangulation of data sources (participants and clinicians), research perspectives, and theoretical frameworks further enhanced the credibility and reliability of the results. These methodological strategies support the transferability of our findings to similar populations and settings while maintaining rigor in our qualitative approach (Guest et al., 2006).

Furthermore, our personalized, participants-centered approach, tailored to the specific needs, motivations, and experiences of people using cannabis and tobacco within SUTPs, may be a limitation, as it may reduce the applicability of the results to other populations or treatment contexts. We acknowledge that the web app's content and narratives may not fully resonate with individuals from different demographic and cultural backgrounds. Nevertheless, the co-creation process itself stands as a core strength, offering a replicable model for developing similar interventions across diverse settings. This approach highlights the potential for adapting co-creation frameworks to meet the needs of other vulnerable or specialized populations.

Despite these limitations, our study has several noteworthy strengths. The co-creation process, which actively involved clinicians, gamification experts, and individuals currently or formerly using cannabis, enabled a nuanced understanding of the target population's needs and enhanced the web app's relevance, usability, and engagement potential. Our structured four-phase conceptual framework, including qualitative research, narrative development, and technical validation, provides a comprehensive, replicable model for future indicatives.

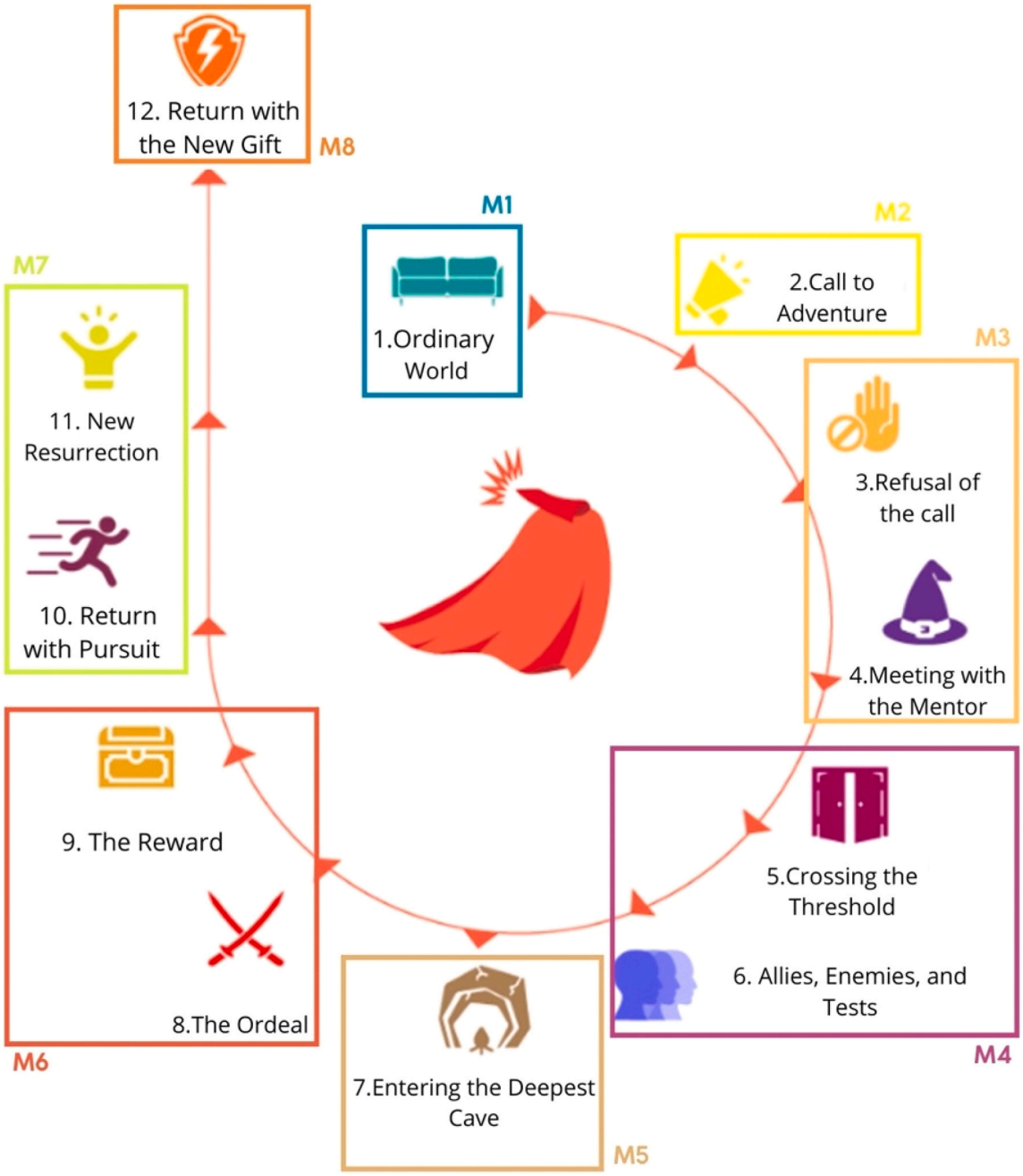

Fig. 2. Story structure of the app consisting of 12 missions (adaptation of the Hero's journey; Campbel, 1968). M= mission. *Footnote:* The original 12 steps of the "Hero's Journey" framework have been condensed into 8 missions to fit within the 6-week follow-up period of the study. This adaptation preserves the core narrative structure while simplifying the progression to align with the treatment timeline and enhance user engagement.

Finally, upcoming phases of the DuCATA_GAM-CaT project will evaluate the web app's feasibility and effectiveness in clinical settings (Saura et al., 2024), offering further insights into its real-world applicability.

5. Conclusion

This study successfully co-created a web app tailored to the specific needs of individuals who use cannabis and tobacco and attend SUTPs, demonstrating the value of using a systematic inductive methodology. Through a four-phase process—Discovering, Deepening in Co-design, game Development and Storytelling, and Technical Development— we engaged individuals who use cannabis, clinicians, and other stakeholders to ensure the app's relevance, usability, and alignment with participants' real-life experiences. Key outcomes include the identification of distinct participant typologies, such as Achievers, Free Spirits, and Socializers, which informed the app's design to better address individual motivations and preferences. This co-creation approach underscores the importance of tailoring in mHealth interventions, particularly for vulnerable populations.

Future research should explore the potential of digital, gamified tools to support substance use treatment, with further studies needed to assess their feasibility, engagement, and behavioral impact.

Author disclosures

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Declaration of Competing Interest

The authors declare no financial conflicts of interest with respect to the research, authorship, or publication of this article.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.drugalcdep.2025.112880.

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