

Article

A Participatory Evaluation of the *No le entres* App Prototype for Tobacco Prevention Among Mexican Adolescents

Rosa Dabinia Uribe-Madrigal ¹, Betzaida Salas-García ², María del Carmen Gogeoascoechea-Trejo ²,
Xóchilt de San Jorge-Cárdenas ², Juan Manuel Gutiérrez-Méndez ³ and María Cristina Ortiz-León ^{4,*}

¹ Doctor of Health Sciences Program, Universidad Veracruzana, Xalapa 91190, Ver., Mexico; dabinia.uribe@gmail.com

² Institute of Health Sciences, Universidad Veracruzana, Xalapa 91190, Ver., Mexico; besalas@uv.mx (B.S.-G.); cgogeoascoechea@uv.mx (M.d.C.G.-T.); xdesanjorge@uv.mx (X.d.S.J.-C.)

³ National Laboratory of Advanced Informatics A.C., Xalapa 91000, Ver., Mexico; juan.gutierrez@lania.edu.mx

⁴ Institute of Public Health, Universidad Veracruzana, Xalapa 91190, Ver., Mexico

* Correspondence: cortiz@uv.mx; Tel.: +52-228-230-3073

Abstract

Adolescent tobacco use remains a critical public health challenge, requiring innovative early prevention strategies. This study participatively evaluated a medium-fidelity prototype of the *No le entres* app, designed to prevent tobacco use among adolescents. The prototype was developed based on user-centered design and gamification frameworks, with the aim of ensuring cultural relevance and active user engagement. Qualitative design with content analysis was employed. Four focus groups were conducted in Xalapa, Veracruz: two with health professionals from Medical Specialty Units—Community Mental Health and Addiction Centers (UNEME CECOSAMA), and two with secondary school students. Nineteen professionals and twenty-two adolescents participated. Data were analyzed using MAXQDA 2022, applying both a priori and emergent categories. Professionals valued the app's innovative approach but recommended improvements in navigation speed, visual design, message clarity, and cultural validation. Adolescents emphasized the need for more engaging features, such as music, rewards, team competitions, and updated graphics. Both groups highlighted the importance of interactivity, personalization, and contextualized content. Findings underscore the value of participatory methods in designing digital health interventions and confirm that involving end users enhances usability and acceptability. The app demonstrates potential for integration into school settings as a preventive tool, with implications for influencing adolescent knowledge, attitudes, and behaviors regarding tobacco use.

Keywords: smoking prevention; mobile applications; gamification; adolescent; health personnel; community-based participatory research; user-centered design



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1. Introduction

The onset of tobacco use during adolescence constitutes a global public health concern, as this stage of human development is characterized by greater risk-taking, identity-seeking, and peer influence, factors that facilitate the adoption of habits that may persist into adulthood [1,2]. Several studies have identified factors associated with the initiation of smoking among youth, such as early age, low self-esteem, the presence of smoking family members, limited parental supervision, peer pressure, and the desire for social acceptance [3–5].

It is estimated that there are 50 million adolescent smokers worldwide between the ages of 13 and 15 [3]. In Mexico, the National Health and Nutrition Survey (ENSANUT) reported in 2022 a prevalence of 1.4 million adolescent tobacco users [6], with a growing trend in the use of emerging products such as electronic cigarettes and heated tobacco [3,7]. This situation is particularly concerning since tobacco industry marketing strategies are increasingly directed at young people [4].

Within this context, Information and Communication Technologies (ICTs) have shown great potential in health promotion and addiction prevention by offering accessibility, interactivity, and personalization [8–10]. Digital interventions such as educational video games and mobile applications have demonstrated their ability to strengthen psychosocial skills necessary to resist peer pressure and experimentation with substances [11,12]. Given the limited effectiveness of traditional school-based programs, these technologies have emerged as complementary strategies to prevent risk behaviors [13–15].

Mobile applications (apps) are especially promising, as adolescents not only show broad familiarity with electronic devices and digital environments but also perceive it as natural to manage health-related aspects through these technologies. Their constant exposure to smartphones, social networks, and digital games fosters confidence and willingness to engage with health apps [16,17]. Furthermore, they value features such as personalization, gamification, immediate feedback, and eye-catching graphics, which align with their digital habits [14,16,18]. Systematic reviews confirm that mobile health (mHealth) interventions are culturally and developmentally appropriate strategies to promote preventive behaviors, support self-care, and improve treatment adherence in chronic diseases [19,20]. They have also demonstrated effectiveness in tobacco prevention and cessation, showing higher quit rates and sustained abstinence compared to conventional interventions [21].

In the specific field of tobacco prevention, various experiences show that apps can influence adolescents' perceptions and attitudes. For example, photoaging apps have been used in schools to graphically illustrate the aesthetic effects of tobacco consumption, increasing risk perception and rejection of cigarettes [22]. More recently, a randomized controlled trial in Oman demonstrated that such an application was more effective than a conventional school-based intervention in modifying students' attitudes toward smoking [9]. However, systematic reviews have pointed out that many apps targeting youth lack documented participatory design and robust scientific evidence regarding their effectiveness [23–25].

Regarding adolescents' preferences, studies confirm that usability, visual appeal, and gamification features are associated with greater acceptability and effectiveness of cessation apps [26–28]. Qualitative and mixed-methods evidence highlights that visually engaging interfaces, customizable avatars or "digital pets," and virtual rewards such as points, badges, and leaderboards help adolescents identify with the intervention and sustain adherence to prevention and cessation programs [28–31]. These preferences are consistent with user-centered design principles, which recommend integrating recipients' perspectives from the early stages of technology development.

The literature also underscores that participatory design and usability evaluation are essential to achieve acceptance and adherence among adolescents. For example, the design and evaluation of a mobile application for self-care among Iranian adolescents showed that involving young users in testing phases enhanced cultural relevance and user satisfaction [32]. Complementary approaches have also explored the use of conversational artificial intelligence to support smoking cessation, with systematic evidence showing that chatbot-based interventions can strengthen engagement and effectiveness, particularly among younger populations [33].

Thus, participatory evaluation emerges as a key component to ensure cultural relevance, usability, and acceptance of digital applications targeting adolescents. The success

of such interventions depends not only on technical quality but also on their alignment with users' expectations and contexts [34,35]. Additionally, their design can be grounded in theoretical frameworks such as Self-Determination Theory, which emphasizes intrinsic motivation [36]; Social Learning Theory, which highlights peer influence [37]; and constructivist approaches, which promote active learning through meaningful experiences [38,39].

In Latin America, however, digital prevention initiatives remain scarce and culturally limited. In Mexico, a pioneering study with secondary school students in Veracruz identified key behaviors to be modified—such as leisure-time management, resistance to peer pressure, and strengthening of self-concept—which led to the design of a low-fidelity prototype of the *No le entres* app [15]. The expression “*No le entres*” is a colloquial Spanish phrase meaning “don’t get into it” or “stay away from it,” commonly used to discourage involvement in risky behaviors; in this context, it refers to avoiding the initiation of tobacco use. This early version consisted of simple sketches focused on the app’s structure, navigation flow, and basic functions.

This initial step was decisive in advancing toward an iterative design process based on user-centered and gamification principles [40,41], which later enabled the development of the medium-fidelity prototype evaluated in the present study. This version already incorporates visual and interface elements (e.g., colors, typography, buttons, and images) and allows for more specific usability testing, providing a preliminary resemblance to the final product.

In the iterative development of digital health applications, prototype fidelity progresses through stages that vary in complexity and interactivity. Low-fidelity prototypes allow early feedback on the conceptual structure, while medium-fidelity prototypes—such as the one evaluated in this study—incorporate preliminary graphics, partial functionality, and interactive elements that enable users to experience the app’s logic and provide detailed input on usability and navigation. This version also integrates visual and interface components (e.g., colors, typography, buttons, images), offering a closer approximation to the final product and allowing for more specific usability testing.

Despite these advances, research on tobacco prevention apps for adolescents remains limited, particularly in Latin America and middle-income contexts. In this scenario, the development of *No le entres* represents a relevant contribution by rigorously documenting a participatory design process with adolescents and health professionals in Mexico. In addition to being culturally adapted, this prototype is grounded in qualitative evidence and seeks to provide an innovative model for the early prevention of tobacco and nicotine use.

Based on the above, the objective of this study was to participatively evaluate the medium-fidelity prototype of the *No le entres* app, identifying the perceptions of health professionals and secondary school students regarding its design, usability, and relevance as a digital tool for tobacco prevention among adolescents. The next step following this study is the development of a high-fidelity prototype, which will integrate the improvements identified by adolescents and professionals. This version will incorporate interactive elements, animations, and transitions to simulate the user experience of the final application. Importantly, it is this high-fidelity prototype that will be used in the subsequent pilot evaluation, where the application’s effectiveness in preventing smoking among adolescents will be formally tested.

2. Materials and Methods

2.1. Study Design

An exploratory qualitative study with a participatory, user-centered design approach was conducted to evaluate the medium-fidelity prototype of the *No le entres* app. This methodological strategy allowed for an in-depth exploration of the perceptions, suggestions,

and experiences of both adolescents and health professionals regarding the usability, design, and preventive potential of the application [42–44]. The use of participatory evaluation responds to the need to involve future users from the initial stages of development, thereby enhancing the cultural relevance and acceptability of the final product [45].

2.2. Context

The study was conducted in Xalapa, Veracruz, Mexico, between April and October 2023. Two focus groups with professionals were conducted online via Zoom from UNEME-CECOSAMA, specialized units dedicated to the prevention and early treatment of substance use in both adults and adolescents. In Mexico, these units form part of the national network of mental health and addiction services of the Ministry of Health and implement programs specifically designed for adolescents aged 12 to 17, delivered through outpatient services and community-based interventions [46]. Given their mandate and service profile, UNEME-CECOSAMA staff have substantial experience in caring for adolescents at risk of substance use and conducting preventive activities in school settings [47]. Two additional groups were held face-to-face in public secondary schools, selected to represent both urban and semi-urban educational settings. This approach ensured that the perspectives of institutional personnel and adolescents were captured, thereby enhancing the transferability of the findings.

2.3. Sampling and Recruitment of Participants

Purposive sampling was applied. Inclusion criteria for health professionals included working in UNEME CECOSAMA with at least one year of experience in addiction prevention or counseling and willingness to participate in an online focus group. Exclusion criteria included lack of access to stable internet or prior involvement in the design of the app. Professionals were recruited through institutional invitations sent to unit directors, who shared the study information with eligible psychologists, physicians, and social workers. Participation was voluntary and limited to those who met the criteria. For adolescents, inclusion criteria included being enrolled in the first, second, or third grades of secondary school, aged 12–15 years, prior experience using a smartphone (Android or iOS), and providing parental consent. Exclusion criteria included refusal to provide assent or absence on the day of the focus group. Recruitment was carried out in coordination with school administrators and teachers from public secondary schools. Researchers visited classrooms to explain the study and distribute parental consent forms; only students who returned the signed consent and provided their assent were eligible. In total, 19 professionals (psychologists, physicians, and social workers) and 22 adolescents (balanced by grade and gender) participated, with the number of groups determined until theoretical saturation was reached.

2.4. Description of the Medium-Fidelity Prototype of *No le entres*

In Supplementary File S1, a video is provided that illustrates the content of the evaluated prototype—a medium-fidelity version developed on the Unity platform, designed according to the behavioral objectives defined during the preliminary design phase [15]. Before accessing the levels, the application presents an interactive tutorial introducing the basic controls, movement mechanics, and overall purpose of the app, as well as a list of healthy activities that adolescents can engage in. The initial interface displays a structured urban environment with bright colors, geometric buildings, and a central circular platform that hosts the main menu.

Subsequently, a screen appears in which adolescents can design their own avatar. These avatars are fully animated and customizable, with expressive facial movements, smooth locomotion animations, and interactive gestures that enhance emotional engage-

ment and help adolescents visualize themselves in real-life decision-making situations. During the tutorial, animated cues highlight collectible items, obstacles to avoid, and decision points, contextualizing the behavior-change elements that guide each level.

The first level consists of a trivia game with multiple-choice questions about tobacco use, aimed at reinforcing self-concept and correcting common misconceptions among adolescents. The second level, or rally, takes place in a broader 3D virtual city with identifiable streets, parks, shops, and urban objects. In this environment, users identify cigarette packs, smoke clouds, and peer-interaction scenarios, selecting responses through pop-up decision windows. These dynamics situate decision-making in everyday contexts and strengthen resistance to peer pressure. The third level is an obstacle game in which adolescents must avoid animated cigarettes moving at different speeds while collecting rewards represented as floating icons or glowing spheres, encouraging the positive use of free time.

Throughout the prototype, audiovisual feedback is integrated, including sound effects for correct and incorrect answers or collisions, as well as flashes and luminous outlines that reinforce interaction and gamified elements. All scenes maintain a coherent visual identity, based on a palette of bright but non-overstimulating colors—turquoise, purple, pink, and yellow—and on rounded icons and shapes aligned with adolescent-friendly design standards.

Taken together, the prototype's components—customizable avatars, animated tutorial, navigable urban scenarios, decision-making and obstacle dynamics, audiovisual feedback, and coherent aesthetic—were developed following the principles of the BUS model and a user-centered design approach. These elements enrich the interaction experience, reinforce the behavioral objectives, and promote playful, meaningful, and contextually relevant engagement among adolescents.

Nevertheless, this was established during the preliminary development phase. Building on this foundation, the primary purpose of the *No le entres* app is to prevent the initiation of tobacco use among early adolescents by strengthening self-concept, promoting healthier decision-making, and enhancing resistance to peer pressure in situations where smoking may occur. The target audience for the application is secondary school students aged 12 to 15, a developmental period in which early prevention is particularly impactful. In terms of dissemination, the app is intended to be implemented within school-based prevention programs and supported by health professionals and educators, allowing for integration into existing institutional health-promotion strategies and ensuring that adolescents can access the intervention in both educational and community settings.

2.5. Data Collection

Four focus groups were conducted: two with health professionals (April–May 2023) and two with secondary school students (July–October 2023). Each session, held in a secluded setting, lasted 60 to 90 min and was guided by experienced researchers trained in participatory dynamics, with the support of an observer who also took detailed field notes. Semi-structured discussion guides were developed based on the contents and target behaviors of the *No le entres* app and were subsequently refined through an expert consensus process. A panel of professionals (three psychologists, one physician, and one addiction specialist) with experience in adolescent substance-use prevention and treatment reviewed the guides to ensure clarity, relevance, and alignment with the app's preventive objectives, following the domains established in the validation framework (content, theoretical basis, style, and language). Their feedback informed minor adjustments to wording and cultural appropriateness.

User-centered design (UCD) informed the overall methodology by structuring the study as an iterative, participatory process in which adolescents and health professionals were involved from the early testing of the prototype to the refinement of its elements. Consistent with UCD principles, the focus group guides were intentionally developed to elicit users' perceptions, expectations, and experiential feedback regarding the prototype's visual design, usability, navigation, clarity of messages, and gamification features. The guiding questions were crafted to explore real-life relevance, cultural and linguistic appropriateness, and alignment with adolescents' digital habits, ensuring that participants' needs and contexts directly shaped subsequent design iterations.

In both groups, discussions followed the validated semi-structured guides and focused on identifying necessary improvements to the *No le entres* prototype, addressing four core areas: (1) visual design—including colors, graphics, avatars, and overall aesthetic appeal; (2) usability and navigation, such as app flow, accessibility, interaction speed, and technical performance; (3) language and content, evaluating clarity, relevance, age appropriateness, and perceived usefulness of the messages; and (4) gamification elements, including engagement, rewards, competitiveness, and preferred interactive features. In the case of health professionals, additional discussion topics included the app's preventive value and its potential integration into school or clinical settings, whereas adolescents placed greater emphasis on visual design and interactive components. Example guiding questions included: "What do you think about the colors and graphics of the app?", "How useful do you consider the messages for adolescents?", and "What elements could make the app more attractive for young people?". A summary of the main thematic areas is presented in Table 1, and the complete focus group guides have been included as Supplemental File S2.

Table 1. Main topics covered in the focus groups.

Focus Group Dimension	Description of Topics Explored
Visual Design	Colors, logo, avatars, graphic quality, attractiveness, realism, and alignment with adolescents' preferences.
Usability and Navigation	App speed, ease of interaction, clarity of instructions, flow across levels, accessibility, technical issues.
Language and Content	Clarity, tone, age appropriateness, redundancy, relevance of messages, usefulness for tobacco prevention.
Gamification Features	Engagement, rewards, competition, interactivity, suggestions for enhanced playability.
Institutional Relevance (professionals only)	Feasibility of incorporating the app in prevention programs, alignment with clinical/school contexts.
Perceived Preventive Impact	Perceptions of whether the app could influence knowledge, attitudes, or behaviors related to tobacco use.

All sessions were audio-recorded with participants' consent and later transcribed verbatim for analysis.

2.6. Analytic Categories and Subthemes Defined a Priori

Four analytic categories were defined a priori based on the study objectives, the theoretical framework—particularly user-centered design—and the structure of the focus group guides. As illustrated in Figure 1, these categories served as the initial coding framework and guided the deductive phase of the analysis:

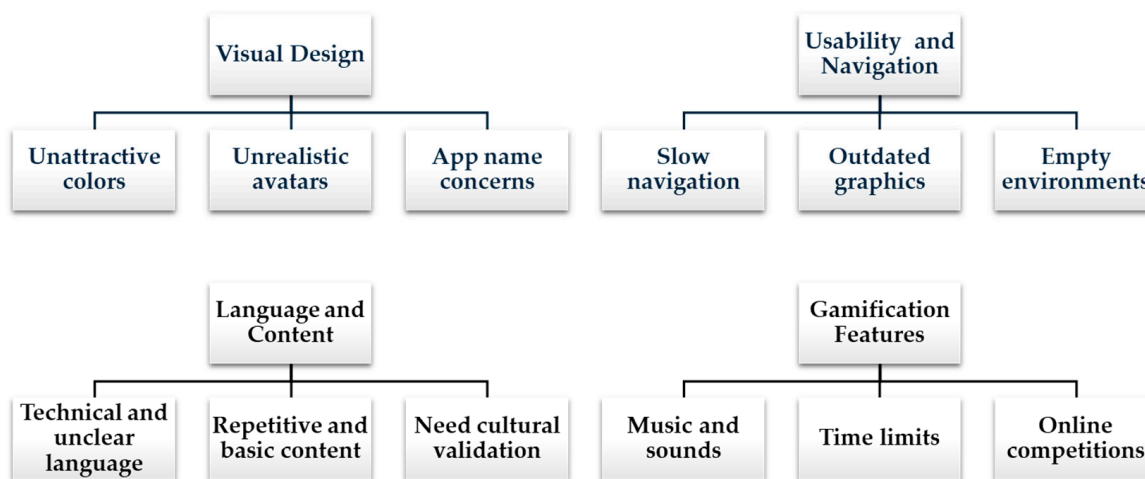


Figure 1. Analytic categories and subthemes defined a priori.

2.6.1. Visual Design

This category encompassed aspects related to the aesthetic qualities of the prototype, including colors, avatars, and the naming of the application. These elements were examined to understand how adolescents and health professionals perceived the appeal, clarity, and coherence of the interface.

2.6.2. Usability and Navigation

This category focused on participants' experiences with the fluidity, speed, and intuitiveness of the prototype. Subthemes included ease of movement through the levels, responsiveness of controls, and general impressions of accessibility.

2.6.3. Language and Content

This category captured perceptions regarding the clarity, relevance, and appropriateness of the textual and narrative content within the application. It included predefined subthemes such as technical language, repetition, and the adequacy of explanations provided.

2.6.4. Gamification Features

This category addressed the motivational elements intentionally incorporated into the prototype, including time limits, rewards, sound effects, and interactive components designed to enhance engagement.

Together, these four a priori analytic categories constituted the deductive structure of the coding process and served as the foundation for identifying additional emergent subthemes during the inductive phase of the analysis.

2.7. Data Processing and Analysis

The transcripts were processed and analyzed using MAXQDA 2022 following a hybrid thematic coding approach that [48] combined both deductive and inductive strategies. Deductive, or a priori, codes were derived from the study objectives, the theoretical framework—particularly user-centered design—and the structure of the focus group guides (e.g., usability, visual design, navigation, gamification, and content). In parallel, inductive

coding enabled new categories to emerge directly from participants' narratives, revealing unanticipated insights such as perceptions of avatars as "childish" or suggestions to incorporate online competitions. This combination ensured that the analysis addressed predefined areas of interest while remaining open to emerging themes, enhancing both the depth and cultural relevance of the findings.

Coding was conducted by three trained members of the research team. Two researchers independently coded all transcripts, and a third senior researcher reviewed the coding outputs to ensure consistency across the dataset. Coding reliability was strengthened through independent coding, iterative comparison of coded segments, consensus meetings to resolve discrepancies, and continuous refinement of the codebook as new inductive themes appeared. Analytic memos, field notes, and documentation of analytic decisions were maintained throughout the process to support transparency and methodological rigor.

2.8. Trustworthiness, Triangulation, and Theoretical Saturation

To ensure validity and trustworthiness, several triangulation strategies were applied. Source triangulation involved comparing the perspectives of adolescents and health professionals, which helped identify both convergent and divergent views regarding the prototype. Investigator triangulation—embedded in the multi-researcher coding process—allowed for multiple interpretations to be examined and reconciled, thereby reducing individual bias and strengthening the reliability of the thematic structure.

Theoretical saturation was assessed iteratively across the four focus groups. After each session, the coding team compared new codes and themes with those identified earlier to determine whether additional conceptual insights were emerging. Saturation was considered achieved when subsequent transcripts no longer contributed new codes or subthemes relevant to the study aims; instead, participants reiterated observations already identified—such as the need for faster navigation, more engaging graphics, and enhanced gamification. This process aligns with user-centered design principles, as it allowed refinement of the prototype based on recurring user feedback until thematic stability was reached. Analytic memos and field notes documented the decision-making process, providing an audit trail throughout the analysis.

2.9. Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and received approval from the Research Ethics Committee of the Institute of Health Sciences, Universidad Veracruzana, and is registered with the National Bioethics Commission (Record No. 005/2023). All participants were informed about the objectives and scope of the research. Adolescents participated only with the informed consent of their parents/guardians and their own voluntary assent. Confidentiality was ensured through the anonymization of transcripts and the secure storage of digital data.

2.10. Use of Artificial Intelligence

Artificial intelligence tools were used in a limited and transparent manner during the preparation of this manuscript. ChatGPT (version 5.1) was employed exclusively for minor language editing and wording refinement in the Abstract, Introduction, and Discussion Sections. In addition, Figure 1 was generated with AI assistance (ChatGPT-4o in combination with Python/Matplotlib) solely to support the visual representation of categories and subthemes identified through the focus group analysis.

No artificial intelligence tools were used for data collection, qualitative coding, data analysis, or interpretation of results. All analytical decisions, interpretations, and conclusions were developed by the research team. The final manuscript was fully reviewed,

validated, and approved by the authors, who take full responsibility for its scientific content, in accordance with MDPI ethical policies.

3. Results

3.1. Interaction with the Prototype and Participants' Experiences

Before beginning the discussion, adolescents and health professionals interacted directly with the medium-fidelity prototype previously described. During this initial phase, participants explored the main features of the application, manipulated the customizable avatars, and navigated the urban environment that serves as the setting for the different game levels. Each session followed a consistent structure: a welcome and introductory explanation, guided interaction with the prototype, an open-ended group discussion, and a closing reflection. Throughout the sessions, the facilitator encouraged equitable participation, while an observer documented field notes and relevant nonverbal cues. The focus group guides included questions such as: "What do you think about the app's colors and graphics?", "How would you evaluate the ease of navigating between levels?", "What elements could make the app more appealing to adolescents?" and "How useful do you find the messages for tobacco-use prevention?".

Following this interactive exploration of the prototype, a total of 19 UNEME CE-COSAMA professionals and 22 secondary school students participated in four focus groups.

3.2. Overall Positive Reactions to the Prototype

Both adolescents and health professionals identified several positive aspects of the *No le entres* prototype. Adolescents particularly appreciated the app's playful elements, including the trivia format, the obstacle game, and the possibility of customizing avatars, which they perceived as engaging and aligned with their everyday digital experiences. They also highlighted the colorful urban environment and the potential for the app to feel "like a real game." Health professionals valued the app's clarity of purpose, its alignment with prevention goals, and its potential usefulness as a complementary tool within school-based tobacco prevention strategies. They also appreciated the structured levels, the relevance of the messages, and the innovative approach of integrating gamified elements into health promotion.

Participants also described elements of the prototype that align with behavioral mechanisms associated with tobacco-use prevention. Adolescents emphasized that navigating challenges and customizing avatars made them feel more confident—indicating potential for strengthening self-concept. Several noted that the obstacles and decision points resembled real-life peer pressure scenarios, allowing them to practice resisting negative influences. Others highlighted missions related to leisure-time activities, which they perceived as helpful reminders of healthy alternatives to substance use. These insights reflect the app's potential to integrate protective behavioral components within its design.

3.3. Initial Analytic Categories Derived from the Study Framework

3.3.1. Visual Design

The visual identity of the app was one of the first elements to elicit comments from both professionals and students. Professionals considered the color palette too neutral and insufficiently stimulating to capture adolescents' attention:

"Colors should be much more eye-catching for adolescents... the ones used looked too neutral"

(Professional, Female)

Students agreed with this critique but framed it in terms of dynamism and creativity, suggesting that each level should adopt a different scheme:

"It focuses on a single color. . . it should change colors by level"

(Student, Male)

Avatars were also a recurrent source of criticism, particularly among adolescents, who described them as unrealistic and "childish."

"The avatars look strange, with big heads and small bodies. . . they don't seem like teenagers"

(Student, Male)

While professionals commented less on this aspect, they acknowledged that insufficient identification with avatars could negatively affect user engagement.

Finally, the app's title *No le entres* generated contrasting opinions. A male professional warned about a possible boomerang effect:

"The brain does not process the word 'No,' so subliminally it induces 'Go ahead'"

(Professional, Male)

In contrast, some students valued the title's clarity and directness:

"The name is attractive, it's like telling you directly: don't do it, don't get into it. . . it's concrete"

(Student, Female)

3.3.2. Usability and Navigation

Usability was one of the most frequently mentioned areas for improvement. Both professionals and students pointed out that the app's navigation was slow and the graphics outdated, limiting overall engagement:

"In the end, they are going to say: this is too slow for what I'm looking for. It should be more interactive, with better resolution or faster progression"

(Professional, Male)

Students echoed this concern, but framed it in terms of aesthetics and immersion:

"It looks kind of old, like from a long time ago. I would quit using it easily"

(Student, Male)

Another recurring observation concerned the lack of dynamism in the virtual environment. As one student explained:

"The open world feels very empty. . . there should be cars or more people"

(Student, Male)

This difference in emphasis highlighted distinct perspectives: professionals tended to evaluate usability as a functional requirement to ensure retention in school or clinical contexts, whereas adolescents directly compared the app to the commercial video games they use daily, setting higher expectations for interactivity and visual appeal.

3.3.3. Language and Content

Language and content emerged as central points of discussion. Adolescents frequently described the material as repetitive, lengthy, or overly basic, underscoring the need for more engaging and innovative approaches:

"Level 1 felt tedious because of too much text"

(Student, Female)

"It's very basic, like what they always tell you in school"

(Student, Female)

"It would be better if instead of showing the typical, it was presented differently to catch our attention"

(Student, Female)

Health professionals, by contrast, were divided. Some considered the language adequate for adolescents, while others viewed it as overly technical and potentially disengaging. They also expressed concerns about the repeated use of tobacco imagery, which they feared could produce unintended effects:

"Showing tobacco images over and over. . . I'm not sure if it could be counterproductive"

(Professional, Male)

Beyond specific design elements, several professionals emphasized that the app should not be regarded as a stand-alone solution but rather as a complement to broader prevention strategies:

"It can be useful. . . but not exclusively. Work with users must be approached from several angles. This application can help, yes, it can help"

(Professional, Female)

3.3.4. Gamification Features

Gamification was the theme that generated the greatest enthusiasm among adolescents. They emphasized that adding playful and competitive elements would make the app more attractive and engaging:

"If you put a countdown, people will feel pressured to win"

(Student, Female)

"They could play in teams online, and if a teacher is watching in class. . . they'll earn points"

(Student, Female)

Health professionals likewise acknowledged the importance of interactivity, though they focused more on preventive potential:

"Eventually, an app that sends you follow-up images of tobacco could create a feeling of disgust"

(Professional, Male)

3.4. Emerging Cross-Cutting Themes

In addition to the four primary categories, several cross-cutting themes were identified, which intersect and inform multiple dimensions of the application's design, implementation, and use.

1. Institutional Relevance: Health professionals emphasized the importance of embedding the application into school routines and existing prevention programs. Rather than being seen as a stand-alone product, its sustainability depends on institutional alignment and integration into broader public health strategies:

"If it is not linked to the school program and to prevention activities that are already being carried out, the app will remain isolated and lose impact"

(Professional, Female)

2. Cultural and Linguistic Resonance: Although language clarity was considered within the main categories, both groups highlighted the need for content to be congru-

ent with their culture and way of expression, ensuring resonance both culturally and linguistically:

"The words they use should sound like the way we speak; otherwise, we are not going to take it seriously"

(Student, Male)

"The language has to be very clear, not prone to misinterpretations, and understandable for the kids according to their culture"

(Professional, Female)

3. Comparison with Commercial Video Games: Adolescents consistently evaluated the app in relation to commercial video games, setting higher expectations for visual quality, interactivity, and overall playability. This tendency illustrates that engagement with preventive applications is strongly conditioned by adolescents' everyday digital experiences:

"It looks very simple, like it's for little kids, not like the games we usually play"

(Student, Male)

"If it were more like the games we play on our phones, with better graphics and more things to do, we would want to use it"

(Student, Female)

4. Complementary Role of the Application. Professionals considered *No le entres* not as a replacement for educational or therapeutic programs, but as a complementary tool. One professional summarized this perspective by stating:

"It can be useful... but not exclusively. Work with users must be approached from several angles. This app can help, yes, it can help"

(Professional, Female)

"It can help, yes, but users need more than just an app. It must be part of a bigger plan"

(Professional, Female)

3.5. Integration of Perspectives

Overall, both groups acknowledged the innovative approach of the application but emphasized the need to optimize its design and functionality. Participants pointed to specific areas for improvement, including a more attractive visual design, faster navigation, personalized avatars, and reformulated messages. While adolescents prioritized visual appeal, navigation speed, and playful dynamics comparable to the video games they regularly consume, professionals placed greater emphasis on message clarity, cultural validation, and institutional relevance. Both groups agreed that the application should balance entertainment value with credible health content to maximize its preventive impact.

These perspectives were reinforced by several cross-cutting themes that emerged across categories. Adolescents' repeated comparisons with commercial video games highlighted the grand expectations they bring to digital tools and underscored the centrality of gamification, visual quality, and interactivity for sustained engagement.

At the same time, professionals stressed the importance of institutional relevance, noting that the app would only be sustainable if embedded within school programs and broader prevention strategies. Both groups also pointed to the need for cultural and linguistic resonance, emphasizing that language, content, and visual elements should align with adolescents' symbolic references and everyday communication styles. Finally, professionals highlighted the complementary role of the app, stressing that it should support but not replace in-person educational and therapeutic activities. As illustrated in

Figure 2, these cross-cutting themes intersect with the four central categories of analysis—visual design, usability and navigation, language and content, and gamification—showing how technical improvements and contextual adaptation must converge to ensure the app’s long-term sustainability.

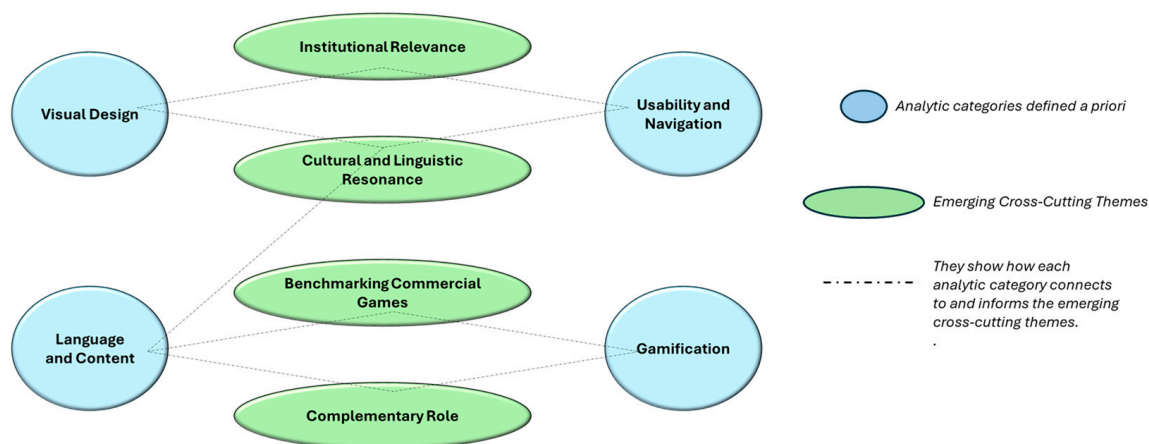


Figure 2. Visualization of the relationships between the a priori analytic categories and the emerging cross-cutting themes identified in the focus groups.

Taken together, these findings indicate that the success of the prototype depends on its ability to integrate adolescents’ demand for engaging, game-like experiences with professionals’ concern for cultural adequacy, institutional integration, and preventive rigor. Table 2 summarizes the specific modifications proposed to strengthen the prototype based on these converging perspectives.

Table 2. Changes in the App *No le entres*.

Element	Modification	Cross-Cutting Theme
Color	Replace the current color palette with more attractive shades (blues, greens, reds).	Comparison with Commercial Video Games
Avatar	Improve avatars with youthful and modern style, adding hairstyles, clothing, accessories, and colors for individuality.	Comparison with Commercial Video Games
App Name	Rename the app to convey a positive tobacco-free lifestyle (e.g., ‘Breathe and Play’).	Institutional Relevance/Cultural and Linguistic Resonance
Graphics	Review and enhance graphic elements, e.g., city environment.	Comparison with Commercial Video Games
Message Content	Shorten and update questions/messages with novel content.	Cultural and Linguistic Resonance
Audio	Add music and audio to the levels.	Complementary Role of the App
Websites	Include links to websites related to tobacco and vaping prevention.	Institutional Relevance/Complementary Role of the App

3.6. Comparative Analysis of Themes Across Participant Groups

Table 3 provides a comparative summary of the themes identified by adolescents and health professionals, encompassing both the four core analytic categories and the emerging

cross-cutting themes. Adolescents emphasized visual appeal, dynamism, personalization, and frequent comparisons with commercial video games, reflecting their everyday digital experiences. Professionals, on the other hand, focused on institutional relevance, linguistic and cultural appropriateness, and the complementary role of the app within prevention programs.

Table 3. Comparative Themes Identified by Adolescents and Health Professionals.

Theme Area	Adolescents	Health Professionals	Shared Themes
Visual Design	Compared app to commercial games; requested more attractive graphics, dynamic environments, and avatar personalization.	Highlighted clarity and coherence; noted unrealistic or childish avatars.	Improve overall visual appeal and strengthen interface and avatar design.
Usability and Navigation	Reported slow navigation, limited interactivity, lack of dynamism.	Emphasized intuitive, responsive navigation; noted outdated graphics and empty environments.	Navigation should be faster, smoother, and more interactive.
Language and Content	Found content repetitive or unengaging; preferred conversational, culturally aligned language.	Prioritized linguistic clarity, cultural adequacy, and avoidance of ambiguity.	Content must be clearer, more relevant, and culturally adapted.
Gamification Features	Requested challenges, competitions, music, rewards, team play.	Considered gamification secondary but useful; cautioned against overstimulation.	Gamification increases engagement and should be strengthened.
Emerging Cross-Cutting Themes	Compared app to commercial games; requested personalization and immersive environments.	Emphasized institutional relevance, cultural resonance, and complementary educational role.	Both highlighted the need to balance entertainment with credible, developmentally appropriate health messaging.

Despite these differences, both groups agreed on the need to improve the app's visual design, increase navigation speed and interactivity, enhance cultural and linguistic clarity, and strengthen gamification features. The emerging cross-cutting themes—comparison with commercial games, cultural and linguistic resonance, institutional relevance, and the complementary role of the app—illustrate how contextual and experiential factors shaped participants' evaluations.

4. Discussion

This participatory evaluation of the *No le entres* app highlights both its innovative potential and the challenges of developing culturally relevant digital tools for adolescent tobacco prevention. By systematically incorporating the perspectives of adolescents and health professionals, the study advances knowledge on how usability, design, and contextual adaptation can shape engagement with mHealth interventions.

Consistent with prior research, adolescents highlighted visually appealing design, rapid navigation, and dynamic environments, reinforcing evidence that aesthetic quality and interactivity are critical for sustaining engagement in digital health tools [16,32,33]. Their comparisons with commercial games illustrate how preventive apps are judged against the standards of the entertainment industry, underscoring the need to integrate gamification, rewards, and personalization, which have been shown to enhance engagement and intrinsic motivation [16,17,36].

These findings align with Self-Determination Theory [36], which emphasizes that autonomy, competence, and meaningful experiences are essential drivers of intrinsic moti-

vation, sustained learning, and behavior change. They also resonate with constructivist approaches, where knowledge and skills are actively built through interaction and contextualized experiences.

As these insights were generated from a medium-fidelity prototype, the modifications summarized in the study represent recommended changes rather than adjustments already implemented. These recommendations will be incorporated into the development of the high-fidelity prototype, which will subsequently undergo additional cycles of user testing and iterative refinement, including a pilot evaluation where the app's effectiveness in preventing smoking among adolescents will be formally assessed. For example, Zimmermann and Tomczyk showed how adolescents construct health-related meanings through their engagement with social media [38], while Park and Chang demonstrated that digital media interventions can empower adolescents in prevention of smoking by fostering autonomy and active participation [39].

The adolescents' critiques of the avatars as "big-headed" and unrealistic, as well as their comments that the virtual world looked "empty," further confirm that cultural adaptation must include aesthetic elements. Their suggestions for gamification—such as "feeling pressured because time is running out" or "playing in teams online"—resonate strongly with Self-Determination Theory [36], since autonomy, relatedness, and competence can be fostered through challenges, rewards, and team competition. Prior evidence supports this, showing that digital games and interactive features significantly enhance the effectiveness of health promotion interventions among youth [18,22].

In contrast, health professionals emphasized the importance of clarity, cultural validation, and institutional integration, which aligns with international evidence identifying digital technologies as complementary strategies for preventing risk behaviors among adolescents [13–15]. They also expressed concern about message framing, particularly regarding the potential "boomerang effect" of the title *No le entres*, in which a message intended to discourage a behavior could paradoxically encourage it—a finding consistent with previous studies on unintended consequences of poorly designed health communication campaigns [49,50]. Finally, they stressed that the application should be conceived as a complementary resource rather than a stand-alone intervention, a stance consistent with international frameworks that recommend health technologies be user-centered, sustainable, and integrated into broader care strategies [34,44].

The cross-cutting themes identified in this evaluation—including institutional relevance, cultural and linguistic resonance, comparison with commercial video games, and complementary use—reinforce the rationale that digital interventions must move beyond technical innovation to achieve contextual fit. As illustrated in Figure 2, the app's acceptance and sustainability depend not only on technical or design improvements but also on its institutional integration, cultural pertinence, and complementary role in health promotion. This implies that, beyond simplifying terminology, the app must reflect adolescents' sociocultural realities to strengthen identification and acceptance. Moreover, this transversal dimension highlights that digital interventions are more effective when embedded in multicomponent strategies that combine counseling, school-based prevention, and community activities, thereby ensuring long-term relevance and sustainability. These findings are consistent with systematic reviews showing that many adolescent-focused apps lack robust participatory design and scientific evidence, limiting their effectiveness [51–53].

By contrast, the present study demonstrates how involving adolescents and professionals from the initial stages can strengthen usability, acceptability, and cultural adaptation, aligning with the World Health Organization's [WHO's] call for youth-centered digital health interventions [40,41].

International evidence also supports the feasibility of such tools. Several studies have shown that photoaging apps increased risk perception and reduced susceptibility to smoking [9,22]. Similarly, recent systematic reviews confirm that digital interventions targeting school-aged youth can improve knowledge and attitudes toward tobacco prevention, especially when interactivity and gamification are included [8,12]. Against this backdrop, *No le entres* represents a pioneering contribution in Latin America by rigorously documenting a participatory design process in a middle-income setting.

From a practical perspective, the findings confirm the feasibility of integrating apps like *No le entres* into school-based prevention strategies, complementing initiatives such as smoke-free schools promoted by WHO [54,55]. Combining adolescents' emphasis on aesthetics and gamification with professionals' focus on validation and contextualization offers a roadmap for improving adoption and sustained use. This integration is particularly relevant considering adolescents' high exposure to digital platforms and the urgent need for accessible and scalable preventive strategies.

Nevertheless, some limitations should be acknowledged. The sample was relatively small and restricted to a single municipality (Xalapa), which may limit the transferability of the findings to other regions or school settings. In addition, the evaluation focused on a medium-fidelity prototype rather than a fully operational app, which may have influenced participants' perceptions of usability, navigation, and design. Adolescents accustomed to high-quality commercial video games may have been particularly critical of the graphics and interactivity. Another limitation is that all adolescent participants were recruited from public schools and all professionals from UNEME-CECOSAMA units, which may have narrowed the diversity of perspectives and experiences represented in the focus groups. Despite these limitations, the study's methodological rigor—including triangulation, multi-researcher coding, and an iterative analytic process—strengthens the credibility and trustworthiness of the findings. Finally, although some behavioral elements of the prototype may be relevant to the prevention of other substances (e.g., alcohol or vaping), the app was evaluated exclusively in the context of tobacco prevention; therefore, its applicability to other drugs remains untested and should be considered a limitation of the present study. In perspective, the iterative design process outlined here marks a critical stage in the progression of development. Future research should prioritize the development of a high-fidelity prototype and conduct pilot studies in diverse school contexts, followed by randomized controlled trials to assess effectiveness in changing knowledge, attitudes, and behaviors. Beyond tobacco, the app could be adapted to address other risk behaviors such as alcohol and vaping, thereby expanding its preventive potential.

Beyond participants' general impressions, the app's design and usability features also align with behavioral mechanisms recognized in the tobacco-prevention literature. Adolescents frequently noted that the interactive tasks, customizable avatars, and action-oriented dynamics strengthened their sense of competence and personal agency—elements associated with self-concept enhancement, a known protective factor against tobacco initiation [56]. They also described how the challenges embedded in the prototype simulated situations of social pressure, offering opportunities to practice refusal strategies in a gamified environment [57]. Furthermore, missions linked to constructive leisure activities resonate with recommendations to promote the positive use of free time as a buffer against experimentation with substances [58]. These game-like interactions are consistent with digital health research showing that gamification strengthens engagement, motivation, and behavioral learning [59]. Taken together, these perceptions suggest that the app integrates behavioral components with theoretical relevance for adolescent smoking prevention, aligning with Self-Determination Theory principles emphasizing autonomy, competence, and meaningful engagement [36].

These findings can also be interpreted through the lens of established theoretical frameworks. From a Social Learning Theory perspective [37], adolescents' comparisons with commercial video games reflect the influence of peer norms and modeled behaviors in digital environments, which shape expectations and engagement. Similarly, constructivist approaches highlight the value of interactive, immersive experiences that promote active meaning-making rather than passive reception of information [38,39]. By aligning with these perspectives, the app not only addresses usability and aesthetic concerns but also fosters social and experiential learning processes that are central to behavior change. Situating these results within the WHO Global Strategy on Digital Health 2020–2025 emphasizes that participatory, youth-centered design is not only culturally relevant but also consistent with international priorities for scalable, sustainable, and equitable digital health solutions [60]. In this way, the app reinforces its contribution to Sustainable Development Goal 3 on adolescent health [61]. Thus, *No le entres* exemplifies how co-designed, ICT-based solutions can support both national and international efforts to reduce tobacco use among youth.

Finally, in the context of Latin America, these findings underscore the importance of aligning school-based digital interventions with broader public health and educational policies. Strengthening institutional partnerships between health and education sectors, as well as leveraging regional initiatives promoted by Pan American Health Organization and WHO, could facilitate the large-scale implementation of youth-centered digital tools. This approach would ensure not only technological innovation but also sustainability and policy relevance across diverse sociocultural settings.

5. Conclusions

This participatory evaluation of the *No le entres* app provides empirical evidence on how adolescents and health professionals perceive the design, usability, and preventive relevance of a medium-fidelity prototype aimed at tobacco-use prevention. Findings show that adolescents place strong emphasis on visual appeal, navigation speed, personalization, and gamification, underscoring that these elements are essential for engagement. Health professionals highlighted the importance of linguistic clarity, cultural adequacy, and alignment with existing prevention efforts.

Both groups identified specific areas requiring improvement, including visual design, interactivity, navigation, and message refinement. They also agreed that the app must balance engaging features with clear, developmentally appropriate health content. Cross-cutting themes—such as cultural resonance, comparison with commercial games, and the need for institutional integration—further illustrate the contextual factors that shaped participants' evaluations.

Overall, the study demonstrates that integrating end users' perspectives is crucial for enhancing the usability, acceptability, and preventive relevance of digital interventions for adolescents. Although the findings are limited by the local sample and the evaluation of a medium-fidelity prototype, they offer a solid empirical basis for refining the application and preparing subsequent stages of development.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/adolescents6010017/s1>, File S1: Demonstration of the medium-fidelity prototype of “No le entres”, showing the main screens, navigation flow, and core interactive features. File S2: Focus group guides used for the qualitative exploration of perceptions about the “No le entres” prototype, including the questions, prompts, and structure employed during the sessions.

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M.C.O.-L.; investigation, R.D.U.-M. and M.C.O.-L.; resources, R.D.U.-M., J.M.G.-M. and M.C.O.-L.; data curation, R.D.U.-M. and J.M.G.-M.; writing—original draft preparation, R.D.U.-M. and M.C.O.-L.; writing—review and editing, B.S.-G., M.d.C.G.-T., X.d.S.J.-C., J.M.G.-M. and M.C.O.-L.; visualization, R.D.U.-M. and M.C.O.-L.; supervision, M.C.O.-L.; project administration, R.D.U.-M. and M.C.O.-L.; funding acquisition, R.D.U.-M. and M.C.O.-L. All authors have read and agreed to the published version of the manuscript.

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Abbreviations

The following abbreviations are used in this manuscript:

ENSANUT	National Health and Nutrition Survey
UNEME CECOSAMA	Medical Specialty Units—Community Mental Health and Addiction Centers
WHO	World Health Organization

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