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HabitHero: A Gamified Approach To Teach Digital Wellbeing

Supervisors:

Luigi De Russis

Alberto Monge Roffarello

Candidate:

Xiaozhen Zhu

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Chapter 1

Introduction

Over the past few years, technology has rapidly evolved and provided us with a plethora of digital tools and platforms that have affected various aspects of our daily lives, including how we communicate, work and even relax. Although the integration of these technologies has been fast and widespread, it has also raised concerns about their impact on our wellbeing. The constant notifications and the unlimited online content have blurred the lines between our digital and physical lives, leading to feelings of overwhelm and distraction, sometimes leading to addiction.

Amidst this context, the concept of digital wellbeing has become a pivotal area of focus. It emphasizes the need for a healthy balance between the use of technology and avoiding excessive consumption. The dual role of digital devices, serving as both catalysts for challenges in digital wellbeing and means for delivering interventions, further highlights the complexity of this balance. Digital wellbeing extends beyond the simplistic notion of minimizing screen time, it aims to address the nuanced relationship between individuals and technology.

Traditional responses to digital wellbeing challenges, such as Digital Self-Control Tools (DSCTs), have offered a variety of mechanisms to monitor and restrict digital usage. A few notable examples include RescueTime [1] and MyTime [2], which are equipped with timers, lockout mechanisms, and monitoring features to offer users insights into and control over their digital habits. Despite their utility, these tools often provide a temporary fix, with users reverting to prior habits post-intervention. This short-lived impact is partly attributed to an over-reliance on self-monitoring, which fails to instigate lasting behavioural changes without the incorporation of habit-formation strategies [3].

Another significant limitation of many DSCTs is their generic approach, often failing to take into consideration the unique habits, preferences, and needs of individual users. While some tools, like Socialize [4], stand out by learning from

smartphone user data and providing proactive support, a significant number of DSCTs require users to self-program them without any guidance. This highlights the need for more personalized and adaptive solutions since what works for one individual may not work for another.

Moreover, the absence of a robust theoretical foundation in the design of many DSCTs and the predominant focus on blocking or mitigating interactions [3] overlooks the essential aspect of fostering meaningful digital experiences. While tools like Forest [5] offer a more engaging approach by linking device usage to the wellbeing of a virtual tree, the broader landscape often lacks actionable insights or educational content to assist users in interpreting data and making informed decisions.

In light of the challenges presented by contemporary DSCTs, this thesis adopts an educational stance, emphasizing the need to provide users with knowledge and skills for better digital device usage, particularly within the school setting. A recent study [6] highlights young adults' view of digital wellbeing as a journey of personal growth, where education plays a pivotal role, overshadowing the need for self-monitoring. The focus is on imparting knowledge on proper technology use from a young age, which could potentially shape a future generation that inherently understands and navigates the digital landscape responsibly, rendering timers or lockout mechanisms redundant.

This is where the role of schools becomes pivotal, as educational institutions serve as a foundational setting for the next generation, and by incorporating digital wellbeing into their curricula, they can influence long-term behavioural change.

To this end, the thesis introduces a platform designed to "teach" digital wellbeing within educational settings like schools. Central to this platform's design is the use of gamification, which refers to the use of game elements in non-game contexts. By leveraging game mechanics such as challenges, and feedback systems [7], gamification can target motivation, self-efficacy, and social influence, thereby addressing not only the superficial symptoms but also the underlying root causes of our digital challenges.

1.1 Goal

Building on the premises of the introduction, the primary objective of this thesis is to develop and evaluate an educational platform designed to facilitate digital wellbeing education among teenagers.

The design of the platform, as detailed in Chapter 4 of the thesis, is a synthesis of the theories outlined in Chapter 2 and the user needs identified in Chapter 3. The theoretical frameworks, including Self-Determination Theory, Dual-System Theory,

Flow Theory and Constructivist Theory, provided a foundational understanding of behavioural patterns associated with digital technology overuse as well as the educational strategies that could be adopted in teaching digital wellbeing among teenagers.

In response to the user needs identified through focus groups with high school students and individual interviews with teachers, the platform adopts a gamified approach to make the learning process more engaging and effective. This approach results from combining the insights from the aforementioned theories with the practical needs of students, such as their desire for autonomy in managing their digital habits and preference for visually appealing, interactive and less formal environments.

The platform features a series of challenges and progressive levels designed to incrementally build students' knowledge and skills, which is in line with the Constructivist Theory. This structure aims to maintain active participation and motivation, ensuring a continuous and interactive learning experience. Complementing this, the platform also adopts an anime-style theme, a choice aimed at addressing the visual preferences expressed by students.

The resulting platform is intended to be used under the guidance of educators, providing them with tools to lead the learning process, while allowing students the autonomy to explore and internalize the concepts in their own way.

Following the design and development steps, an evaluation process was conducted to assess the platform's effectiveness and user experience. This test primarily focused on rating its user-friendliness as well as the interactive and gamification elements. The objective was to ensure that the platform was not only engaging and educational but also aligned with the needs and preferences of its target audience.

To achieve this, the platform was tested individually with high school students, which allowed for a direct feedback on various aspects, including its ease of use, attractiveness and overall user experience. The testing process provided insights into how intuitively the students could navigate through the platform and carry out the activities offered, as well as the effectiveness of visual cues and interactive elements.

Overall, the usability test was instrumental in validating the design choices made for the platform and identifying areas where adjustments were needed.

1.2 Thesis Structure

The research conducted in this thesis is organized in seven chapters, organized as follows:

- Chapter 2 starts by defining the concept of Digital Wellbeing, particularly in the context of teenagers, and then moves on to outline the challenges they face in digital environments. A brief critical overview of existing Digital Self-Control Tools (DSCTs) and their limitations is also presented. Following this, the chapter explores the foundational theories on which this research is based, discussing the role of gamification and highlighting how they can be employed to teach digital wellbeing among young users.
- In Chapter 3, the focus shifts to the methodology used during the Needfinding phase, including the recruitment and interviewing process. It provides insights gathered from student focus groups and teachers individual interviews.
- Chapter 4.1 explains the thought process behind the creation of the final platform. This section details various elements of the interface, starting from the low-fidelity prototype to specific submodules. It also discusses how the design integrates into current school curricula and bridges the communication between students and teachers. The chapter concludes by briefly describing the user experience design and the gamification elements used within the final application.
- Chapter 5 outlines the technology stack used during the development phase. It also details how the Model-View-ViewModel architecture was employed within the platform's project, the navigation design and various challenges encountered, along with the solutions adopted.
- Chapter 6 presents the methodology and recruitment process used during the testing phase of this research. It sets clear objectives for the usability tests and discusses the results.
- Finally, the thesis concludes with Chapter 7, which reflects on the study's limitations and future work. This chapter offers a critical evaluation of the study, acknowledging its constraints and suggesting improvements for future research.

Chapter 2

Background

The rapid advancement of technology and the increasing integration of digital tools into our daily lives have highlighted the need to understand how individuals interact with their devices. Teenagers are a particularly important group in this area of study, as they are exposed to both the benefits and challenges of the digital environment. This chapter provides a foundation for understanding the key concepts that are essential to this thesis.

Section 2.1 starts with an explanation of digital wellbeing, shifting the focus to teenagers and exploring their specific experiences with digital technology. It also introduces Digital Self-Control Tools (DSCTs), detailing their functionalities and analyzing their strengths and limitations as examined in the existing literature.

In Section 2.2, the emphasis shifts towards the theoretical aspect of habit formation, providing insights into behaviours associated with the use of digital technology, especially among teenagers.

The chapter concludes with Section 2.3, discussing gamification strategies and highlighting their role in promoting digital wellbeing as well as their effectiveness and challenges in educational settings.

2.1 Digital Wellbeing

2.1.1 Definition

In recent years, the concept of digital wellbeing has emerged as a significant area of interest, reflecting concerns about our increasing dependence on technology. Digital wellbeing can be formally defined as the impact of digital technology on our lives and how it affects our overall experience in an information society [8]. As this definition suggests, it goes beyond the mere use of technology itself and it takes into account its broader implications on our overall wellbeing.

Despite its advantages, the pervasive nature of technology has led to initiatives aimed at moderating the interaction and promoting breaks. In fact, a growing number of individuals have been struggling with the unease of excessive device usage and find it hard to disconnect. Digital detoxes are often proposed as a solution, but complete abstinence from technology is not feasible given its integral role in modern life. While moderation appears to be an appropriate approach, defining the precise boundaries of moderate use can be challenging. This lack of clarity emphasizes the importance of thoroughly examining the nuanced effects of constant digital engagement on our lives.

Beyond essential tasks and needs, people often use digital devices out of boredom, habit or the desire for instant gratification. These factors are further amplified by the appealing design of digital media [9]. In particular, social media and gaming platforms employ a variety of strategies to purposely maintain user engagement, such as:

- **Endless scrolling:** Many platforms constantly update their content as users scroll, making it difficult for them to stop browsing.
- **Push notifications:** This is another way of keeping users engaged. When a user receives a notification, it often signals that something new and exciting is happening, which can be difficult to resist, even when the notification is not critical.
- **Flashy graphics:** Digital media often employ flashy graphics and animations to attract users' attention. This can be effective as well as overwhelming and distracting.

These features effectively extend the time spent on digital devices, often more than it was originally intended.

In response to the growing concerns posed by digital wellbeing, there has been a noticeable shift in the design philosophy. Major tech companies such as Google [10] and Apple [11] are now integrating elements of digital wellbeing into their platforms, striving to find a balance between user engagement and healthier interaction patterns. The urgency of this shift becomes clear when considering the repercussions of extensive digital engagement.

On a psychological level, as highlighted by Andreassen et al. [12], the constant flow of notifications and the endless scroll of online content can lead to feelings of overwhelm and anxiety. Their comprehensive study has also proven that there is a positive correlation between the addictive use of technology and symptoms of psychiatric disorders like ADHD, OCD, anxiety and depression.

Regarding the physical impact, the same study by Andreassen et al. [12] indicates that extended screen time can result in eye strain, disrupted sleep patterns and other health issues. The blue light emitted by screens can interfere with melatonin production and sleep cycles, leading to sleep deprivation.

2.1.2 Specific challenges for teens

Digital wellbeing is a broad concept which concerns people of all ages. However, this thesis primarily focuses on adolescents, a demographic that is particularly affected by the widespread use of technology due to their developmental, social and educational needs.

Despite being often overlooked, it is important to start early and consistent dialogues with teenagers about safe digital practices [13].

For an effective communication, both their learning and behavioural patterns should be taken into consideration within the analyzed context. In fact, teenagers are often more aware of their tech habits than we generally think and they often express the desire for more control over their digital interactions [14]. This should be the basis for designing educational strategies and guidelines that respect teens' autonomy while offering the necessary support and boundaries.

According to a recent interview conducted by Harvard researchers [13], teenagers' addiction to digital devices can also be attributed to psychological factors, such as their susceptibility to peer influence. In fact, there are many social pressures that teenagers have to face, which may be the reason behind the urge to share content that makes them look good.

One of the main factors that may induce this behaviour is the fear of missing out (FOMO), defined as "a pervasive apprehension that others might be having rewarding experiences from which one is absent" [15]. Hence, focusing solely on screen time when studying teens' digital habits may not be enough to understand their experiences [13].

For instance, the Differential Susceptibility to Media Effects Model [16] suggests that media effects on individuals can vary depending on a combination of personal traits, developmental stages and social contexts, which can influence how they interact and respond to digital content: a teen with a curious mind might explore more online platforms, while another might be more reserved and cautious about their digital interactions.

An important insight that emerged from the previously mentioned study is that teens are in a crucial phase of cognitive, emotional and social development, which means that their interpretation of digital content changes as they grow. A younger user may not fully understand all the nuances of an online conversation the same

way as an older one. This implies that a universal approach is not feasible as the effects of digital devices on teenagers are not uniform.

One way to help teens without invading their privacy is to try to understand and sympathize with their challenges and struggles, using an unprejudiced and non-judgemental attitude [13]. More importantly, it is crucial to ask and reflect on what makes digital media so appealing to them, while offering empathy and validation. This aspect is often overlooked by adults but it helps build trust and it ensures that teenagers feel understood and supported in their learning journey.

2.1.3 Overview of current DSCTs and their limitations

In response to the interruption overload caused by the ubiquity of available technology, a growing number of digital self-control tools have been developed and adopted as a viable solution to balance the benefits of technology with the need for undivided attention to tasks. Based on the existing literature [17][18][19][20], the main features offered by current DSCTs can be categorized as follows:

- **Self-monitoring:** It involves providing users with tools to track and display usage data and other relevant information. The main objective is to help users become more aware of their digital activity.
- **Block/Removal:** They aim to assist the user in avoiding distractions as well as to restrict the use of the phone by blocking access during certain times or after a certain duration of use.
- **Change UI Appearance:** It serves to nudge users towards decreased usage by modifying the user interface, such as changing the display colour.
- **Gamification:** It includes features like badges, rewards, punishments and levels, used to increase engagement and motivation. However, there's also a concern that they might create a dependency, potentially triggering further addictive behaviour.
- **Social Support:** A few examples are comparison, competition, or support among users. They can be used to create a sense of community and motivate users to reduce their screen time.

Practical examples of applications offering some of the mentioned features include NUGU, TimeAware, Lock n' Type, Lock n' Lol, RescueTime and HabitLab. Each of these applications has its distinct approach and focus.

For instance, NUGU [21] and TimeAware [22] mainly focus on self-monitoring, with the difference that the former improves self-regulation through social support, goal setting and competition while the latter is an ambient widget promoting self-awareness by capturing and reflecting on computer usage behaviours.

NUGU's design is based on principles like persuasive technology and the Social Cognitive Theory (SCT) [23], which states that learning is often shaped within a social context and through observation. This means that the tool leverages the influence of social interactions to motivate and guide users in managing their digital habits more effectively.

Conversely, TimeAware employs framing effects to enhance personal productivity [22]. Building upon this, the widget also incorporates the concept of reactivity and reactive effects, where the former refers to the changes in one's behaviour when one becomes aware that they are being observed. In other words, users may alter their behaviour positively when being monitored. This reactive effect is further amplified when feedback is provided, allowing users to compare their current digital behaviour with desired goals.

Other examples of DSCTs that incorporate blocking and self-monitoring features in their systems are Lock n' Type [24] and Lock n' LoL [25], both allowing users to set restrictions on app usage during specific times. Lock n' Type focuses on individuals and discourages the use of certain apps by employing a lockout task. The underlying principle behind this design choice is the Uses and Gratification Theory (UGT), which explores why people actively use media to meet their needs [24]]. By introducing lockout tasks, the tool aims to increase the cost of using an app, thereby discouraging its use.

In contrast, Lock n' LoL is designed for group settings, with the aim of fostering a shared understanding and awareness among the members of a community. The synchronized restriction is based on the idea that one's device usage can influence the behaviour of others in the group.

RescueTime [1] and HabitLab [26] try to help users through goal-advancement and UI modification features. In particular, RescueTime is a commercial platform that focuses on raising awareness by allowing users to set specific goals and providing them with detailed statistics on their digital activities [27]. HabitLab also adopts goal-setting features but it uses a different approach: users can set goals for how much time they want to spend or not spend on specific sites. After that, the platform will use a variety of interventions, including pausing videos, hiding content and persuasive messages to help users reduce their time on distracting sites [28]. The main difference between the two platforms is that RescueTime provides a broader overview of user's digital activity across all applications while HabitLab is more focused on reducing time on specific, user-identified distracting sites.

Although all the DSCTs discussed have shown promising results, several studies have highlighted their limitations, and some interesting findings have been shared.

For instance, block features in some apps, such as Lock n' Type and Lock n' LoL, have faced criticism for being either overly restrictive or too easy to bypass [17].

As for gamification features, while liked by users and supporting habit formation, they might also create dependency and trigger further addictive behaviour. Interventions that aim to promote extrinsic motivation might only work in the short term and prevent users from developing sustainable self-determination [17] [29] [30].

On a related note, self-monitoring tools like RescueTime can be subject to accuracy issues, with bugs in visualization statistics that can potentially mislead users [18], hence reducing the tool's effectiveness.

As important as self-monitoring is, using it alone is not sufficient to achieve long-lasting results [17] [31]. In fact, initial reductions in screen time often prove temporary [18] [32], with behaviours typically reverting back to how it was initially after the tool is uninstalled or not used anymore.

Finally, ethical concerns also need to be considered as they could arise with restrictive features, thus negatively impacting user autonomy and self-determination, both crucial for habit formation [32].

In light of the challenges outlined above, it becomes clear that, while many DSCTs have been designed to help users become more aware and proactive about their digital habits, they still have many limitations, particularly when it comes to fostering long-term habit changes. In this respect, it is crucial to take steps in adopting different approaches, which not only raise awareness towards digital usage but also allow users to consciously reshape their habits.

2.2 Foundational Theories

The lack of foundational theories in the current literature on DSCTs, as highlighted in some studies [33] [3], is another important factor which contributes to the limitations and challenges of many digital interventions, especially when it comes to providing long-lasting behavioural changes. One reason that would explain this theoretical gap could be the large number of existing theories, which makes it even more difficult to choose the correct strategy and employ it effectively [3].

After a thorough literature review, though, it was possible to narrow down the theories that could be used as a foundation for the work presented in this thesis. These include the Self-Determination Theory (SDT) and Dual-System Theory

(DST) for what concerns behavioural formation and the Constructivist Theory and Flow Theory as a basis for the teaching methodology and design.

Self-determination theory [34] [35] is a well-established framework that explores the factors that influence human motivation and how this can be sustained over time. As highlighted in the Oxford Handbook of Human Motivation [36], central to SDT is the distinction between intrinsic (self-determined) and extrinsic (non-self-determined) motivation.

The former is associated with greater persistence and adaptive outcomes like satisfaction and wellbeing, while the latter is driven by external outcomes like rewards or punishments. Intrinsic motivation leads to experiences of willingness and enjoyment, fostering high persistence while extrinsic motivation can sometimes undermine autonomy and lead to feelings of coercion.

Furthermore, SDT distinguishes three basic psychological needs: competence, autonomy and relatedness. Competence indicates the desire to feel capable and effective in one's goals, autonomy refers to the need for individuals to be in control of their own decisions, and relatedness is linked to a sense of connection with others.

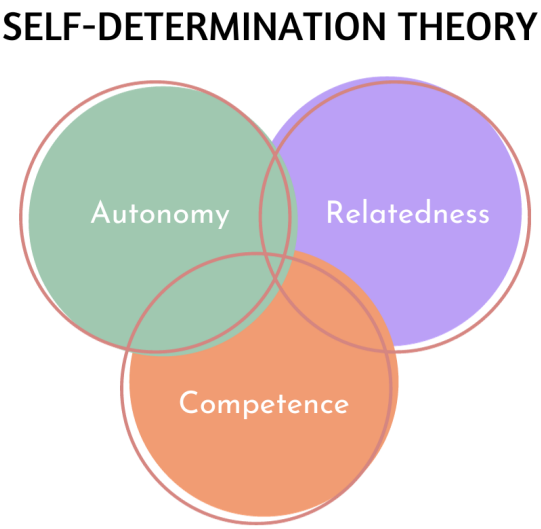

Figure 2.1: A diagram showing the three elements of self-determination theory.

In the context of this thesis, research [37] has indicated that autonomy-supportive teaching allows students to experience a sense of volition and choice, leading to greater intrinsic motivation and self-determination. Competence also plays an important role in educational settings and it can be supported by positive feedback and challenges that are carefully designed to match an individual's ability. This means offering students tasks that are neither too easy, which could lead to

boredom, nor too hard, which could cause anxiety and disengagement.

The Cognitive Evaluation Theory, a sub-theory of SDT, adds one more layer to the discussion as it differentiates between controlling and informational or verbal rewards [38].

The summary of meta-analyses by Richard M. Ryan et al. [38] clearly explains the difference between the two: informational rewards provide feedback and acknowledge performance without trying to control behaviour whereas controlling feedback focuses on pointing out mistakes or areas of improvement without offering constructive guidance or support.

The study also suggests that extrinsic rewards can have a controlling aspect that undermines intrinsic motivation, but if they are delivered as feedback about competence without attempting to control behaviour, they can actually enhance self-determination. In this respect, Flow Theory offers additional insights into the dynamics of motivation and engagement and it complements the principles of SDT.

As introduced and explained by Csikszentmihalyi [39][40], Flow Theory stresses the importance of challenge-skill balance, clear goals and immediate feedback, all features that align with STD's core ideas on competence and autonomy.

When individuals are given tasks that are designed to be optimally challenging or, in other words, aligned with their skill levels, they are more likely to experience a state of intrinsic motivation called the "flow", where the activity itself is rewarding and enjoyable [41]. This encourages a sense of mastery and control, which are fundamental to maintaining motivation and promoting learning. The framework could be used as a basis on which DSCTs can build up their interventions to achieve long-term behavioural change.

In fact, by integrating flow theory into the design process, it would be possible to create more immersive and motivating experiences. In an interview reported by Karen Stansberry Beard [39], Csikszentmihalyi emphasizes the importance of differentiation and integration in education. Differentiation means recognizing and addressing the unique strengths and interests of each student while integration involves tying them up to a larger, common theme or objective.

For instance, while the core activities within a learning module could be standardized for all students, the educational environment should still offer personalized insights and feedback based on the individual's personal reflections and experiences.

Within the scope of this thesis, the digital platform could draw from these observations and consider offering various tools and resources to satisfy different learning styles and preferences, while ensuring that students are learning about and contributing to a common subject.

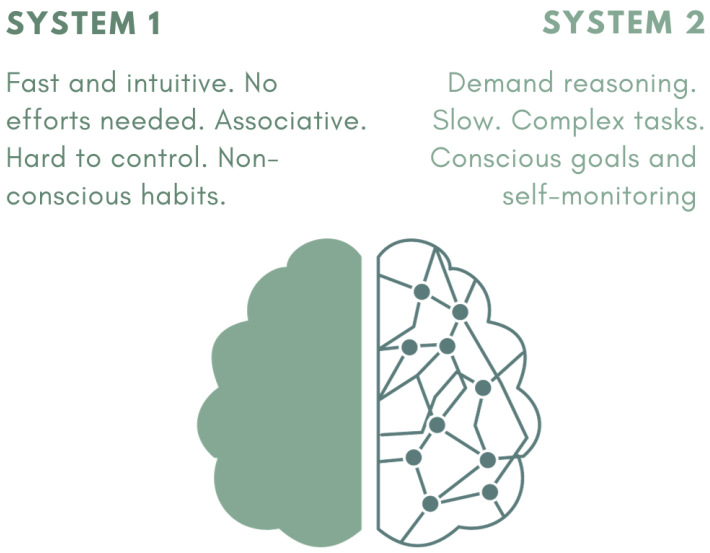

Figure 2.2: Dual system theory scheme.

Following the concepts explored in the Self-Determination Theory and Flow Theory, another important framework that brings insightful contributions to the design of the educational platform discussed in this thesis is the Dual System Theory (DST) [42][43]. The main idea is that individuals have two distinct sets of cognitive processes: System 1, which is fast, automatic and often subconscious, and System 2, which is slower, more deliberate and conscious.

As far as it concerns digital wellbeing, System 1 processes are involved in quick and habitual responses to digital stimuli while System 2 processes require more conscious thought and are activated when individuals make deliberate choices about their digital behaviour.

Although there have been attempts to use DST as a theoretical basis in DSCTs [24], some studies [20][3] have shown that the high-level conception, lack of specificity, and theoretical gap leave the cognitive design space ambiguous.

The current landscape of digital self-control tools is dominated by features that prevent the activation of unwanted non-conscious habits by making them unavailable. However, it may not fully leverage the potential of DST to foster long-term habit change [20].

In the context of this research, the intention is to systematically apply Dual System Theory along with the insights from Self-Determination Theory and Flow Theory. This integration aims to support both intrinsic motivation and effectively take advantage of the dual cognitive processes. The final platform, a mobile

application, will offer a user-friendly interface and allow for immediate actions while also providing tools for reflection and conscious decision-making about digital habits.

The learning modules will offer both activities like quick quizzes and interactive games which appeal to System 1, but also reflective exercises that require more consideration, thus involving System 2. For educators, the platform will be equipped with tools designed to facilitate the reflective and analytical aspects of the learning process, enabling teachers to guide students through more complex layers of digital wellbeing.

The last theory that will be discussed in this chapter is the Constructivist Theory which can be integrated into the design of our platform so as to make the learning experience and teaching methodology more effective.

Constructivism, as outlined by Ernst von Glasersfeld [44], states that knowledge is not passively received but actively built by the learner through experience. This clearly underscores the need to find a system that encourages users to construct their own understanding of digital wellbeing, especially when considering that students are often trained to give correct answers without understanding the concepts, as further pointed out by Glasersfeld in his research.

In this regard, the platform could challenge students to solve problems related to digital habits, perhaps encouraging them to design their own strategies with some guidance from educators. By doing so, we avoid training them to only perform specific actions but to also understand the reason behind healthy digital behaviours.

Another interesting concept discussed in the same study is viability over truth, which could be applied to the platform's activities. Instead of presenting information as absolute truths, the platform can push students so that they test the viability of various strategies and find the one that best works for them. This would allow for a more personalized learning. Details on the specific design adopted in this thesis work will be discussed in the following chapters.

2.3 Gamification Strategies

As previously mentioned, gamification covers a fundamental role in the design of HabitHero, the educational platform we have been discussing so far.

Gamification is a broad concept that encompasses many disciplines and there are several definitions of this term in the existing literature: Deterding et. al [45] have defined it as "the use of game design elements in non-game contexts", which means incorporating aspects traditionally associated with games, such as rules and other interactive elements, into areas not typically considered game-like.

Along the same line, another insightful interpretation has been given by Werbach [46], stating that gamification is "the process of making activities more game-like".

One of the main disciplines actively exploiting gamification techniques is education, where motivation and engagement are key factors serving the dual purpose of improving learning results and making the process more enjoyable [47].

In educational settings, gamification is not merely about adding points or leaderboards but it focuses more on creating an environment that takes advantage of the pull of games to reach didactic objectives. This approach makes tedious tasks into challenges, turning the learning journey into an adventure that the students are more willing to take on.

Despite the extensive body of research and the large number of practical applications, the correct approach to employ gamification techniques remains unclear. More often than not, it remains an experimental methodology rather than an exact science [47].

The challenge lies in identifying the right balance between educational content, in our case, and gamification so as to ensure that the latter only serves to improve the learning experience rather than become a source of distraction.

In the context of digital wellbeing, Forest [5] and Study Bunny [48] are only a few of the many examples of applications that make use of gamification features.

Although these tools have been generally well-received [18] by users and can be effective in promoting the formation of new habits through repetitive engagement [30], there's also a concern that gamification might foster a reliance on extrinsic rewards, thus leading to temporary results and potentially causing further addictive behaviours [30][29].

This is a critical problem to consider when designing a DSCT, since the goal is to promote digital wellbeing without creating additional dependencies.

As suggested by [17], one way to exploit the potential of gamification is to combine its elements so as to promote intrinsic motivation, such as providing users with the means to set their own goals or activities that are both purposeful and educational, yet sufficiently engaging to sustain users' involvement.

In this respect, Michael Sailer et al. [49] explores the impact of gamification on motivation within the framework of SDT, discussed in the previous section.

The author conducted a randomized controlled study using an online simulation environment to analyse how different configurations of game design elements affect the fulfilment of basic psychological needs.

The same study revealed some insightful findings: interactive components like badges, leaderboards and performance graphs positively affect competence while

avatars, meaningful stories and teammates influence relatedness.

Michael Sailer et al. also emphasizes that not only the presence of game design elements is important but also how they are implemented. The aesthetics (how appealing design elements are) and the quality (how well the elements function within the gamified environment) both play a crucial role in the overall effectiveness, which means that for gamification to be successfully employed, the game design elements need to be both visually appealing and functionally integrated into the activity.

In an effort to understand the real impact of gamification on digital health behaviour change, Brian Cugelman [50] was able to identify seven core ingredients which align with proven behaviour change strategies [7].

These include goal setting, overcoming challenges, feedback, reinforcement, progress comparison, social connectivity and fun. Goal setting refers to the commitment of individuals in achieving specific objectives, providing a clear direction and purpose, whereas overcoming challenges does not merely consists in overcoming obstacles but also personal growth, learning and development.

Just as important is the feedback on performance, since constant and constructive responses help to better visualize one's progress and refine the strategies adopted.

Reinforcement aims to shape and encourage desired behaviours by providing positive outcomes and it's based on the principle that habits which are followed by positive consequences tend to be repeated, while those followed by negative consequences are less likely to last. In gamification, reinforcement can take many forms, such as earning points, badges, or new levels for completing tasks. These rewards serve as a positive reinforcement, providing a sense of accomplishment and encouraging continued engagement.

Reinforcement is most effective when it is immediate, consistent and tied directly to the desired behaviour [51].

Another feature of gamification is progress comparison, which adds a layer of self-awareness and foster a sense of community and collaborative learning.

Similarly, social connectivity refers to interactions and connections with others, which enriches the overall experience. The last element discussed is fun and playfulness, which turns routine tasks into captivating experiences.

In this context, the persuasive architecture introduced by Cugelman [50], and supported by proven theories [52][53], suggests that the integration of these strategies should create an experience that is greater than the sum of its parts.

Following these lines HabitHero's design should ensure that the aforementioned

elements work in harmony to create an immersive and effective learning environment. More importantly, when selecting the right persuasive architecture for an intervention, it's crucial not to fixate on a single framework but consider the best fit for the application. This depends on the target audience and the context in which gamification will be used.

As we have seen, while the application of gamification shows promising results, it needs a nuanced approach that balances the main objectives with the motivational pull of game elements.

Careful attention should be given to how each component is integrated into the platform so that it is possible to foster intrinsic motivation through aesthetically pleasing game design elements, while avoiding dependence on extrinsic rewards.

Chapter 3

Needfinding

In user-centered design, Needfinding plays a crucial role in understanding the needs and challenges of the target users, as well as their preferences and expectations. The information gathered during this step will be essential in defining the requirements of the digital wellbeing platform and guiding the development process.

Despite the availability of many well-known strategies, this thesis work employed focus groups as the chosen methodology for conducting needfinding. This choice was made due to the ability to gather valuable information through structured conversations and the opportunity to explore unexpressed needs and pain points.

In the following paragraphs detail the structure of the interview, along with the questions and an explanation of their purpose within the focus group:

In Section 3.1 a clear definition of focus groups will be provided, and then move on to discuss the questions used during the interviews with the target users. This section serves as a bridge between the methodology chosen and the actual findings, showing the rationale behind the interview design process.

Section 3.3 will present the results of interviews with students, highlighting their experiences with technology, challenges and perceptions regarding digital wellbeing.

Section 3.4 shifts the focus to teachers, offering an overview of their perspective on digital wellbeing in an educational context. The goal is to gain a deeper understanding of how teachers perceive the role of technology in their students' lives and what they believe would be more effective in promoting healthier digital habits.

The needfinding phase not only allows us to create a solution that aligns with the actual needs and experiences of the target audience, but it also contextualizes the challenges and opportunities that exist within the educational landscape and

provides us with a foundation for the next steps.

3.1 Methodology

The interviews used during the Needfinding phase were designed following a specific approach called Focus Group, a technique commonly used both to clarify research questions in the initial stages and also to establish results after the study's completion.

Within the scope of this thesis, focus groups were used only to explore user needs, perceptions and attitudes towards digital wellbeing before the design of the final platform. Typically, these discussions involve a small group of up to ten individuals, guided by a moderator, whose role is to navigate the group dynamics, ensure all members participate and keep the discussion focused and productive [54].

Following the approach of focus groups, I designed a set of questions for students' focus groups, aimed at exploring various aspects of digital wellbeing and providing a student-centric view of the topic. Here is the structure of the interview, along with a detailed explanation of their purpose within the focus group. The actual questions used in the interview script are reported in Appendix A.

Demographic Questions
The demographic questions serve to establish a baseline understanding of the participants' backgrounds.

Habits on Technology Use
This section aims to understand students' daily technology usage patterns, preferences and the impact of digital devices on their academic and personal lives. The questions are designed to prompt discussion about the balance between technology use for learning versus leisure, the impact on concentration and study habits, and collaborative strategies for improving digital wellbeing in the school environment.

For example, the question about balancing educational and leisure activities on digital devices can help us better understand students' self-regulation skills. This could help in the design of features that encourage reflective thinking about digital use.

School Rules
The questions on school rules provide a clear overview of the school's stance towards digital devices, highlighting the measures, if any, that the institution has implemented to enhance digital wellbeing.

This section also explores the students' perspectives on the effectiveness and relevance of school policies regarding digital device usage. This discussion contributes to the development of a learning ecosystem that supports student autonomy, providing them with strategies that they can adopt voluntarily.

Perceptions of Digital Wellbeing
In this section, the focus shifts to the students' understanding and personal experiences with digital wellbeing, their self-awareness regarding their tech habits, and their knowledge of or interest in strategies to improve digital wellbeing. By asking students to define digital wellbeing in their own words, it is possible to assess the level of existing knowledge and misconceptions. This could provide more insights as to how we can build a platform that facilitates the construction of knowledge from their individual perspectives, ensuring the platform is in line with their experiences.

Learning Methods
The final set of questions is designed to understand the students' learning preferences, the importance of structure and feedback in their learning process, and their openness to using online resources and receiving support. This information is crucial for developing educational strategies and tools that accommodate their preferences and enhance their learning experience regarding digital wellbeing.

Questions about the importance of structure, routine, feedback, and support systems are essential for creating an engaging and effective learning environment within the platform. For example, if students value regular feedback, the platform could incorporate progress tracking and provide periodic observations to satisfy this need. Similarly, if there's a preference for group work, collaborative tools and features could be integrated.

To complement this picture, another set of questions was designed for individual interviews with teachers, aimed at assessing their viewpoints.

Teachers, often being the ones to observe changes in student behaviours, have a first-hand view of how students engage with technology and can offer nuanced insights into their behaviours and needs. The teacher interviews are structured to explore several key areas, the specific questions are reported in Appendix B:

1. **Teachers' Observations:** Teachers were invited to share their thoughts regarding student interactions with digital devices, especially within the school setting. Questions like "Have you noticed a change in the use of technology in lessons over the last few years? In which ways?" (Question 2) were used to uncover trends and shifts in student behaviour.

2. **Teachers' Relationship with Technology:** Here, educators are called to reflect on their own use of technology in their professional lives. This

self-reflection helps to understand their comfort level with digital tools and their potential biases or enthusiasm towards technology use in education. For instance, the question "How would you describe your relationship with technology?" (Question 3) encourages teachers to think about their own digital habits and how this may hypothetically affect their approach to teach digital wellbeing.

3. **Integration of Digital Wellbeing:** The questions aim to gather teachers thoughts on how the concept of digital wellbeing could be included into the school curriculum. This includes their openness to incorporate such topics and the methods they believe would be most effective. Questions like "Were you aware of the concept of digital wellbeing before this conversation" (Question 4) explore educators' current awareness and attitudes towards digital wellbeing.

4. **Gamification in Education:** Teachers provide their insights on the use of gamified elements in lessons. Those who have employed gamification elements are asked about its effectiveness and impact on student engagement and learning outcomes. The question "Have you adopted gamification strategies in your teaching methods?" (Question 15), followed by "If so, how did the students react?" allows us to understand the practical implications of gamification and its impact on learning and student engagement.

3.2 Recruitment and Interviewing Process

In this study, convenience sampling was used as the primary method for participant selection. Convenience sampling is a selection method where participants are selected based on their easy accessibility and proximity to the researcher. The use of this technique within the parameters aforementioned aimed to optimize the research process, acknowledging the practical limitations of the educational environment. It still allowed for an efficient gathering of data while ensuring that the participants' experiences were reflective of the high school context, which is the study's primary interest.

The recruitment process focused on high school students, specifically from two senior classes. This choice was based on a combination of factors, including their availability and logistical feasibility within the school's context. The selection inherently excluded groups outside the high school demographic, such as middle school or university students. This boundary was needed to maintain the study's relevance to the high school setting, a critical period for shaping students' digital habits and attitudes.

Following the selection process, focus groups were organized as follows:

- **Group 1:** Consisted of six 17-year-old females from the fourth year of a linguistic high school.
- **Group 2:** A more heterogeneous group of nine students - six females and three males - from a linguistic course, with ages ranging from 18 to 20 years.
- **Group 3:** Included ten students (six females and four males), aged 18 to 19 years, from both social economics and human sciences courses.

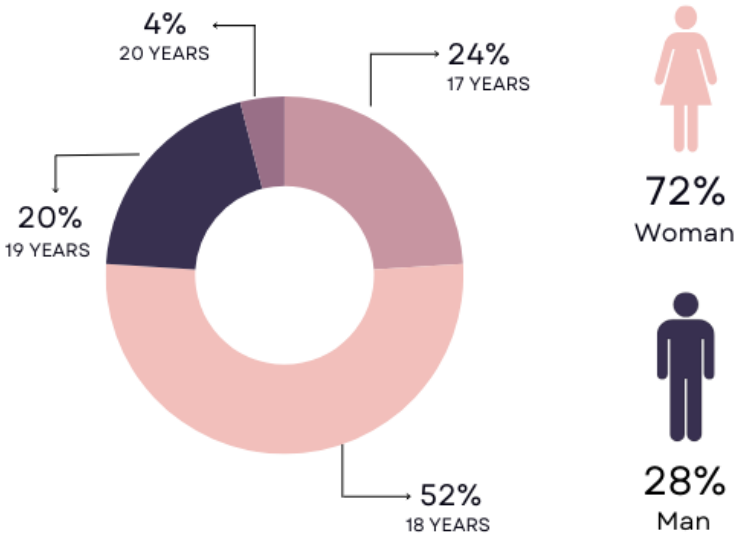

Figure 3.1: Age and Gender Distributions from Student Focus Groups

Similarly, the selection of teachers for individual interviews followed the convenience sampling approach, with a focus on those who were available and willing to participate. Despite this method's reliance on accessibility, I was able to include a diverse range of educators in the study. The teachers interviewed represented a variety of subjects, ages, and levels of technological literacy. In particular, a total of seven teachers were recruited: The group consisted of two mathematics teachers (ages 60 and 54), an Italian literature, history, and geography teacher (age 50), an English teacher (age 29), a Chinese teacher (age 37), an Italian and Latin teacher (age 27), and a natural sciences and computer science teacher (age 40). A detailed representation of the demographic data is represented in the following figure.

Before starting with the interviews, a consent form was provided to all participants. This form outlined the objective of the thesis, the purpose of the interviews

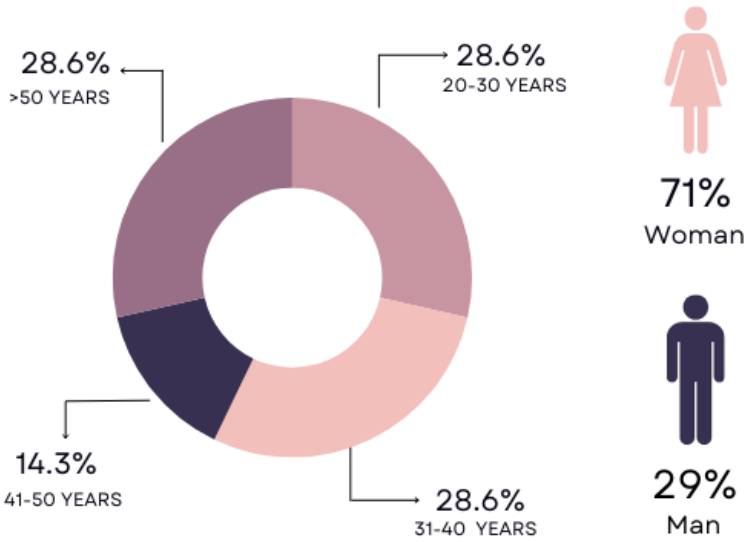

Figure 3.2: Age and Gender Distributions from Teacher Interviews

and how the information gathered would be used. It was essential to inform both students and teachers about the study's objectives to ensure transparency.

Both focus groups and teacher interviews were conducted within the school environment, during school hours. This scheduling was chosen to ensure ease of access and to fit within the participants' daily routines. One important note is that teachers were not present during the student focus groups to create a more comfortable and open environment, encouraging students to express their opinions and experiences with digital wellbeing freely.
The absence of teachers helped mitigate the potential influence or bias that their presence might have had on the students' responses.

Despite the ideal setup, the audio quality in the interviewing environment was deemed insufficient due to ambient noise and the dynamic nature of group discussions. Therefore, it was decided not to record these sessions. Instead, the interview process was carefully structured to facilitate thorough note-taking.

Each focus group session began with questions from a specific macro-topic. Students were encouraged to take turns answering, and sharing their thoughts and views on each subject. To achieve a balanced contribution from all participants, special attention was given to engaging less talkative students. If a particular participant was noticeably quiet, I would direct a question to them or ask for their opinion on a matter being discussed. This approach helped in drawing out perspectives from all students.

Continuing with the interviewing process, the individual interviews with teachers

followed a structured protocol, with a script prepared beforehand. This allowed for a comprehensive investigation of teachers' perspectives on digital wellbeing and their observations of students' digital habits.

Teachers showed considerable enthusiasm about the topic, often providing in-depth answers that addressed multiple questions at a time. To avoid repetitive statements, I adapted the interview flow dynamically, skipping over questions that were already inadvertently covered.

As with student focus groups, I opted for note-taking during the interviews with teachers. The note-taking approach allowed for real-time documentation of the discussions, capturing key points, opinions and nuances. This method proved effective in collecting rich, qualitative data which will be outlined in the upcoming sections.

3.3 Results From Student Focus Groups

During the students' interviews, several interesting observations were shared about their experiences and needs regarding digital wellbeing.

A recurring theme was the difficulty they faced in balancing educational and leisure activities on digital devices, with many students reporting that this had a negative impact on their ability to concentrate and focus. This finding is consistent with the existing literature reviewed in Section 2.1. Although this initial part of the focus groups did not yield any novel information, it still played an important role in establishing a comfortable and open dialogue with the participants, focusing on topics they were familiar with and relevant to their daily experiences.

Alongside these initial reflections, further discussions on school policies revealed some new insights that were more relevant to the objectives of this research. Students expressed a varied range of opinions regarding this topic: some acknowledged the necessity of these rules, while others perceived them as overly restrictive, expressing concerns about the effectiveness and fairness of some punishments.

However, there was a clear consensus across the focus groups regarding the importance of finding a balance between guidance and personal responsibility when creating a healthier digital environment at school.

Students consistently advocated for more flexible rules and highlighted that an approach based on personal experience and individual choice-making is crucial when developing new digital habits. They believe that building trust, even if it's not always reciprocated, can lead to a more positive culture.

In fact, students think that digital wellbeing should be a personal skill that can be developed only over time, being aware that mistakes are inevitable in the beginning. This preference for autonomy and a trust-based approach is in line with

the principles of Self-Determination Theory (SDT), as outlined in Section 2.2, and it further validates its importance in this context.

Additionally, students expressed a keen interest in understanding the physical effects of digital device overuse, including the decline in attention span and strategies for self-control, which hints at the need for more awareness about the implications of prolonged digital engagement. This is certainly something to be taken into account during the design of HabitHero.

The discussions also underscored the importance of personalized feedback during the learning journey, especially through detailed breakdowns.

In terms of learning preferences, the focus groups showed appreciation for the simplicity of certain digital platforms, like Canva, and a desire for a learning environment that offers various methods, such as learning through visual tools, reading, and writing, with some preferring to listen to lectures rather than applying knowledge through practical activities.

The majority of students seemed to prefer to work independently over team activities. Students also expressed interest in alternative, offline activities, and the need for personalized usage statistics to better understand and manage their habits.

During the interviews, students also expressed a clear preference for learning environments that are visually appealing and less formal. They particularly stressed the importance of including elements like colour psychology, motivational quotes based on one's personality, and rewards.

These preferences indicate a clear shift from the traditional educational setting towards a more interactive and engaging learning experience. In this respect, some students from the second focus group shared various ideas on learning strategies that could be used to promote healthier digital habits, for example gradually establishing habits, informing and discussing problems and challenges, engaging the school, and focusing on personal motivation.

Following the analysis of student focus groups, I summarized the findings in Table 3.1, which displays the main user needs that will be addressed in the design of the final prototype along with a brief description for each.

3.4 Results From Teacher Interviews

In this section, we'll shift our focus to the findings that emerged from the interviews with educators, which add another layer to our understanding of digital wellbeing within the educational context.

User Need	Description
Personalized Device Usage Breakdowns	The user needs personalized device usage breakdowns to better understand their habits
More Flexible Guidelines	The user needs more flexible guidelines that promote autonomy, individual responsibility and decision-making related to technology usage.
Inclusive Conversations with Teachers	The user needs more inclusive conversations with teachers about the use of digital subjects.
Support for Implementing Strategies	The user needs support to implement strategies for digital wellbeing consistently.
Diverse Learning Needs	The user needs diverse teaching methods that can meet their individual learning preferences.
Visually Appealing Interface	The user needs visually appealing elements that make the learning process more attractive.
Less Formal, Non-Competitive Environment	The user needs a less formal, non-competitive learning environment which offers a clear structure and feedback in the learning process.

Table 3.1: Student User Needs

Regarding the relationship of teachers with technology, the interviews revealed a diverse range of experiences, with some showing a keen use of technology in their courses while others displayed a more cautious or limited engagement of such tools.

A consistent platform used across all the interviewed teachers is Google Classroom, with a few teachers employing Kahoot and Word Wall to make lectures more interactive and playful. In general, teachers seemed to have a tendency to use digital tools for basic classroom functions, such as recording attendance and displaying e-books. On the contrary, they showed some reluctance towards more complex technologies.

Their relationship seems to be characterized by a preference for traditional teaching methods, viewing technology only as a supplementary rather than a

central component of their teaching approach.

The interviews also highlighted the challenge many teachers face in managing students' use of technology. A common concern was the distraction and negative effects on student behaviour.

Teachers observed that the recent increase in the availability of digital devices in classrooms, partly due to legislative changes, has worsened these challenges.

In this respect, their responses were again heterogeneous. Some educators advocate for stricter controls while others emphasize the importance of fostering responsible digital habits in students.

Moving on to the third main topic of teacher interviews, which is about the challenges in teaching digital wellbeing at school, a recurring theme was the difficulty in integrating this subject into the existing curriculum, due to time constraints, diverse learning needs, and varying levels of student receptiveness.

Teachers also observed that students often resist advice on improving their digital habits, preferring to manage it themselves. This could be explained by the generational gap, as suggested by one of the interviewees, and the student's reluctance to accept guidance from authority figures, a reason offered by another educator.

Furthermore, the educators pointed out that domestic habits significantly influence students' digital behaviours, suggesting that interventions at school might be less effective if not supported by changes at home. The absence of a dedicated professional figure to guide both teachers and students in this area was seen as a major obstacle.

Teachers also expressed concerns about the negative impacts of excessive digital device usage, such as anxiety, anger, cyberbullying, diminished focus and a decline in physical activities, some of these aspects were already mentioned in Chapter 2.

The interview then shifted to another important theme regarding the content of digital wellbeing that should be taught to students. Teachers highlighted the importance of teaching students to distinguish between the activities that necessitate the use of technology from those that don't. They also think that it is important to guide students in responsible device usage through practical examples by sharing personal experiences and maintaining an honest dialogue. Another aspect that emerged was the importance of mindfulness, as well as finding a balance between digital and physical activities.

Teachers suggested that lessons on digital wellbeing could be incorporated into existing subjects like civics education, gradually introducing digital devices in lectures with careful consideration of their impact.

In relation to the use of gamification strategies in education, it was observed that although a majority of teachers have not extensively adopted gamified elements in their lectures, those who have implemented such strategies reported noticeable increases in student engagement and positive outcomes.

This shift from traditional teaching methods, albeit not widespread, has shown promising results. The use of platforms like Kahoot and Word Wall, as mentioned earlier, has clearly proven teachers' perceptions.

These tools, which introduce an element of play and competition into the learning process, have been particularly effective in breaking the monotony of conventional classroom settings and capturing students' interest.

The following list summarizes the main findings that emerged from the interviews with teachers.

1. **Teaching Content:** As suggested by educators, the content provided during the learning path on digital wellbeing should include lesson plans, multimedia presentations, case studies and role-playing scenarios.

   Interactive activities should involve quizzes, self-assessments and group exercises that encourage students to reflect on their personal digital habits and learn from one another. Case studies should provide real-life examples of digital wellbeing issues faced by individuals, role-playing scenarios can help students practice resolving dilemmas related to device usage.

2. **Resources and Tools for Digital Wellbeing Education:** One of the main challenges that emerged several times across the interviews was the lack of appropriate tools that could help in teaching digital wellbeing at school.

   It is clear that the user needs a platform that is able to support peer-to-peer learning, encouraging students to share experiences, challenges and successes related to digital wellbeing with one another.

3. **Integration Into the Current Curriculum:** As discussed before, time constraints as well as the diverse learning needs of students make it difficult to incorporate digital wellbeing within the existing curriculum.

   Given these issues, the user needs a platform that allows to teach digital wellbeing without extensive additional time. The activities and resources offered should enable students to engage with the content at their own speed, with modules that can be taught over a few weeks instead of a single class session.

4. **Bridging Student-Teacher Communication Gap:** During the interviews, another delicate issue was raised by teachers regarding the resistance of students towards advice or guidance from authority figures.

   This indicates the need for a system that can act as an intermediary to help mitigate these conflicts, initiate the dialogue on digital wellbeing and make students more receptive to the topic. It is also important to equip teachers with the tools necessary to effectively communicate and interact with students.

Chapter 4

Interface Design

Following the theoretical foundations outlined in Chapter 2 and the results obtained during the needfinding phase in Chapter 3, this section marks a significant shift from conceptual understanding to the practical design of our digital wellbeing platform, HabitHero. It will serve as a bridge to the gap between theory and practice, showing how the information and the findings from previous chapters were directly translated into the design and functionalities of the platform.

Section 4.1 connects the insights from the literature review in Chapter 2 and the user needs identified in Chapter 3 with the actual design of HabitHero. This section explains how the platform's design is directly influenced by both academic research and the specific needs of students and teachers. It also includes an overview of the low-fidelity prototype, detailing the changes made to achieve the final platform.

In Section 4.2, the focus shifts to the detailed design process of HabitHero. This section will cover how the interface is conceived to be user-friendly, with a particular emphasis on features like ease of navigation, engaging graphics and interactive elements.

Finally, Section 4.3 will wrap up the discussion by providing insights on the strategic use of gamification in increasing users' attention. In acknowledging the significant role of gamification in engaging a teenage audience, this section outlines how game-like elements such as challenges are integrated into the platform. It discusses how gamified features are designed not just for entertainment but to enrich the learning experience, making digital wellbeing education more interactive and appealing to students.

4.1 Design Rationale

As anticipated in Section 2.2, the design of the educational platform, which has been named HabitHero, draws from the principles of Self-Determination Theory (SDT), Dual-System Theory (DST), Flow Theory and Constructivist Theory.

The combination of these frameworks not only addresses the challenges posed by long-lasting habit formation and educational strategies in the context of digital wellbeing but it also aligns with the specific user needs identified through student focus groups and teacher interviews, as detailed in Chapter 2.

In designing HabitHero, a key focus was to create a learning path that is both comprehensive and adaptable. The platform's educational framework is structured into a series of interconnected modules, each building upon the knowledge and skills acquired in the previous activities. This approach follows the principles of Flow Theory and Self-Determination Theory.

Flow Theory, as presented in Section 2.2, revolves around the concept of achieving a state of 'flow', where users are fully immersed and engaged in an activity. This condition is reached when there is a perfect balance between the challenge presented and the individual's skill level.

In the context of HabitHero, the principle is applied in the design of each educational module. As students progress through the learning path, they will encounter activities that gradually increase in complexity, which ensures that each new challenge is slightly more demanding than the previous one, yet not so difficult that it becomes frustrating to accomplish.

This approach also aligns with the principle of competence, one of the three basic psychological needs identified in the Self-Determination Theory, as discussed in Section 2.2.

According to this framework, learning occurs effectively when individuals feel competent in performing a specific activity. In HabitHero, this is achieved by ensuring that the tasks within each module are structured to encourage students to exercise their capacities and express their thoughts without any limitations. As they progress, the tasks will also become more intricate so as to match their developing skills, thus fostering a sense of achievement. The main goal is to reinforce their confidence in their ability to learn and adapt.

Within the scope of this thesis, the focus has been placed on the implementation of a specific module in the HabitHero platform, titled "Understand Digital Wellbeing". The module represents the starting point of the proposed learning path. Its purpose is to build the foundations for the activities that will follow and

it has been structured to help students gradually get familiar with the concept of digital wellbeing.

4.1.1 Low-Fidelity Prototype

In the conceptualization of HabitHero, the initial stages involved drafting a low-fidelity prototype, which was essential in shaping the core concepts for the user interface and the structure of the learning path. The prototype was a basic representation of the app's layout, focusing on the placement of elements and basic interaction flow.

The Home screen of HabitHero, as first conceived, underwent some minor modifications in its transition to the high-fidelity prototype, with the main change being the content offered. The initial prototype showcased a more segmented layout with each module and submodule distinctly outlined and separated.

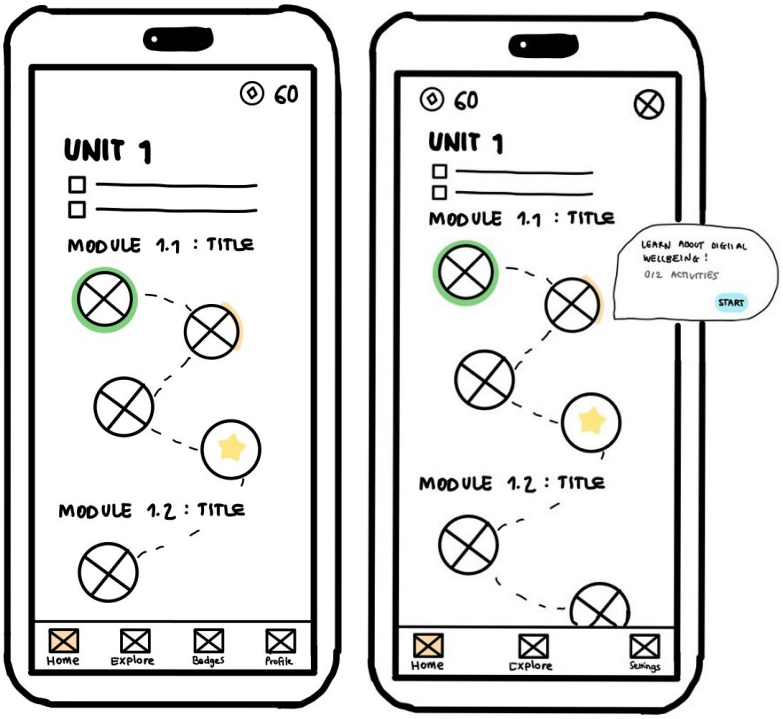

Figure 4.1: Low-fidelity prototype home screen.

In contrast, the final platform presents a more unified screen, incorporating a illustrative background and character representations. It adds a narrative and thematic depth to the learning experience. In fact, the design went from a more direct, task-based interface to one that provides a more immersive and story-driven

user experience. The incorporation of gamification elements also underwent some refinement.

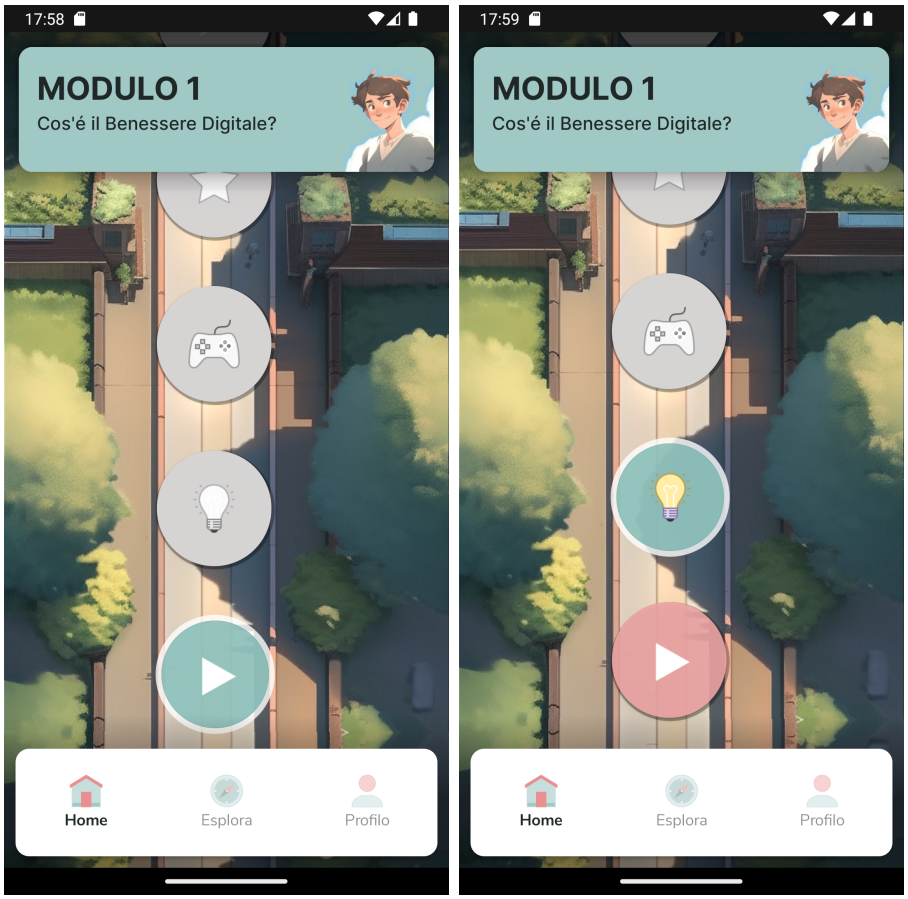

Figure 4.2: High-fidelity Home Screen learning path.

Initially, progress and achievements were indicated by points and badges, considered as add-ons to the core content. The high-fidelity prototype integrates these components into the learning path itself, using colour changes and other visual cues to reflect progress and achievements in real-time. This choice ensures that the gamified elements are not a distraction but serve to reinforce learning and increase motivation.

Another difference between the low fidelity prototype and the final platform is that in the former shows a design that is a bit information dense, with several activities and modules visible at once. In contrast, the high-fidelity prototype opts for a more simplified interface, aligning with Nielsen Norman's heuristic of minimalist design.

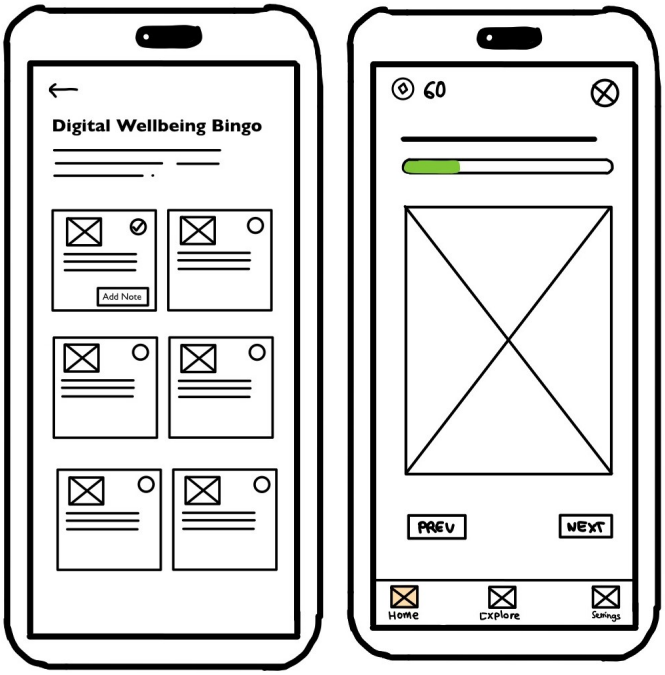

Figure 4.3: Low-fidelity prototype Digital Wellbeing Bingo challenge screens.

With respect to the learning content, in the earliest stages of prototyping, challenges were intended to be placed in a separate screen, distinct from the main screen that displayed the quiz and reflection activities. However, after some careful consideration, it was later decided to embed these challenges directly within each submodule. The choice was driven by the objective to increase the interactive and practical aspects of the learning process.

Without the inclusion of challenges, the learning path risked being too close to traditional learning modules. In this respect, by integrating them directly into the learning path, students could immediately apply what they learnt, reinforcing their understanding. This approach aligns with the principles of Constructivist Theory. In fact, challenges serve as an opportunity to let students build upon their acquired knowledge with fun and practical experiences.

Another significant decision in the design process involved the accessibility of resources and modules for students. Two primary approaches were considered: one allowing students free access to macro units, selected by the professor for a specified timeframe, and the other offering a more guided approach with the professor unlocking one submodule at a time.

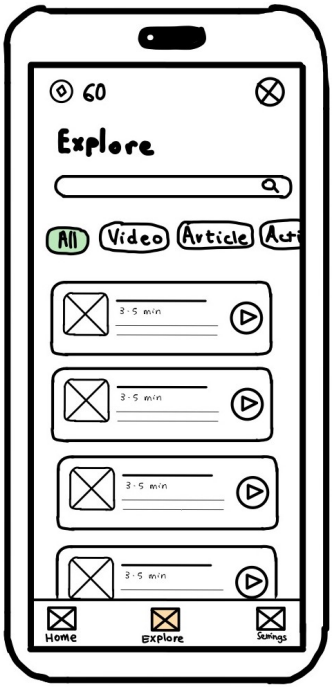

Figure 4.4: Low-fidelity prototype Explore screen.

Given that the app already contained an Explore section for free exploration, the second, more structure option was selected for the main learning path. In fact, this approach would facilitate synchronized learning among all students, increasing the effectiveness of classroom discussions. Another reason was the risk of students engaging with tasks they were not ready for, which could lead to confusion and frustration.

By contrast, the sequential unlocking of submodules ensures that students build their knowledge gradually, tackling more complex tasks as they progress. This choice aligns with the principle of competence from Self-Determination Theory, where learners feel more confident and motivated when they perceive themselves as capable of mastering a task. While this set up is more structured, it still provides some degree of autonomy, as students are given a relatively flexible timeframe (e.g. 2 weeks for each submodule) to complete tasks.

The low-fidelity prototype also featured a separate screen to display badges earned by completing various activities. However, this was temporarily set aside in the high-fidelity prototype due to limited resources and the challenge of creating visually appealing badges. This decision was also taken to prioritize the core features over supplementary ones.

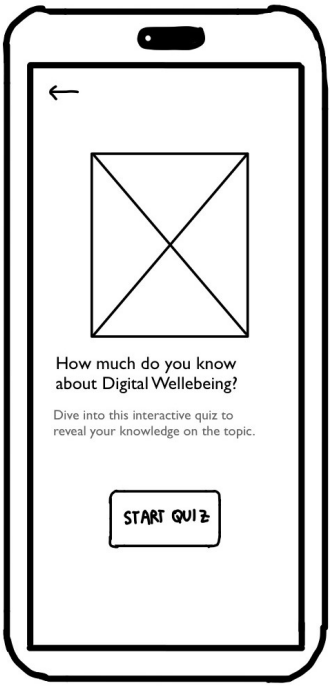

Figure 4.5: Low-fidelity prototype Quiz screen.

Modifications were made to the quiz layout and the digital wellbeing bingo challenge as well. Instructions for the quiz were relocated to an alert dialogue. As for the challenge activity, the original icon indicating the completion of a card was replaced with a colour change. Additionally, the "Add Note" button was removed to streamline the interface, replaced by expandable cards that offered detailed habit descriptions and a text box for students to record their experiences.

In the following paragraphs, a detailed overview of the final design will be provided. This includes a comprehensive description of the learning modules, further illustrating how theoretical frameworks have been taken into account to create an effective educational platform.

4.1.2 Submodule 1

Module 1, as with all modules in HabitHero, is presented as a multi-level learning path, consisting of four distinct activities within each of the two submodules. The journey starts with an interactive quiz, which can be completed either at the beginning of the lecture or at home beforehand, depending on the teacher's preference.

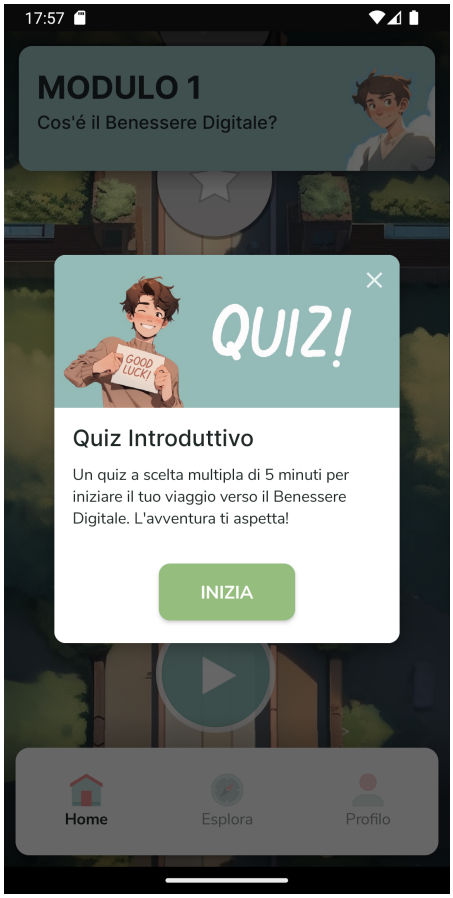

Figure 4.6: Quiz alert dialog containing activity instructions.

It is designed to last approximately 5 minutes and it serves a dual purpose: it measures students' existing understanding of digital wellbeing and helps teachers prepare and shape their lecture to address directly any misconceptions revealed by the quiz results. More importantly, these are presented in an anonymous and aggregate form, including the correct answer for each question, and the distribution in percentage of student responses.

No evaluation is given so as to create a pressure-free environment that encourages students to answer honestly. The quiz is designed as a multiple-choice questionnaire, allowing for a clear and straightforward assessment of students' initial knowledge of digital wellbeing. It also simplifies the answering process as well as the analysis and presentation of results.

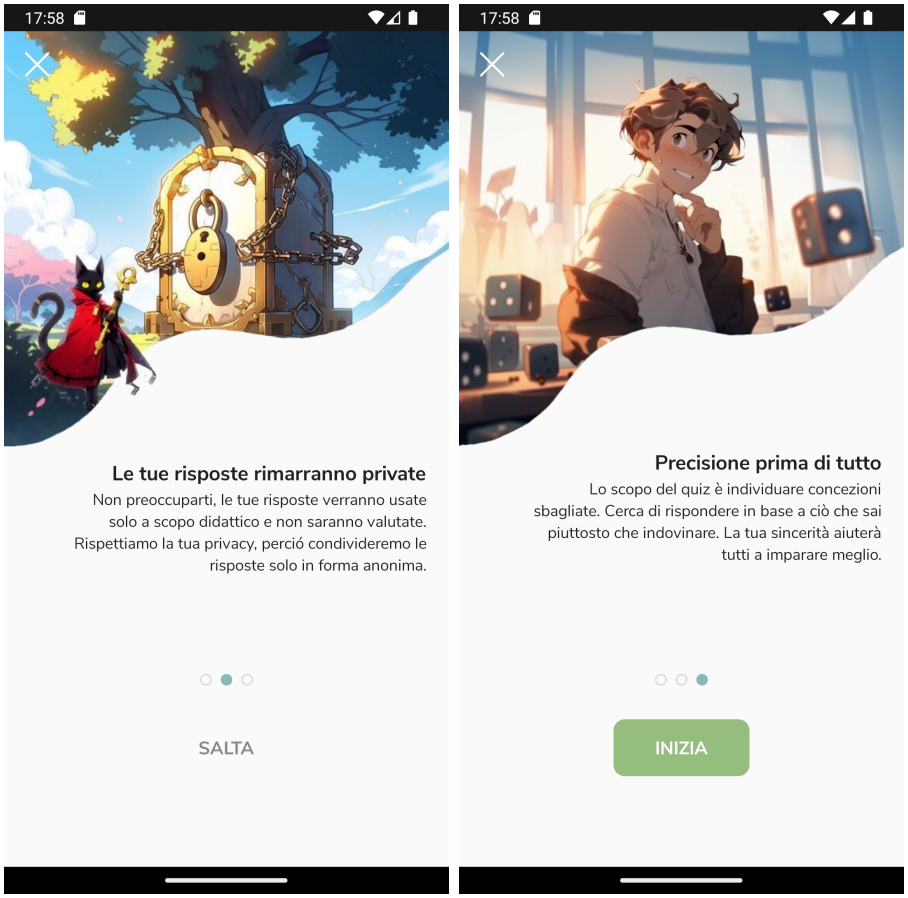

Figure 4.7: Quiz tutorial screens.

Here are the questions that were included in the quiz:

1. How would you define digital wellbeing?
2. What might lead to poor digital wellbeing?
3. Why is taking care of our digital wellbeing important?
4. What kind of habits can negatively affect digital wellbeing?

In line with the principles of Constructivist Theory, highlighted in Section 2.2, the interactive quiz promotes a more active form of learning. Unlike traditional lecture methods where students might only passively absorb the information imparted by teachers, this quiz requires active participation as they should answer the questions based on their existing knowledge and experiences.

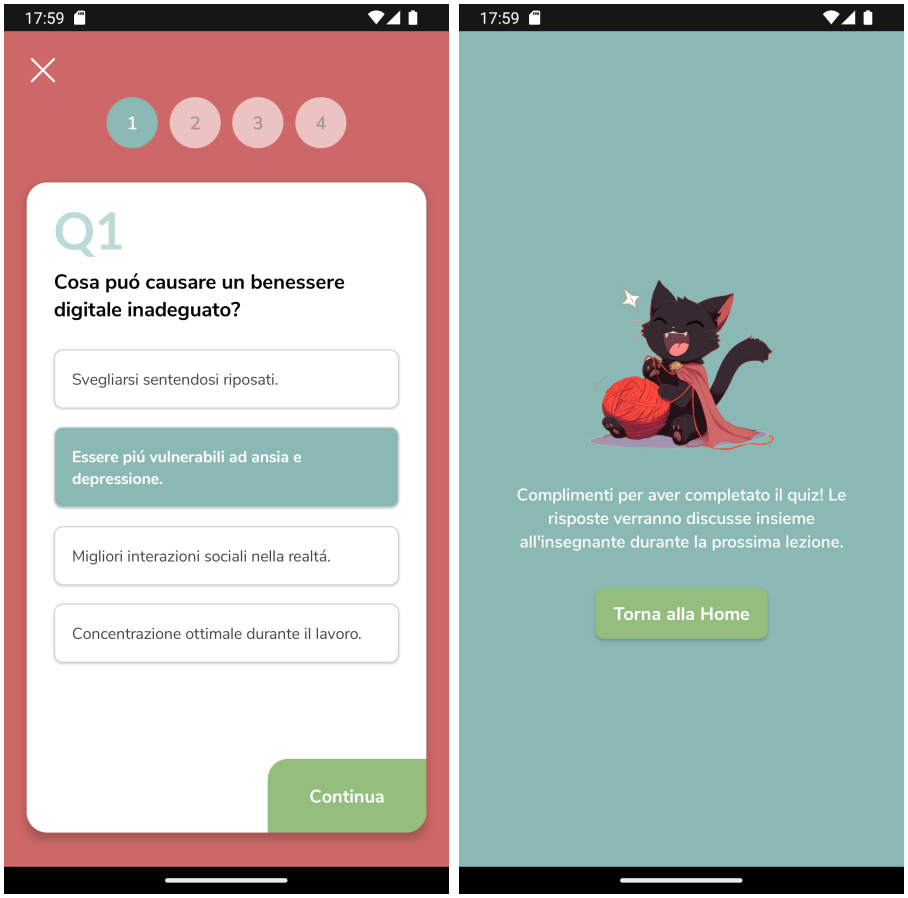

Figure 4.8: Quiz questions screen and confirmation feedback.

The results serve as a starting point for the educator who, rather than delivering a one-size-fits-all lecture, can use the provided insights to address specific concepts and make the learning experience more relevant and effective.

Following the theoretical lecture, students continue with the second activity of the module: a structured 20-minute reflection session. This level provides students with an opportunity to both think about the newly acquired concepts and then actively apply them by creating their own digital well-being strategies. The reflection activity is broken down into three guided sessions.

The first session is centred around a self-assessment of students' current digital habits:

1. **Evaluation of Current Digital Satisfaction:** Rate your satisfaction with your current digital habits. (Scaled question)

2. **Positive Habit Recognition:** What is one digital habit you're proud of? (Open-ended question)

3. **Improvement Opportunity:** What is one digital habit you would like to improve? (Open-ended question)

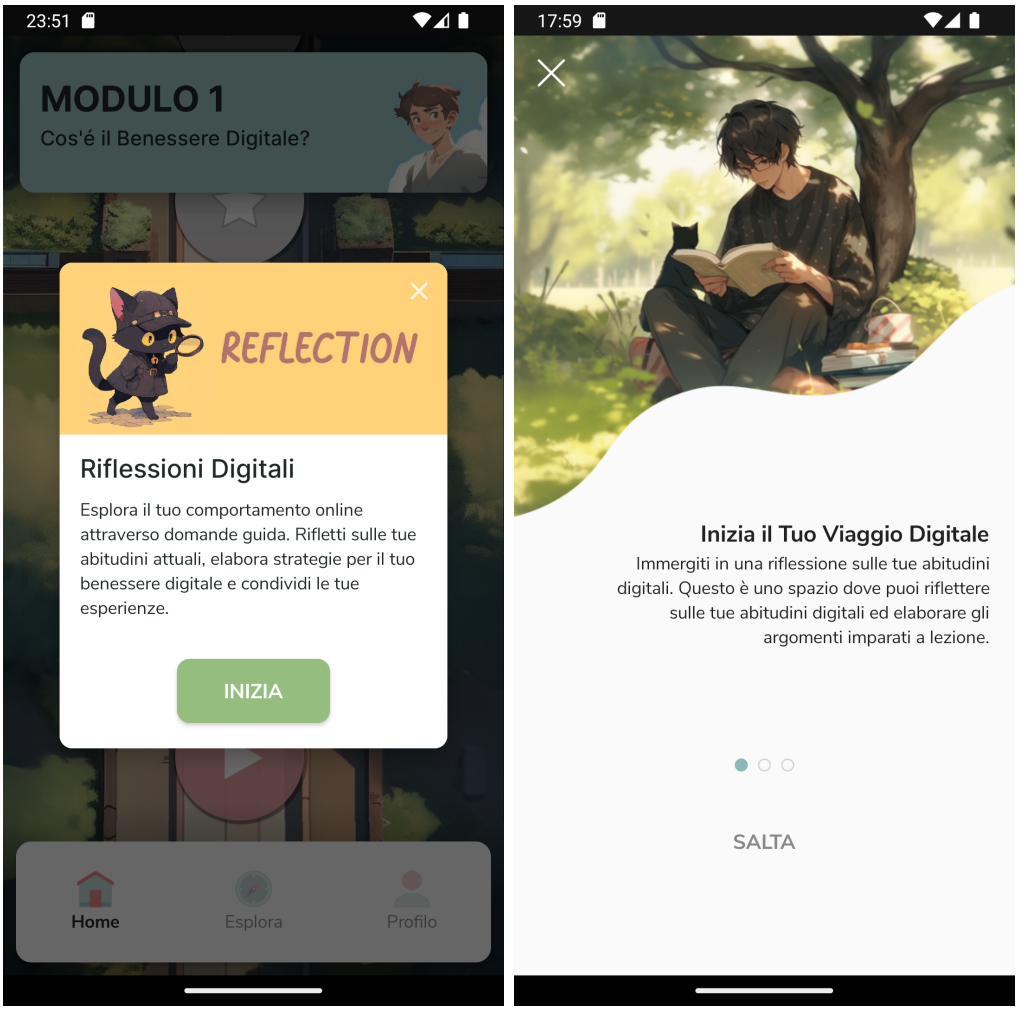

Figure 4.9: Reflection activity dialog and tutorial screen.

This process addresses a key user need identified in student focus groups: the desire for more flexible guidelines that promote autonomy, individual responsibility and decision-making in technology usage.

This need aligns with the principle of autonomy as outlined in the Self-Determination Theory. Instead of the educator telling them what they should improve, the platform asks students to identify and evaluate their own habits.

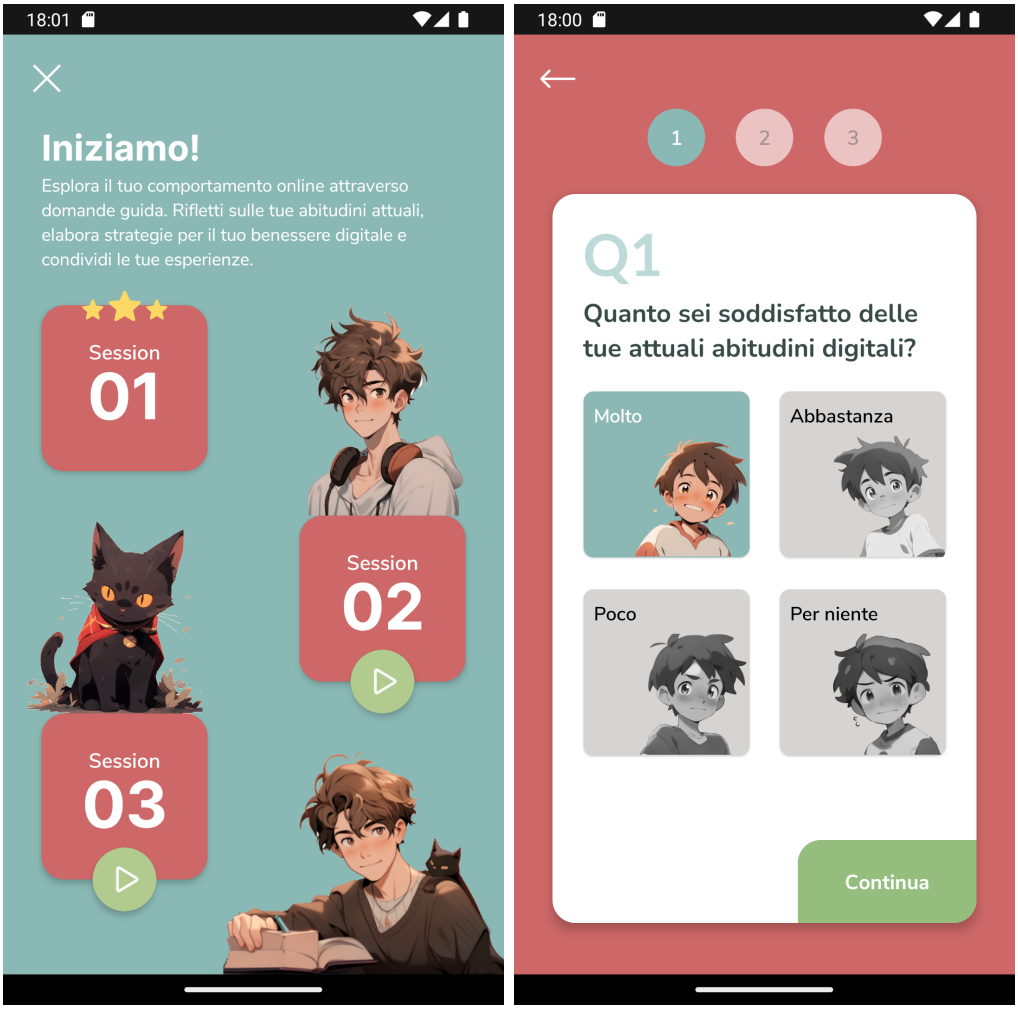

Figure 4.10: Reflection screen (Left) and prompt questions (Right).

Moreover, requesting students to share one habit are proud of and one they wish to improve ensures serves to make them aware not only of the negative aspects of their digital behaviour but also of the positive ones, if any.

The goal is to instil a sense of accomplishment through good practices that are worth maintaining. At the same time, by discussing one habit they would like to improve, students are guided to acknowledge areas where change is needed, without feeling forced.

During the second session, students are prompted to recall and think about a situation where a poor digital habit has had a negative impact on their lives. This question serves to contextualize digital wellbeing within their personal experience, which makes the learning process more relevant.

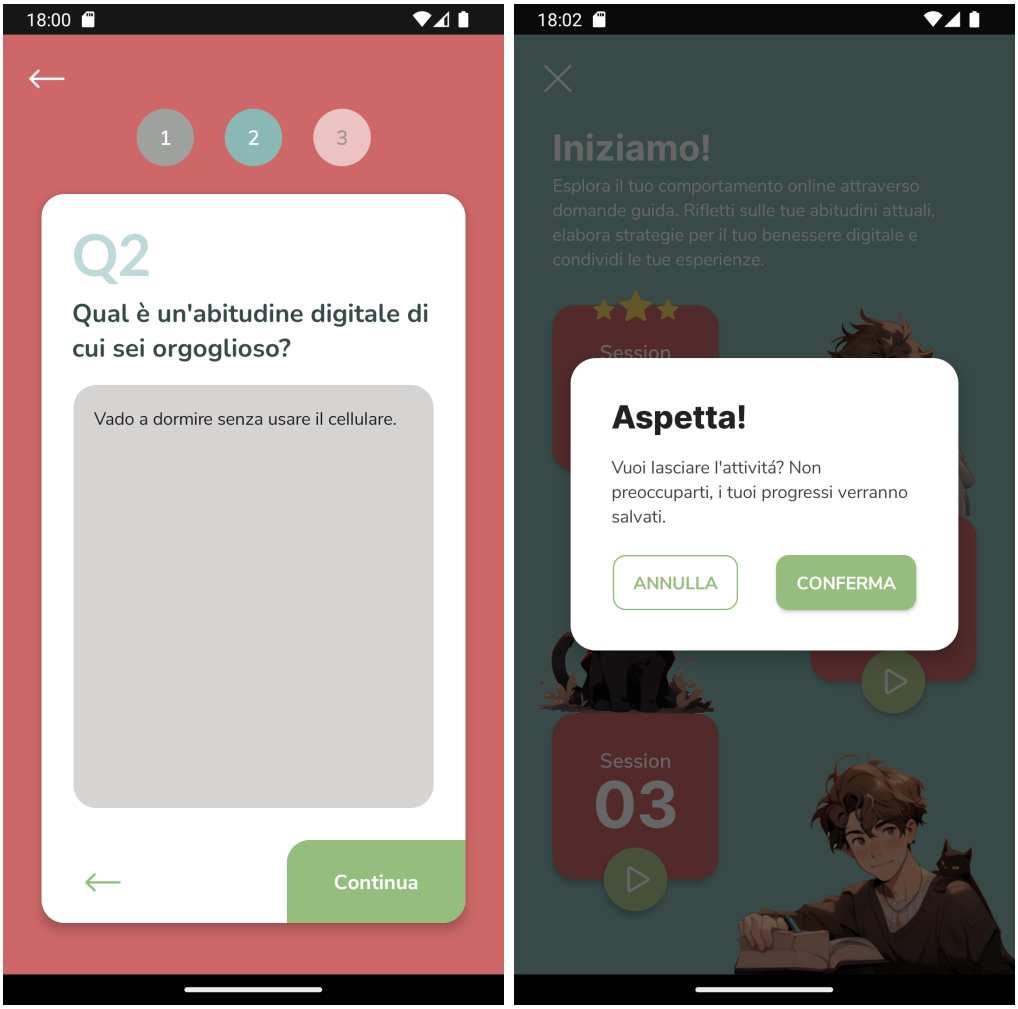

Figure 4.11: Prompt open-ended question (Left) and feedback dialog (Right).

Building on the previous reflections, the last session guides students into applying the newly acquired concepts to develop personalized strategies.

- Based on what you've learned, describe one strategy you could use to improve your digital wellbeing.
- How confident do you feel about implementing this strategy?

This approach aligns with the Constructivist Theory, which posits that learning is an active, constructive process where students build new knowledge upon the foundation of their previous experiences and understanding.

In the context of this module, rather than simply and passively absorbing information presented by the educator, students are given the opportunity to use

the insights they gained from the theoretical lecture to create strategies that suit their individual situations.

They are also asked to rate their confidence in implementing this strategy. This is done to encourage them to realistically assess their ability to make these changes and foster a sense of ownership and accountability.

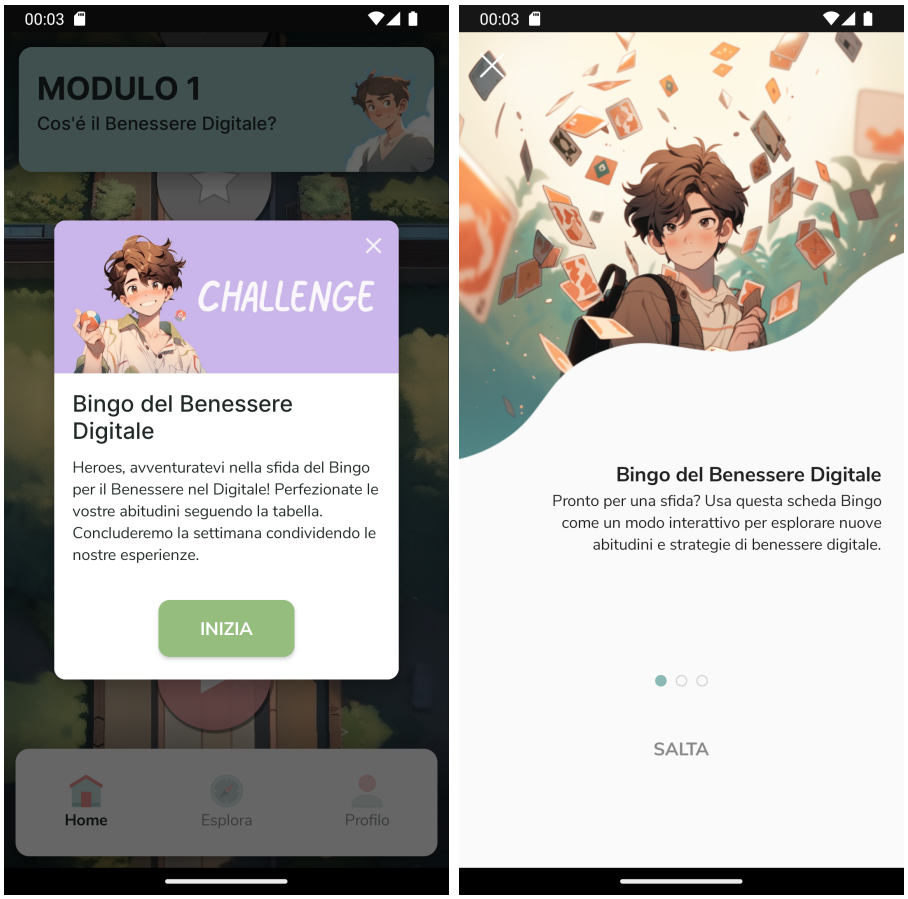

Figure 4.12: Bingo alert (Left) and tutorial screen (Right).

Following the reflection activity, Module 1 introduces the "Digital Wellbeing Bingo" challenge, which is intended to be completed over a week. Unlike traditional bingo cards, the numbers are replaced with specific digital wellbeing goals or habits for students to achieve. The goals include:

- **Morning Routine:** Avoid phone use immediately after waking up
- **Mindful Mealtime:** Enjoying meals without digital distractions
- **Offline Hobby:** Spending quality time on a non-digital hobby

- **Social Awareness:** Discussing digital habits with friends or family
- **Bedtime Unplug:** Turning off digital devices an hour before bedtime
- **Detox Hour:** Disconnecting from digital devices for an interrupted hour

As students try to mark these mini-challenges off their bingo cards, not only do they get the chance to apply the strategies developed in the previous reflection session but they can also actively explore new habits.

This level, like the previous one, also takes into account the user need for more flexible guidelines, as it promotes autonomy and personal responsibility by allowing students to freely choose which goals to focus on.

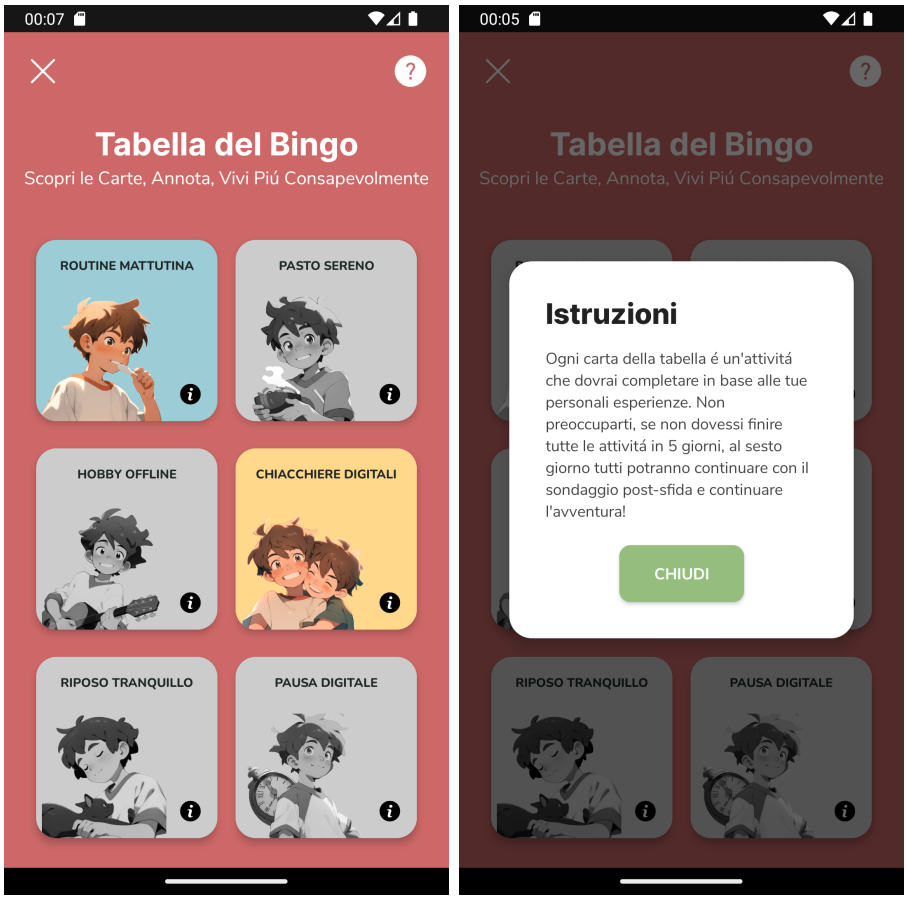

Figure 4.13: Bingo board (Left) and Help instruction dialog (Right).

The bingo activity also addresses the need for support in implementing digital wellbeing strategies. It provides a structured yet engaging way for students to

apply and integrate the strategy they planned in the previous level. This design choice was clearly influenced by the Constructivist Theory in this choice, as the main idea is to promote learning through practical experiences.

The bingo activity does not require students to use the platform continuously; they can interact with it only to mark a goal as achieved, accompanied by a brief reflection on their experience with that specific habit. This format promotes active participation and self-analysis, allowing students to explore the challenge at their own pace and addressing the user need for a varied learning environment.

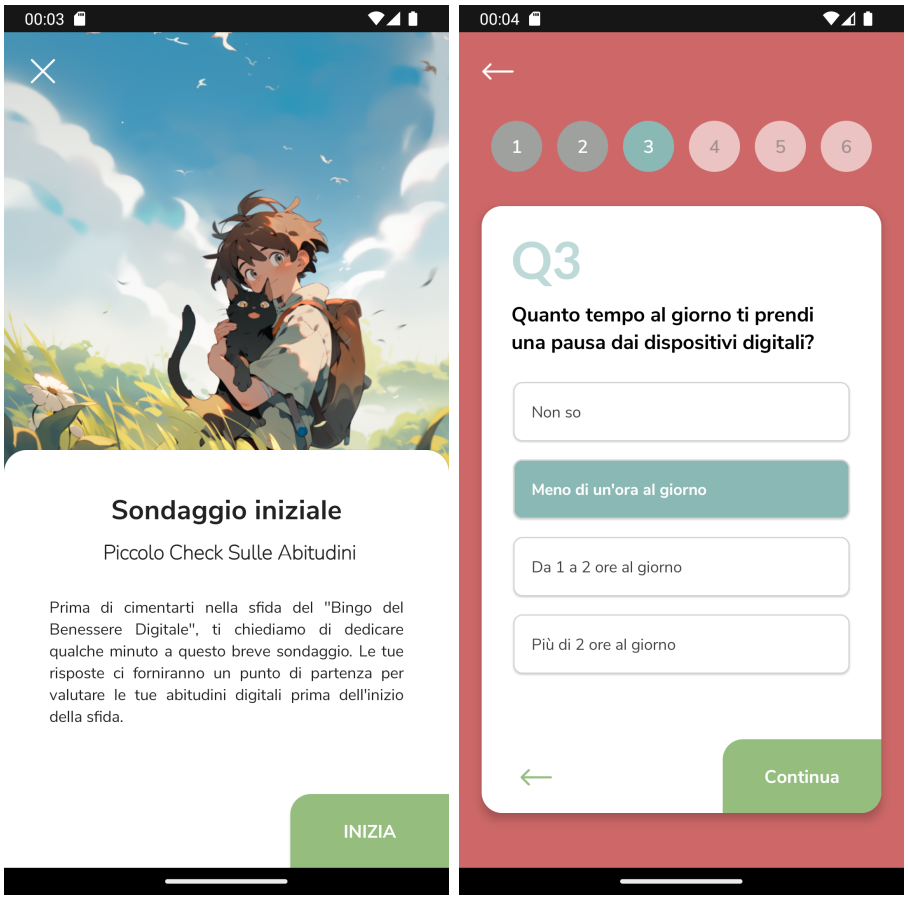

Figure 4.14: Survey instruction screen (Left) and questions (Right).

To measure the impact of this activity, students are required to complete a multiple-choice survey about their digital habits both before and after the challenge. Each question offers four options to choose from, allowing for a structured yet diverse range of responses:

1. How long before bed do you typically stop using your phone?
2. Do you check your phone right after you wake up?
3. How long do you usually take a break from digital devices each day?
4. Do you use your phone while eating?
5. How often do you participate in hobbies that don't involve digital devices?
6. How often do you use strategies to stay away from digital distractions?

The purpose of this comparison is not necessarily to demonstrate any new habit formation, given the brief duration of the challenge, but rather to provide students with insights into how they can effectively apply digital well-being strategies in their everyday lives. It aims to increase their awareness and their ability to recognize positive changes in their habits.

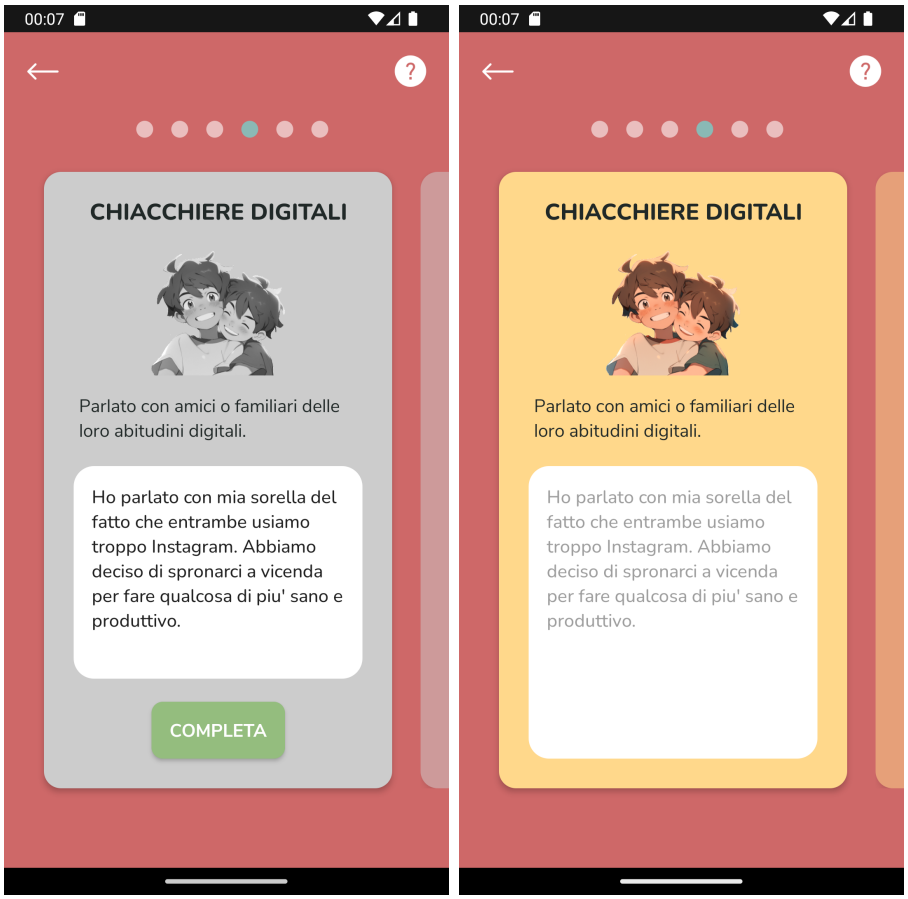

Figure 4.15: Bingo board expanded (Left) and completed (Right).

All aspects considered, the challenge proposed creates a less formal and non-competitive environment, which removes the pressure often associated with traditional learning styles.

After the completion of every challenge, including Digital Wellbeing Bingo, the learning path offers a summary activity, which consists of an in-class session lasting approximately 30 minutes. This activity is led by the teacher, who takes on the role of a moderator rather than a traditional educator, facilitating an open and inclusive discussion among students.

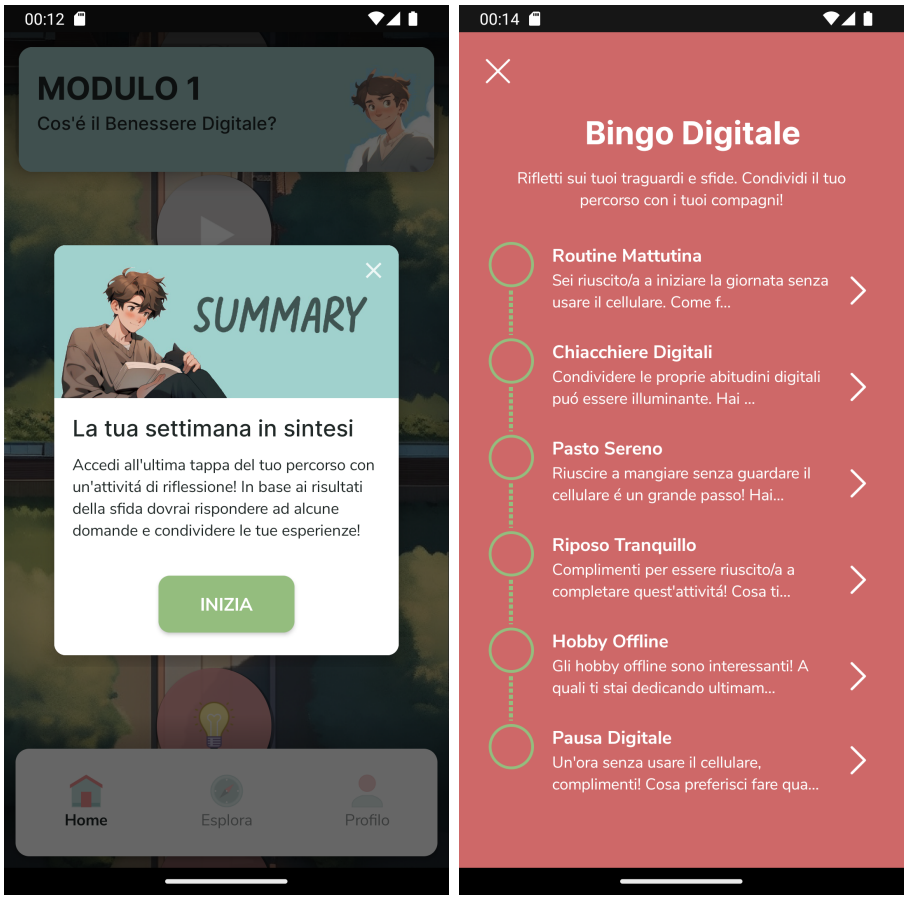

Figure 4.16: Summary alert (Left) and summary screen (Right).

Prior to the in-class activity, the application provides students with a concise overview of their accomplishments and challenges encountered during the bingo. It prompts them to reflect on and document the strategies that contributed to their success or the obstacles that hindered their progress. Here are a few examples of feedback and prompts that the application gives to students based on their

performance during the challenge:

- You've mastered the art of a peaceful morning. What helps you resist the urge to check your phone?
- Mealtime distractions happen. What's the biggest challenge for you in keeping your phone down while eating?
- Offline hobbies are great, aren't they? What non-digital activities have you been into lately?
- Getting away from screens can be challenging. What's stopping you from diving into a non-digital hobby?
- You seem to have done a good job on this card! Is there anything you would like to share that may have helped you succeed?
- It's hard to disconnect before bed, isn't it? What's the main thing keeping you glued to your screen?
- Unplugging can be tough. What is the main reason you find it hard to step away from your devices?

These cues help students to gather insights and ideas, preparing them for the discussion. The app ensures that all inputs and reflections are saved, allowing students to review and use these notes during the in-class session, thus enriching the discussion.

For teachers, HabitHero provides an overview of student participation in each activity proposed in the Digital Wellbeing Bingo challenge and generates a list highlighting the habits students attempted to improve or where there was no noticeable progress. This analysis is derived from the comparison of pre- and post-challenge surveys, giving teachers a comprehensive understanding of the class's performance. The information enables teachers to better shape the summary activity, addressing specific areas where students excelled or struggled.

This activity serves as an important moment of shared reflection, which enables students to learn not only from their experiences but also from their peers.

The main objective of this in-class discussion is to instil a sense of community and connection among students, aligning with the principle of relatedness in SDT, which emphasizes the importance of social connections and feeling understood and cared for in learning environments.

Figure 4.17: Teacher's summary screen with suggestions.

4.1.3 Submodule 2

Moving forward to the second submodule, the focus shifts to the impact of technology on our daily lives. This submodule builds on the foundation established in the previous weeks, investigating further into how digital habits influence personal growth, interpersonal relationship and overall quality of life.

In week 3, the new submodule begins with a 30-minute interactive lecture which introduces students to the effects of technology on various aspects of life. Teachers can use the Live Polling feature to enrich the discussion, employing a format similar to the quiz used in the previous submodule, with the key difference lying in the nature of the questions.

While the initial quiz focused on assessing students' understanding of digital wellbeing, the Live Polling in this submodule aims to explore the effects of technology from the students' perspectives.

1. Do you feel that using digital devices impacts your creativity?
2. How often do you choose digital communication over face-to-face conversations?
3. Do you find that digital device usage impacts your ability to focus on tasks that require long periods of concentration?
4. How have digital devices affected your physical activity habits?

The data gathered from these polls is anonymous and aggregate, ensuring student privacy while providing teachers with insights that could help them guide the lecture and direct the discussion towards specific common effects that have emerged from the students' responses. By identifying prevalent themes and concerns, it is possible to ensure that the lecture is more meaningful and responsive to the student's experiences.

This approach not only creates a more inclusive environment, where students can feel heard and acknowledged, but it also aligns with the principles of Dual System Theory. As presented in Section 2.2, this behavioural framework differentiates between two types of cognitive processing: System 1, which is fast, automatic and often subconscious, and System 2, which is slower, more deliberative and conscious. The Live Polling activity aims at shifting students from their usual System 1 thinking, which often occurs when using digital devices, to System 2 processes, as the use of technology is typically associated with quick, automatic responses and does not naturally encourage in-depth reflection on its effects.

Building on the concepts raised during the in-class lecture, the second submodule includes a scenario-based game in its learning path. The idea is based on the Constructivist Theory, which posits that learners form their own understanding by interacting in real-world situations.

Accordingly, this activity offers an immersive narrative where students can shape their own story based on the choices they make. Each of them starts with the same introduction and character, Alex Mayers, but has the autonomy to decide how the story progresses.

The interactive format not only helps to better understand the theoretical impact of technology usage but it also covers an important role in guiding students to identify these effects in their own lives through a simulated yet relatable environment.

The game serves as a tool for students to make decisions and witness first-hand the outcomes of certain digital behaviours, reflecting on how similar scenarios might play out in real life.

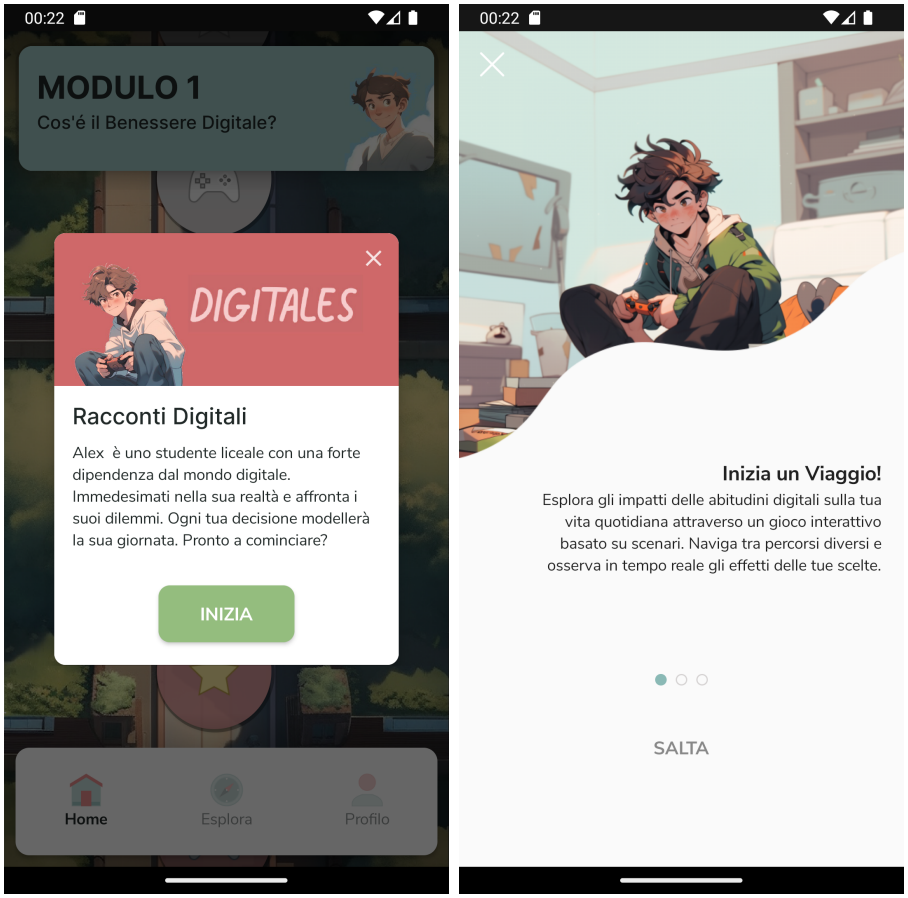

Figure 4.18: Scenario-based game alert (Left) and game tutorial (Right).

Presented in a text format, the game is accompanied by meaningful images, which help bring the character of Alex Mayers to life, improving the storytelling aspect of the game.

The game also aligns with the educational needs identified by teachers, who stressed the importance of providing practical scenarios for role-playing and decision-making. It complements the course content in various aspects:

- **Digital Distractions vs Responsibility:** The initial scenario where Alex chooses between joining an online gaming marathon, using social media or completing his math assignment illustrates the common conflict between digital entertainment and academic obligations. This scenario reinforces the lecture content on managing digital distractions and prioritizing responsibilities.
- **Consequences of Overuse:** In scenarios where Alex engages in prolonged gaming or social media usage, students can see the immediate effects like

fatigue, headache, and anxiety. These outcomes highlight the lecture topics on the physical and mental health impacts of excessive digital consumption.

- **Decision Making and Time Management:** Choices involving balancing gaming or social media with schoolwork highlight the importance of time management and decision-making skills, key aspects discussed throughout the course.
- **Social Dynamics and Digital Etiquette:** Scenarios where Alex interacts with his phone during class or responds to messages in inappropriate settings mirror real-world situations.
- **Peer Influence and Social Pressure:** The influence of Alex's gaming buddies and social media connections reflect the social pressures that can impact digital behaviour
- **Reflection and Self-Awareness:** Each ending, whether Alex faces academic consequences, feels guilt, or learns from his mistakes, serves as a moment of reflection for students. These endings are in line with the platform's aim to foster self-awareness about digital habits.

The following is a table (Table 4.1 that comprehensively summarizes the main themes, lessons, scenarios (S) and choices (C), and portrayal in each storyline of the scenario-based game:

Table 4.1: Scenario-based game main themes and lessons.

Theme	Lesson Taught	Scenarios	Storyline
Digital Distraction vs Responsibility	Balancing digital activities with real-life obligations	C1: Joins gaming, C2: Watches TikTok	Alex is torn between digital activities and academic duties, illustrating the common conflict of digital distraction versus responsibility.
Consequences of Digital Overuse	Understanding the negative impacts of excessive screen time	S1: Prolonged gaming; S2: Prolonged TikTok use	The physical and mental strain following excessive gaming or TikTok use underscores the consequences of digital overuse.

Continued on next page

Table 4.1 Scenario-based game main themes and lessons.

Theme	Lesson Taught	Scenarios	Storyline
Self-Control, Prioritization and Time Management	The need for effective time management and self-control	C1.2: Pulling an all-nighter; C2.2: Making a to-do list	Alex's attempts (or failures) to manage his time effectively in various scenarios highlight the importance of self-control and prioritization.
Social Dynamics and Peer Influence	The impact of peers on digital behavior choices	C1: Responding to gaming buddies; C2.3: Texting a friend	The influence of friends in Alex's decision-making reflects the significant role of social dynamics and peer influence in digital behavior.
Reflection, Seeking Help, and Strategies	Benefits of self-reflection and seeking help in managing digital habits	C1.3: Considering texting a classmate; S2.3: Seeking emotional support	Alex's contemplation and actions about seeking help or reflecting on his behavior emphasize the value of proactive strategies in managing digital habits.
Balance, Self-Care and Health	Prioritizing health and self-care alongside digital activities	C1.1: Falls asleep; C3.1.2: Taking a break to make tea	Alex's decisions to prioritize rest or take breaks illustrate the importance of balancing digital activities with health and self-care.
Awareness, Problem-Solving, and Learning from Consequences	Learn from experiences to make better choices	All Endings	Each ending, whether positive or negative, offers a lesson on awareness, problem-solving, and learning from the consequences of digital choices.

Continued on next page

Table 4.1 Scenario-based game main themes and lessons.

Theme	Lesson Taught	Scenarios	Storyline
The Power of Breaks	Taking breaks as a tool for maintaining focus	C3.1: Taking a short break; C3.2.2: Walking around the room	Alex's choices to take breaks demonstrate their effectiveness in improving concentration and mental well-being.
Tools for Concentration	Using strategies to increase focus in an environment filled with distractions	C3.2.3: Playing instrumental music; C3.3.3: Jotting down struggles	The use of music and note-taking as concentration aids in the game shows practical tools for enhancing focus in a digital context.
Digital Etiquette	Understanding appropriate digital behaviour	Ending 1: Using phone in class; C3: Turning off notifications	Instances of appropriate and inappropriate digital behavior, such as phone usage in class, highlight the importance of digital etiquette.
Importance of Appropriate Device Usage	Recognizing appropriate and inappropriate times for device use	C3: Working on the assignment; S3.1: Checking phone during a break	Alex's decision-making around when to use his device underlines the importance of discerning appropriate times for digital activity.

Following the scenario-based game, the learning path in the second submodule introduces another challenge, titled "The Great Data Hunt". While maintaining a format similar to the Digital Wellbeing Bingo challenge from the first submodule, this new activity addresses the user need emerged from students focus groups for a personalized breakdown of their device usage data.

The Great Data Hunt may seem a more passive activity at first glance, as it provides students with a daily report of their device usage in various contexts. However, it actually also actively engages them in a process of guided self-analysis, personalized based on each individual report. This makes the experience more relevant and personal.

Students begin by filling out a survey that investigate their initial perceptions of their device usage, with questions such as estimating daily screen time, frequency

of checking devices, and the perceived impact of screen time on sleep routine. After five days, marked as the default duration of the challenge, students can complete a post-challenge survey to assess any changes in their awareness and behaviour.

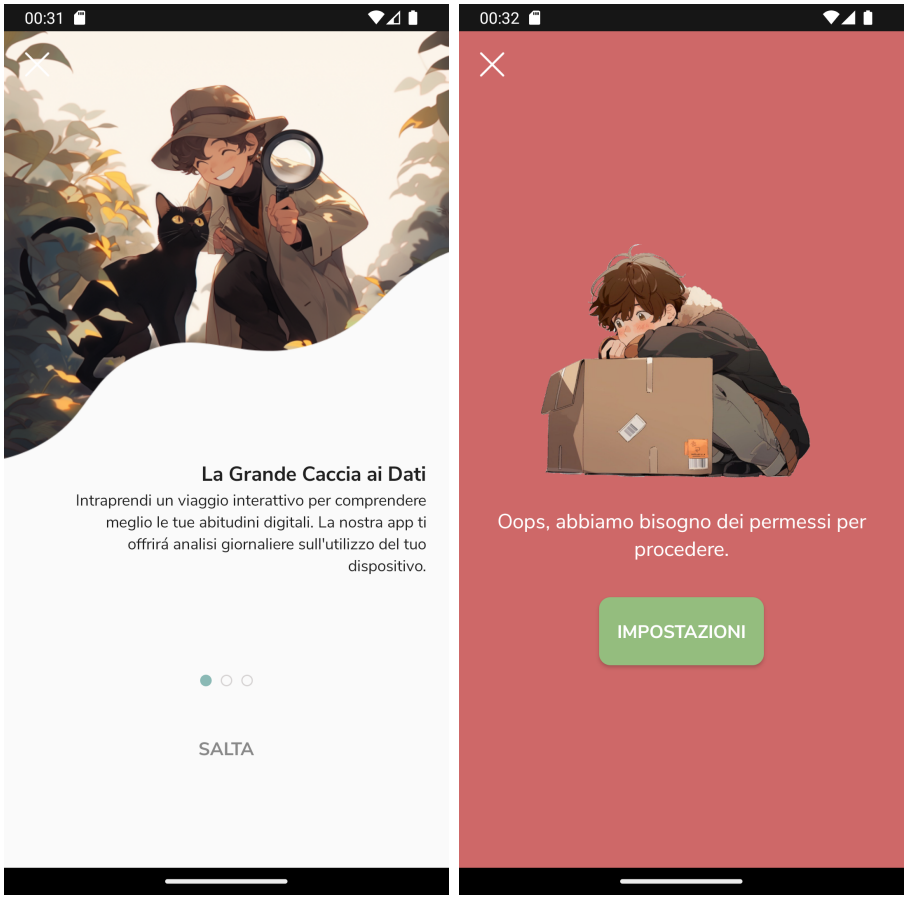

Figure 4.19: The Great Data Hunt challenge tutorial screen (Left) and permissions request (Right).

One of the main features of The Great Data Hunt is the possibility of personalizing the challenge, as students can specify when they would like to receive their usage report, as well as their typical waking and sleeping times. This ensures that the analysis is more relevant.

Unlike some usage statistics tools like Apple's Screen Time, the report provided by HabitHero focuses on some important aspects, like the amount of time spent on devices before sleep and beyond the usual bedtime. Aside from this information, it also offers common data like peak time, number of pick ups, most used categories

and total usage. All of this data is displayed intuitively, complemented by descriptive images, making easy for students to understand and reflect upon their habits.

The guided self-analysis aspect of the challenge includes questions based on the individual report, such as:

- Your highest time investment was in [specific app category]. What drove this choice?
- You were most active on your device around [specific time]. Is there a reason for this?
- There was [amount of time] of device activity around your sleep time. Any thoughts on this?

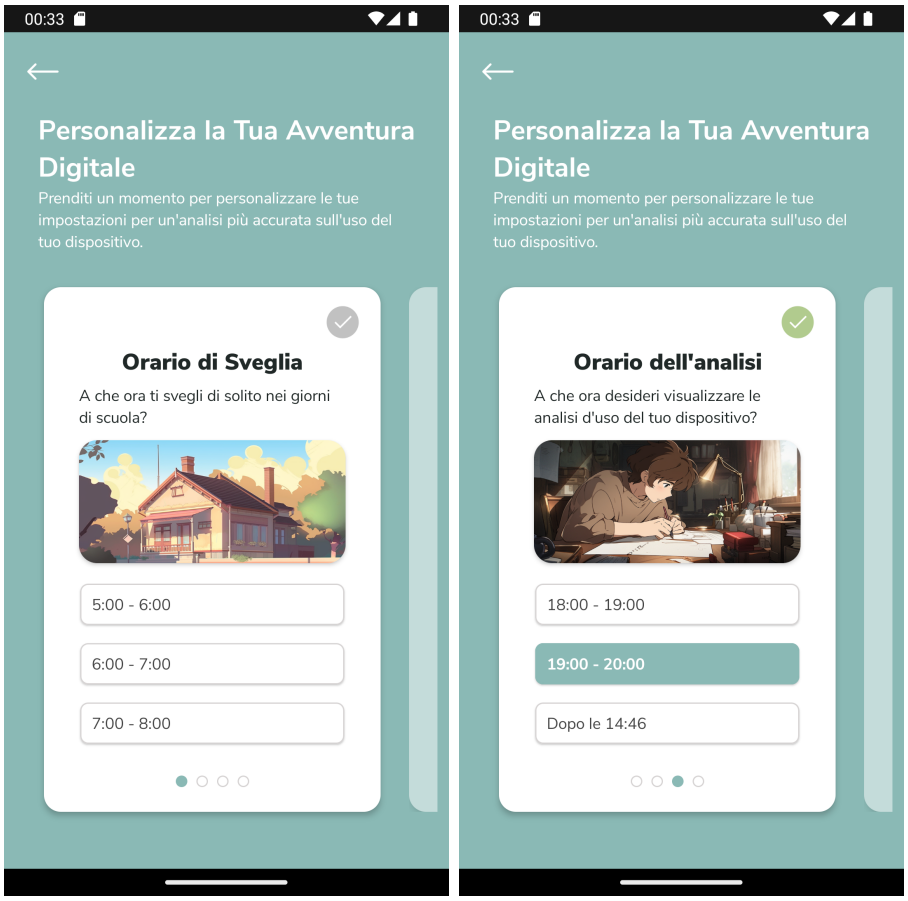

Figure 4.20: Challenge customization screens.

These questions are deliberately phrased to avoid an accusing tone. Instead, they aim to encourage students to reflect on their data, fostering a deeper understanding

of their digital habits and how these might be in line or not with their expectations. In this respect, the pre- and post-challenge surveys serve as a measure of the level of awareness students have regarding their digital activity.

Figure 4.21: Daily report layout

Like in the first submodule, this one also ends with a summary activity, an in-class lecture lasting about 30 minutes, serving as a way to wrap up the module's content. This activity mirrors the approach taken in the previous submodule, where teachers guide the discussion to consolidate learning outcomes.

Considering the sensitive nature of usage data, even in aggregate form, HabitHero provides educators with guiding tips directly related to the topics highlighted in the students' reports, without giving specific information on the statistics. This preserves students' privacy while enabling teachers to prepare relevant prompts and questions that create meaningful interaction.

On the student side, they are provided with an overview of their week's digital habits through a series of questions based on the results of their pre- and post-challenge, as well as the results from each daily report. Examples of such prompts include:

- High frequency of unlocks. What do you think is the primary reason?
- Low frequency of device unlocks. Share your tips for avoiding distractions.
- Low screen time but many unlocks. What usually prompts you to unlock your device?
- High screen time but fewer unlocks. Do you use apps for long periods?
- Your device usage extends beyond your bedtime. What keeps you engaged so late?

These questions encourage students to both reflect on their digital habits and share their experiences with their peers. The way they are phrased is intentional and aims at fostering a non-judgmental environment that promotes open and honest discussion.

Overall, the conclusion of submodule 2 with this summary activity makes the learning path comprehensive and cohesive, as it solidifies the students' learning experience and prepares them for the following modules.

4.1.4 Explore Screen

The Explore screen is another important section present on the platform and it serves as a dynamic and autonomous learning environment, complementing the structured learning path of the main modules on the Home screen, where activities are unlocked sequentially. This feature of the platform is important in providing students with self-guided exploration of digital wellbeing topics, a response to the diverse needs and preferences highlighted in the focus group interviews.

In this part of the application, students can independently access a wide range of additional content. This aspect directly addresses the students' desire for more control and freedom over their learning process.

The content offered is a mix of articles and videos, which students can navigate through the search bar, or filtering by categories, which include "Time and Focus", "Digital Habits", "Health and Science" and "Social Life".

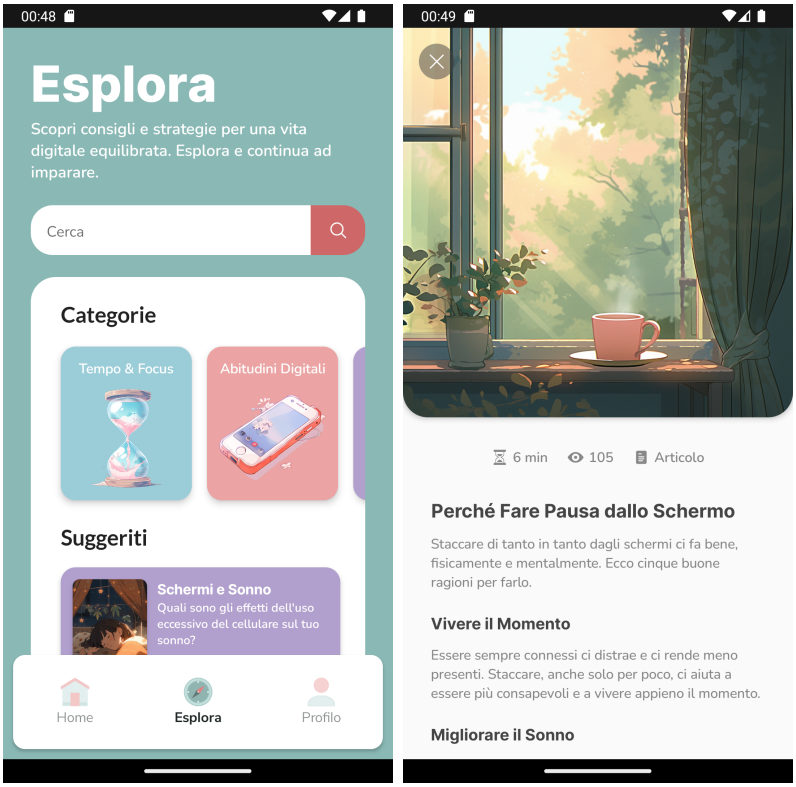

Figure 4.22: Explore screen (Left) and article content (Right).

These areas of interest encapsulate critical aspects of digital wellbeing, directly relating to themes identified during the needfinding phase.

The user interface of the Explore Screen is simple, with cards displaying key information on the content, including a representative image, a title and a brief description as well as the time investment required.

When students select a piece of content that interests them, additional details are revealed: for instance, the type of content (article or video) and the level of engagement it has received. Articles are structured for ease of reading, while videos offer the flexibility to be viewed directly within HabitHero or on external platforms like YouTube.

4.1.5 Integration into current school curricula

A critical aspect which was addressed in the overall design of HabitHero is the challenge of time constraints regarding the integration of digital wellbeing into the existing curriculum, a significant concern raised by many teachers.

In this respect, the learning path of HabitHero has been intentionally structured to be flexible enough to fit into both school hours and students' personal time.

Each module is intended to be completed within a month, with a new submodule introduced every two weeks. These submodules are designed with a balanced mix of in-class and at-home activities. The in-class activities are concise lectures lasting no more than 30 minutes, conducted under the guidance of a teacher.

The platform enriches this learning path with tasks that can be completed outside school hours, employing gamification strategies to make the overall experience more fun. The design of these activities draws directly from the principles of Self-Determination Theory, Constructivist Theory and Flow Theory to encourage active participation.

The approach used to teach digital wellbeing is varied and it involves interactive quizzes, reflection sessions for personal strategy development, challenges and games to provide practical or simulated experiences.

This structure not only facilitates the integration of digital wellbeing education into the school curriculum without burdening teachers but also offers the versatility for students to engage with the content at their own pace, reinforcing learning outside the classroom environment.

4.1.6 Bridging communication between students and teachers

HabitHero also covers a relevant role in bridging the gap between students and teachers, which was another issue raised during the interview with educators. The platform reframes the role of teachers as facilitators and mentors, rather than authoritative figures. This approach is fundamental when dealing with teenagers' digital habits, as highlighted in Section 2.1, and a concrete example is given by the summary activity at the end of each submodule, which provides educators with clear guidelines on how to start the discussion and create an inclusive environment.

Along this line, to assist teachers in adapting their teaching techniques based on the class's collective needs, HabitHero provides clear insights into how students are interacting and progressing throughout the activities. For instance, if a specific topic or habit is proving difficult for the majority of students, the platform will flag this issue and teachers can then give extra attention to these areas in their future lectures or group discussions, ensuring that no student is left behind.

Here is an example of guidelines teachers may receive for the Digital Wellbeing Bingo challenge:

- The habit of looking at phones first thing in the morning is growing. Consider discussing the calm start of the day without the immediate info overload?
- Students are finding it hard to take breaks from their devices. Why not talk about the good things that can come from spending time away from screens?
- Digital activities are still the go-to. Why not bring up the fun stuff to do that doesn't need screens, like drawing, playing outside, or reading?

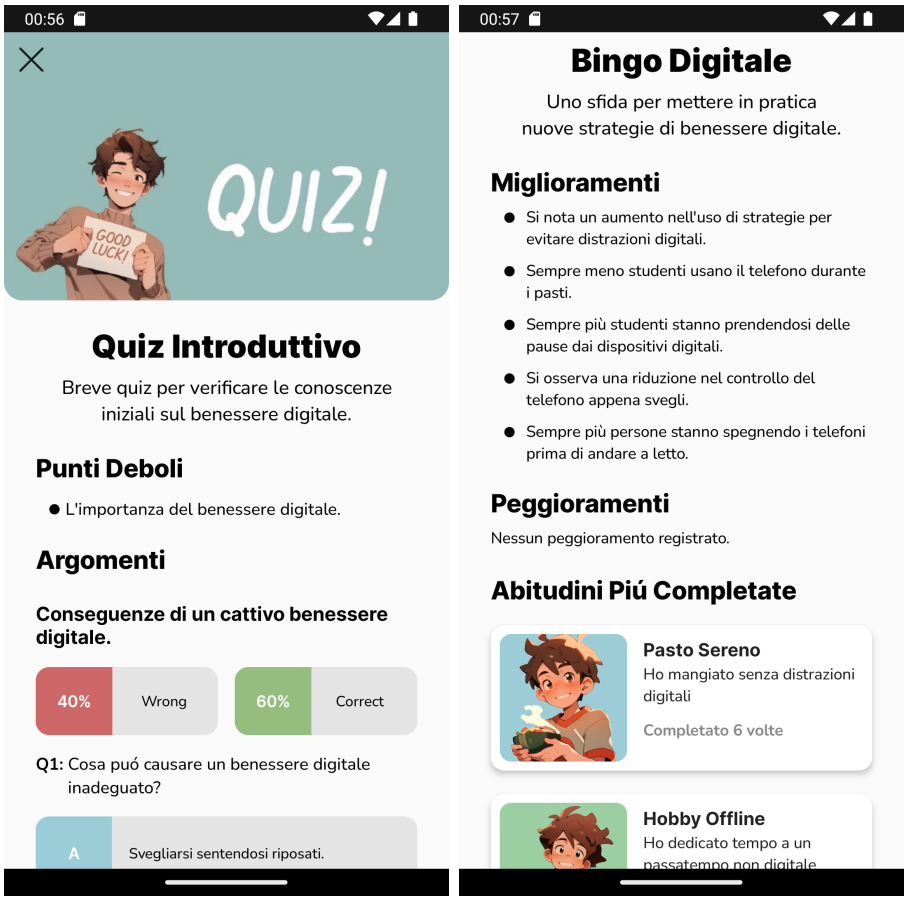

Figure 4.23: Teacher's screen quiz report (Left) and bingo report (Right).

This general design allows educators to initiate broad discussions without compromising individual privacy, creating a safe space for students to talk. In case one of them feels the need to talk about their personal challenges, teachers can take one more step forward and help them find a solution to the specific issue.

The platform ensures confidentiality and respect for students' privacy while still granting teachers visibility into class dynamics. For example, regarding the

reflection activity, they receive aggregate data on students' satisfaction with their current digital habits and their confidence in implementing newly designed wellbeing strategies, rather than access to individual reflections.

Another example is the Digital Wellbeing Bingo challenge, where educators are presented with aggregate improvements or declines in specific digital behaviours. These insights allow for a nuanced discussion on topics like screen-free time before sleep, taking breaks from devices, and enjoying meals without technological distractions.

During student focus groups, many expressed a desire for guidelines that support independent decision-making regarding technology use. HabitHero's design addresses this issue as well by creating an environment that fosters autonomy. The platform encourages students to actively engage with their digital habits, providing a framework that supports self-reflection and informed choices, thereby promoting a sense of personal responsibility.

A few examples to mention are the challenges offered in each submodule, where students can deliberately choose which goals to pursue, or the reflection activity, which prompts them to design a strategy of their own and identify specific habits they would like to change.

4.2 User Experience Design

User Experience (UX) design is a discipline focused on creating products which are pleasant to use and accessible. At its core, UX is about understanding and designing for the user's needs, behaviours, and emotions so as to offer a seamless and meaningful interaction.

In the context of HabitHero, UX design is important to ensure that the platform is intuitive, engaging and effective for both teachers and students to navigate through the digital wellbeing curriculum without any problems.

Upon launching HabitHero, users are shown a minimalist splash screen featuring a vibrant, anime-style cat character, which embodies the playful yet supportive mission of the platform. The character serves both as a logo and a visual anchor, which accompanies the user throughout their journey in the app, reinforcing a consistent and reassuring presence.

Beneath the logo is a meaningful slogan: "A wellbeing adventure", which is prominently displayed, setting the stage for what the app promises, an exploratory journey through topics revolving around digital wellbeing.

After navigating to the home screen, students are presented with a vivid, top-down view of a pathway, a visual metaphor for the user's journey towards digital

wellbeing. This illustration adds depth to the interface and creates a welcoming environment, aligning with the user need for a less formal learning setting.

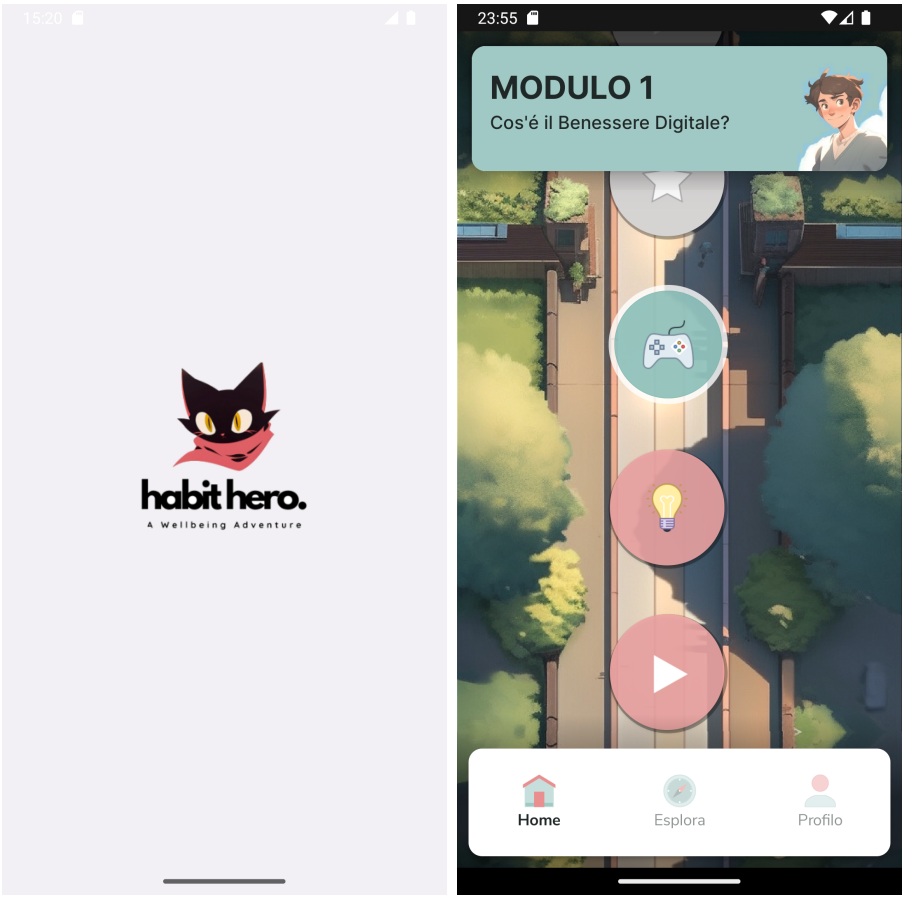

Figure 4.24: HabitHero's splash screen (Left) and learning path (Right).

During the design phase of the platform, other graphic styles were also considered, among these there were two prominent ones:

- Modern anime style, characterized by a soft colour palette, clean lines and subtle shading that gives depth and dimensionality. Characters' features are typically expressive and detailed, with a particular focus on the eyes.
- Vector art style, defined by bold, flat colours, and simplified shapes with minimal shading. Characters are usually stylized with exaggerated proportions and features, giving a sense of playfulness and energy.

Ultimately, the first technique was chosen for its suitability in making a learning environment more playful and captivating. The main reasons include:

- **Emotional Connection:** Anime art has a wide appeal due to its expressiveness and ability to convey a range of emotions vividly. The detailed and nuanced expressions of anime characters can be more relatable.

- **Familiarity and Popularity:** The modern anime style is hugely popular, especially among young audiences. It is commonly associated with storytelling and adventure. Its prevalence in popular media means learners are likely already familiar with this style, which can make the educational content more enjoyable.

- **Character-Driven Narratives:** The anime style often focuses on character development, which can be leveraged in a learning environment to create narratives around educational content. Characters can serve as avatars for learners, making the experience more personal and relatable.

The interactive, vertical path recalls the navigation experience of many role-playing games (RPGs), where scrolling is usually associated with unveiling new chapters or levels. The visuals surrounding the path serve a dual purpose: they enhance the appeal of the interface but also function as a progress map, symbolizing the user's progress through the course.

This design choice highlights the principle of user control and freedom as it offers learners the autonomy to navigate the curriculum at their own pace, in a similar fashion as the exploratory and player-driven mechanics found in many interactive RPGs.

As users advance, completed activities change colour, motivating continued progress and reducing the need for additional elements like checkmarks. The distinction between completed, ongoing and yet-to-be-unlocked levels is further complemented by the naming of buttons in interactive dialogues: 'Review', 'Start' and 'Level Blocked'.

The ongoing module is further distinguished by a progress ring around the level, offering immediate feedback on progress and encouraging commitment to completion. These visual and textual cues provide a smooth, user-led navigation experience. The icons of each activity were chosen to adhere to the principles of UX design by reducing the user's cognitive effort to understand the task associated with each image.

The design of HabitHero takes special care to guide users through their learning journey with clarity and ease. For instance, before navigating directly to a selected activity, users are always presented with a dialogue containing a brief description of what lies ahead, so that in case it was not they meant to access they can simply exit by tapping the 'X' button or outside the alert.

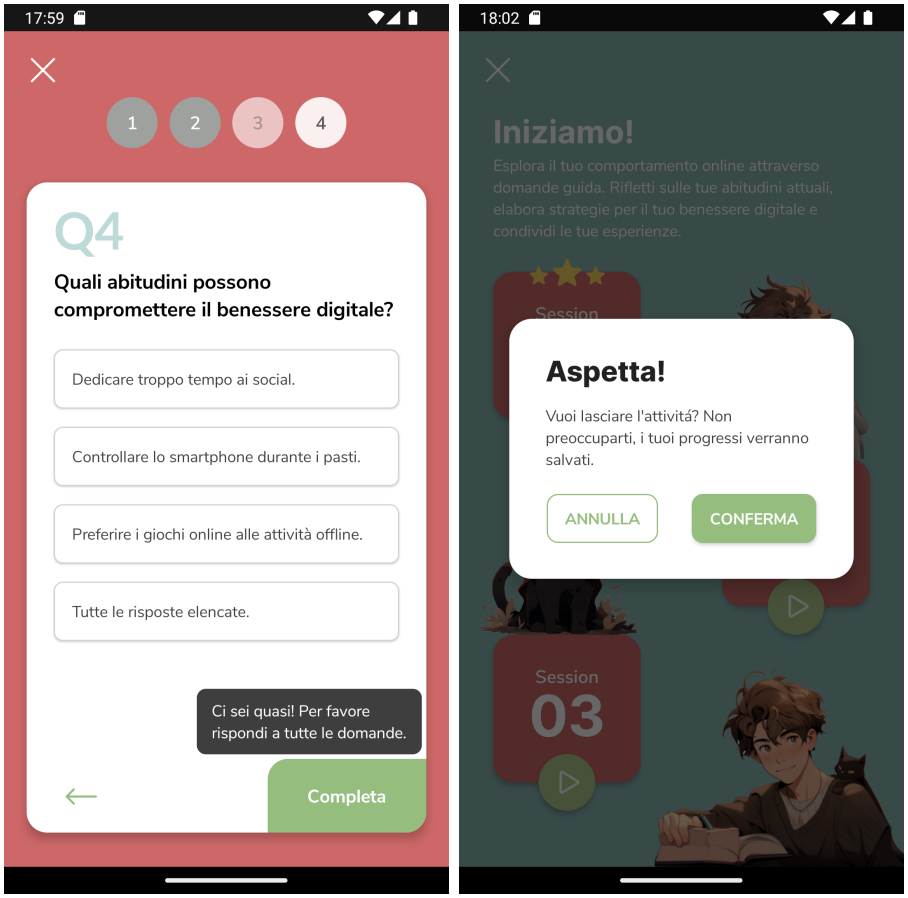

Figure 4.25: Tooltip for missing information (Left) and alert on exit (Right).

Another visual cue the platform offers is concise popovers that alert users in case they want to complete an activity with missing information. This preventive measure draws from the error prevention heuristic from Nielsen Norman, which aims to reduce potential errors through design, rather than relying on users to correct mistakes after they occur.

Moreover, the application also tries to anticipate the varied paces at which users may interact with the platform's content. For instance, if a user decides to leave an activity midway, an alert dialogue will reassure them that their progress will be saved and they can resume where they left off. For certain activities where progress cannot be saved, the dialogue provides a clear warning, ensuring users are making informed decisions about their navigation choices.

In line with these navigational aids, HabitHero also offers tutorial screens for each activity in the learning path. These are used to ensure a smooth transition into

each new task. Each tutorial slide is informative and concise, preparing students for the activity with just enough context to get started without overwhelming them. This immediate guidance helps to foster user confidence.

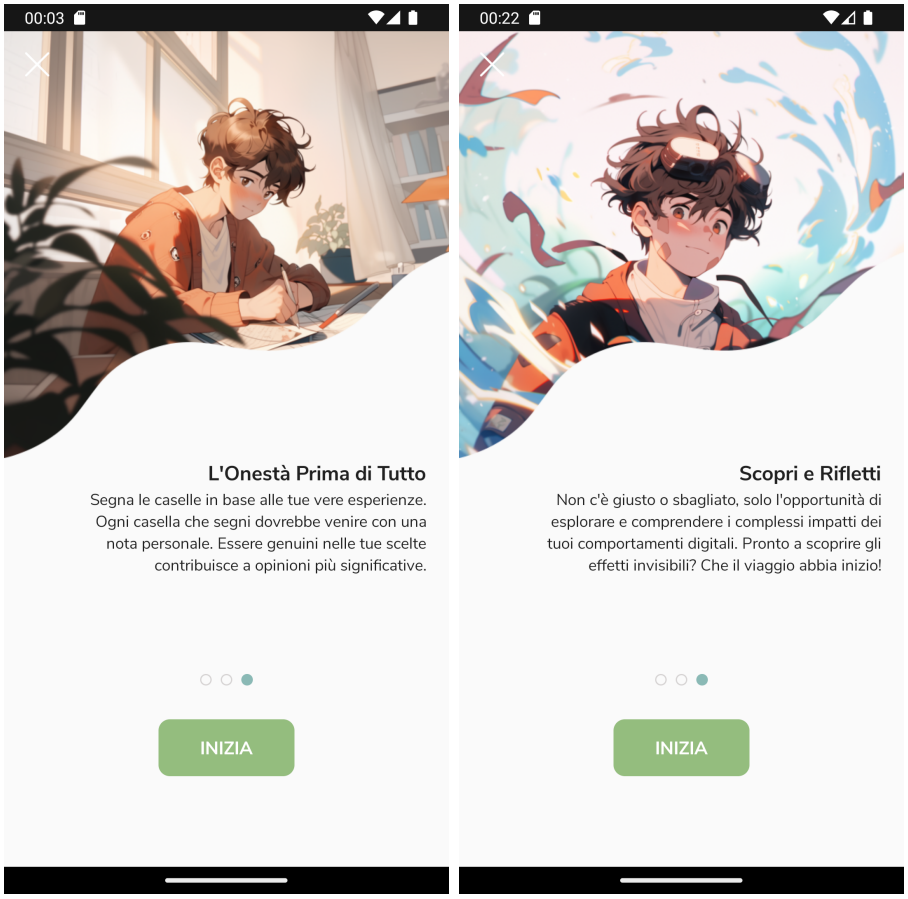

Figure 4.26: Examples of tutorial screens from game and reflection activities.

The tutorials are also visually engaging, featuring anime-style illustrations that provide visual anchors for the instructions, enhancing memory retention and making the learning experience more enjoyable. At the start of each tutorial is a brief animation which invites users to swipe between slides.

This gesture-based interaction is an excellent example of intuitive learning, which employs common mobile interaction that most users are familiar with.

The inclusion of a 'Skip' button acknowledges that users have different levels of familiarity with digital platforms, with some needing more guidance while others prefer to dive straight into the content.

4.3 Gamification

The gamification elements are integrated into the platform with a deliberate balance between playfulness and educational purposes, ensuring that the former complements rather than overshadows the latter.

Each gamified component is designed to motivate and reinforce the educational journey, including the vertical scrollable learning path that visually marks progress and the rewarding stars shown upon completion of the reflection sessions. These stars serve both as a reward and a visual cue for completion, fuelling the intrinsic motivation of learners by providing immediate feedback on their performance.

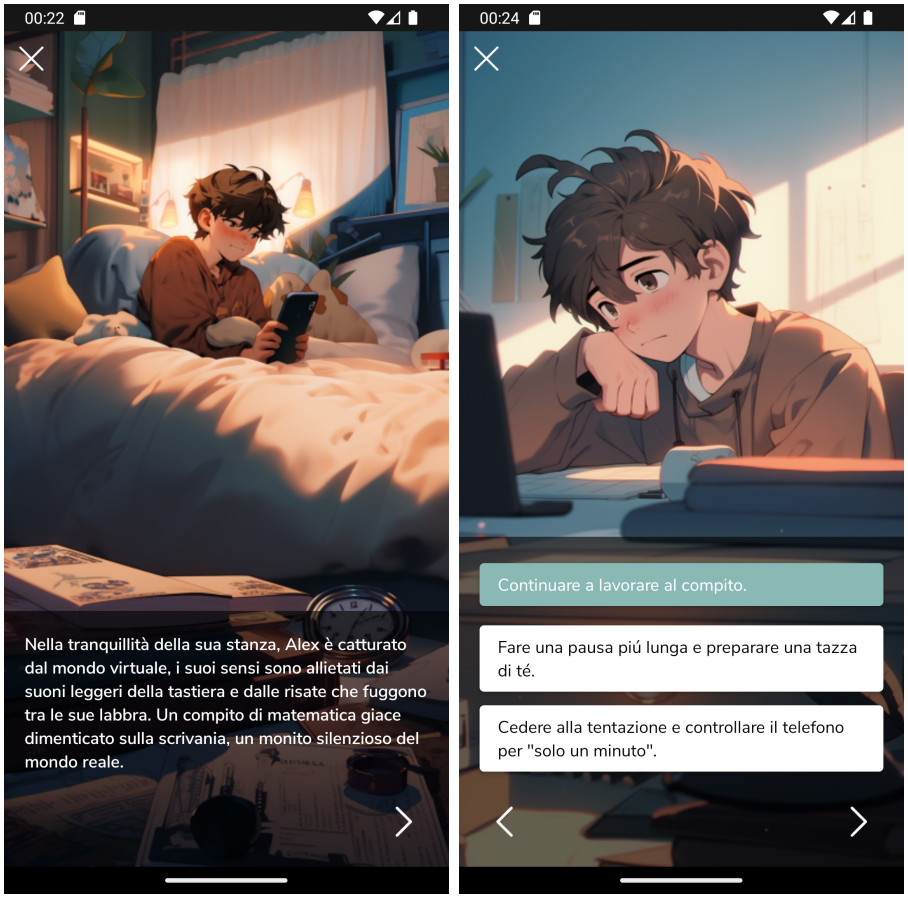

Figure 4.27: Example of scenarios and choices from the scenario-based game.

One of the main gamified features is the scenario-based game, an interactive activity that places students in various decision-making situations. This activity incorporates key gamification elements that are grounded in the theories and

findings presented in Section 2.3.

The game is designed to foster intrinsic motivation by offering students an immersive storyline where their choices directly impact the narrative.

The narrative-driven gameplay exemplifies the concept of relatedness from SDT, as it creates a connection between the user and the character's experiences, where each decision serves not only as a moment of choice but also as an opportunity for introspection and learning.

Figure 4.28: Examples of endings from the scenario-based game.

This interactive format doesn't just impart theoretical knowledge about technology's impact; it actively involves students in decision-making processes, prompting them to consider how similar choices might affect their own lives.

For instance, a storyline might present Alex with a dilemma between joining an online gaming session or completing a school assignment. This choice leads to different outcomes: If Alex chooses gaming, the story unfolds to show the immediate gratification and subsequent academic consequences, offering students a perspective

on the trade-offs of such a decision. Alternatively, prioritizing the assignment leads to a different narrative arc, showcasing the benefits of disciplined digital behaviour.

The game's visual appeal is enhanced by detailed, brightly coloured images generated with Midjourney [55]. These images, styled in line with the modern anime aesthetic of the application, add to the immersive quality of the game, making the narrative more engaging and relatable for students. This visual richness complements the storyline, making the experience more memorable.

Other elements of gamification incorporated within the learning platform are the challenges in each submodule, which are designed to engage students in a series of tasks that, while being educational, are disguised as interactive games.

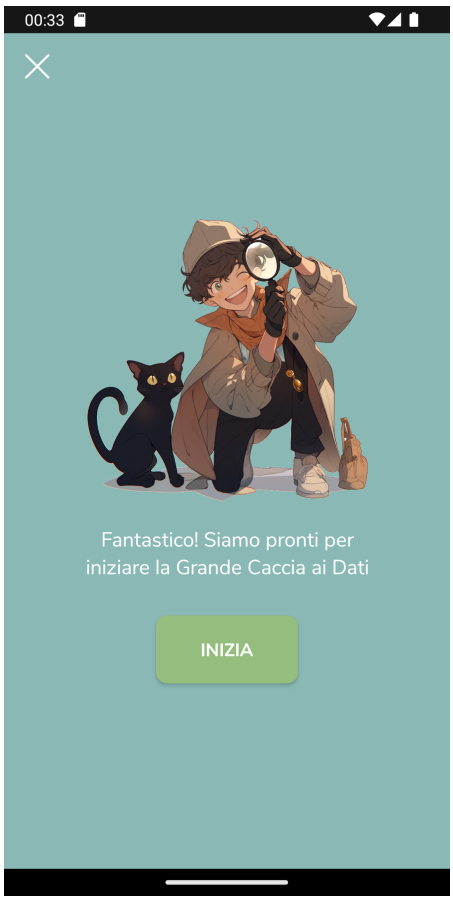

Figure 4.29: Starting screen of the Great Data Hunt challenge

For instance, the Digital Wellbeing Bingo reframes activities related to exploring healthier digital habits into a series of mini-challenges. These are not dictated by

authoritative figures but are instead presented as personal challenges that students can voluntarily undertake. This design choice aligns with the STD's focus on autonomous motivation, where students are more likely to participate in activities they find personally relevant and enjoyable, rather than ones they feel pressured to complete.

Similarly, the Great Data Hunt transforms the monitoring of digital usage into an interactive detective game, encouraging students to identify patterns in their daily technology use. This investigative approach makes the activity more interesting and empowers students to take ownership of their habits.

One key aspect is that these challenges do not include an external evaluation. Students can approach tasks at their own pace, which avoids the anxiety often associated with assessment.

By presenting educational objectives as practical "games", HabitHero masks the learning process within a playful and enjoyable framework, ensuring that students are not passively receiving information but actively participating in their educational journey.

Chapter 5

Implementation

Following the interface design outlined in the previous sections, Chapter 5 marks a turning point in the development of HabitHero, as it bridges the gap between ideas and actual implementation, turning the detailed features into a working application.

In Section 5.1, the focus is on the technical foundations of HabitHero. This section details the selection process for the technology stack, highlighting the rationale behind choosing Kotlin and Android Studio for development and Firestore for database management.

Section 5.2 discusses the architectural backbone of the platform, explaining how the Model-View-ViewModel (MVVM) pattern facilitates a clear division between the UI (View) and business logic (Mode), with the ViewModel acting as an intermediary. This section will illustrate the benefits of this architecture, such as separation of concerns, scalability and efficient data binding.

Section 5.3 describes how HabitHero accommodates different interfaces for students and teachers, ensuring secure and relevant access through Role-Based Access Control (RBAC).

Finally, Section 5.4 provides an analysis of the main difficulties encountered during this phase and the solutions adopted. This section will discuss specific aspects of the application, including image retrieval optimization, the development of a dynamic, choice-driven narrative for the scenario-based game, and the technical challenges of The Great Data Hunt and Digital Wellbeing Bingo.

5.1 Development Environment

In the implementation of HabitHero, one critical decision was choosing the technology stack, including the programming language, frameworks, databases, front-end and back-end tools, and APIs. While cross-platform solutions like React Native offer the advantage of developing both for Android and iOS with a single codebase, Kotlin was ultimately chosen due to its native optimization for Android and suitability for the project's requirements, outlined in Section 4.1.

Kotlin's performance also played a significant role, especially for modules requiring extensive system-level access. For instance, The Great Data Hunt in Submodule 2 necessitated in-depth device usage analytics, a task that is more efficiently handled in Kotlin's native environment. In fact, the restrictive nature of Apple's iOS ecosystem, especially regarding access to device usage data, posed a significant challenge.

Following the choice of the programming language, Android Studio was selected as the main development environment for the implementation of HabitHero, primarily due to its optimization for Android development.

As for the application's data, Firestore was selected as the primary database solution for its real-time data syncing capabilities, which allow for updates to be instantly reflected across all user devices. This is possible by attaching a listener that receives real-time callbacks, ensuring that the query listener is notified whenever the data changes . In terms of data handling, Firestore's design is optimized for storing large collections of small documents, offering flexibility in data structuring and enabling developers to run complex queries efficiently. This feature comes in handy in our platform, where a wide range of data structures needs to be managed, from quiz responses to progress tracking in different modules.

Another advantage of this cloud-hosted database is its offline support, which allows users to interact with the app even in the absence of network connectivity. It stores data offline and syncs it with the database as soon as the connection is re-established. This feature is important as it ensures that students' progress in activities like the reflection session or the Digital Wellbeing Bingo challenge is preserved and synchronized, regardless of their Internet connectivity.

The following image provides a concise summary of the technology stack used in this thesis project.

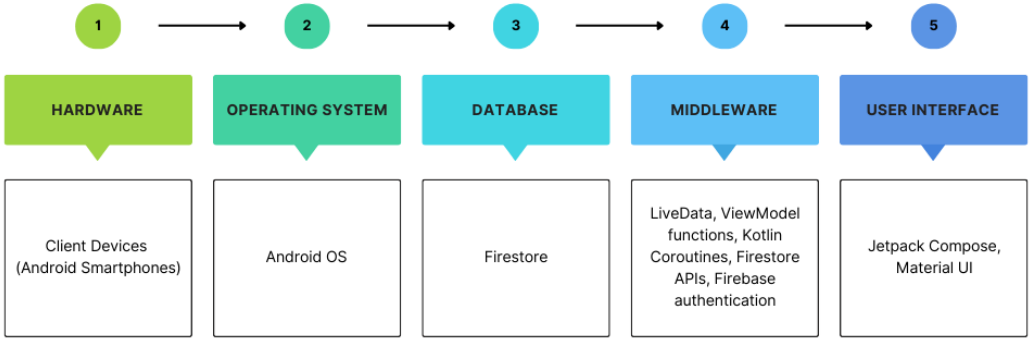

Figure 5.1: Technology stack used in the HabitHero.

5.2 Model-View-ViewModel (MVVM) Architecture

HabitHero's application structure is based on the Model-View-ViewModel (MVVM) architecture, which is a widely adopted design pattern, known for its ability to separate view and business logic. MVVM divides the application into three interconnected components:

- **Model:** It represents the data and business logic of the application, responsible for fetching, storing and manipulating data, typically from a database or web service. In HabitHero, the Model will handle the interactions with Firestore, managing data related to user authentication, learning progress and other core functionalities.
- **View:** It corresponds to the UI layer of the application, as it displays the data and sends user interactions (e.g. button clicks) to the ViewModel. HabitHero's View would include the user interface, designed with Jetpack Compose and Material UI.
- **ViewModel:** It acts as a bridge between the Model and the View. It processes the data from the Model to a form that can be easily presented in the View. The ViewModel in HabitHero takes care of fetching and preparing data, handling user inputs, and updating the View accordingly.

Some of the benefits of the MVVM architecture are separation of concerns, improved scalability and data binding.

Data binding allows automatic updates between the ViewModel and the View. This means that when data in the ViewModel changes, the View reflects these changes without manual intervention, leading to a cleaner and more readable code.

For example, in HabitHero's HomeViewModel, there are multiple LiveData objects like `_activeModule`, `_listSubmoduleDetails` and `_quizData`, which automatically notify the View when data changes, ensuring the UI is always up-to-date with the latest data. If `_activeModule` changes, the UI reflecting the module details will automatically update without requiring additional code to manually set the UI elements.

In the `HomeScreen` composable, LiveData objects from `HomeViewModel` are observed using `.observeAsState()`. This method binds the LiveData to the UI, so any changes in the ViewModel's LiveData are immediately reflected in the UI. For example

```
val module by homeViewModel.activeModule.observeAsState()
```

observes the `activeModule` LiveData from HomeViewModel.

The LiveData-based architecture contributes significantly to a fluid and responsive user experience. In HabitHero, this means users can receive real-time feedback on their activities, progress and results.

The MVVM design pattern also supports scalability by separating concerns. This means different parts of the application can be developed independently. For instance, if we want to change how quiz data is displayed in the UI, we can do it without needing to alter the ViewModel or the underlying data models.

In the context of HabitHero, both repository and data classes play a complementary role within the Model component of the MVVM architecture. Here is an overview of the main data classes used in the application:

- **User:** It represents the user's profile, including identification (UID), name, email, class ID and type (student or teacher), and an optional image ID. It is essential for user authentication and role-based access.
- **Quiz and Question:** The quiz model holds quiz activity details, including ID, title, instructions, type and a list of questions. The Question model is a sealed class with two variants: `Poll` and `Quiz`. The former is used for polling questions with multiple options, while the Quiz represents typical quiz questions with correct answers.
- **Module and Submodule:** Module is used to track a learning module content, including its ID, name, current activity progress percentage and a map of submodules' respective states. Submodule model includes an ID, name and a detailed structure for different module activities (quiz, activity – reflection or game, challenge, summary).

- **Prompts and PromptQuestion:** The Prompt model contains ID, title, and a list of PromptQuestion objects for reflection activities. `PromptQuestion` is a sealed class with two types: `SealedQuestion` for rating-based answers and `TextQuestion` for open-ended ones.

- **Survey:** Contains survey details like ID, challenge ID, pre and post survey titles, instructions and a list of polling questions. It is used to gather user responses before and after a challenge, helping in the assessment of learning outcomes.

- **Summary:** It holds a summary's ID, associated challenge and survey IDs, title, instructions, subtitle, description and feedback details. It is used as a data structure containing the outcomes and feedback of a challenge, offering insights and reflections.

- **ReportStats:** Captures detailed statistics about device usage, including total screen time, unlocks per hour, time spent after bedtime, app category usage, peak usage times, and more. It is a fundamental data structure for the Great Data Hunt challenge, providing users with insights into their digital habits.

- **Scenario and Choice:** The Scenario model describes a particular scenario within the scenario-based game, including its description and a list of possible Choice objects. Choice represents the options available to users in a scenario, guiding the narrative based on user decisions.

- **Challenge:** Contains the details of a challenge, including ID, name, instructions, challenge data (e.g., goals, tasks), type, subtitle, caption, and feedback.

- **ExploreObject:** Contains information on extra learning content provided in the Explore screen, including title, image, duration, description, type, text content, references, colour, category, and views. It is used to facilitate self-guided exploration and learning outside the structured module framework.n

These models collectively form the backbone of HabitHero and are used in Repository classes, where data is retrieved from the remote database, in ViewModels, which prepare the information received from the Repository and in Views, which display the information contained in these data classes to the user.

In HabitHero, the data management aspect, especially interactions with the Firestore database, is handled by specialized classes known as repositories or Data Access Objects (DAOs). These include the `HomeRepository`, `TeacherHomeRepository`, `AuthenticationRepository`, and `ExploreRepository`.

Each of these classes is dedicated to managing the communication with Firestore's APIs, allowing their respective ViewModel to focus on data processing and UI state management. This architecture ensures a distinct separation of concerns, where each segment of the application's data handling is clearly organized.

5.3 Navigation

As previously mentioned, HabitHero's architecture follows the MVVM design pattern and it features two distinct user interfaces: one for students and one for teachers. This is possible through the implementation of Role-Based Access Control (RBAC), which regulates access based on user roles. RBAC in HabitHero ensures that each user category, students and teachers, interacts only with parts of the application relevant to their role.

For example, teachers will have access to administrative features like tracking students' progress, marking or starting a new module, or viewing aggregate data on specific activity results. Students have access primarily to learning modules, quizzes and their own progress reports.

RBAC helps in maintaining security and privacy within the application, as it controls who has access to what information. It also simplifies the process of updating and maintaining the application. For example, if new features or changes are needed, they can be rolled out only to the role they impact.

The MainActivity.kt file in HabitHero plays an important role in the overall architecture, as it is the primary activity and launching point for the entire user interface.

`MainActivity` starts with the `onCreate` method, where the application's splash screen is set up. This is used to improve user experience during the app's loading phase. The splash screen is managed by a timer to ensure it remains on screen for a fixed duration, offering a smooth transition to the main content.

The core UI of HabitHero is defined within the `setContent` block, where the `MainScreen` function is invoked. This composable contains the logic for the app's navigation and employs the `NavHostController` to manage its logic.

In HabitHero, navigation is handled dynamically, adjusting according to the user's role. This is done through the implementation of two lists: `studentItems` and `teacherItems`. Each list contains routes specific to the user's role.

The `Navigation` composable within the `MainScreen` sets up the `NavHost`, which acts as a container for destinations in the app. Each destination corresponds to a specific screen or feature. This arrangement allows the application to switch between different composables, including `HomeScreen`, `QuizScreen` and others.

The `BottomNavigationBar` composable adds another layer to the overall navigation experience, by providing quick access to commonly used features like home, explore and profile screens.

Other than setting up the UI, the activity also includes the code for notification handling. It checks the status of notifications and prompts the user to enable them if they are disabled. Within the scope of this thesis, the notification system will be employed only during the Great Data Hunt, as it serves to notify users when their daily report is ready. The creation of a notification channel, a requirement for newer Android versions, is handled through the `createNotificationChannel` method, which defines the specifics of the notification behaviour and appearance.

5.4 Implementation Challenges and Solutions

The development of HabitHero involved a series of challenges which will be discussed in this section, including specific obstacles encountered and the thought process behind the solutions adopted. The discussion is organized into three subsections, each dealing with specific aspects and features of the application.

Subsection 5.4.1 outlines the main difficulties that have emerged during the implementation of the reflection activity from Submodule 1, especially for what concerns the management and retrieval of images from Firestore. The challenges revolved around optimizing the process to ensure a smooth user experience.

Subsection 5.4.2 concerns the development of the scenario-based game, which required structuring a dynamic, choice-driven narrative to provide users with the flexibility to change their choices and explore multiple narrative paths.

Lastly, in Subsection 5.4.3, the focus shifts to the obstacles faced in implementing The Great Data Hunt. These include accessing and processing user device usage data as well as managing scheduling and time-bound data presentation.

5.4.1 Reflection Session and Image Retrieval

During the implementation of some features, particularly for activities like the Reflection Sessions in Submodule 1 and the Digital Wellbeing Bingo, managing the efficient retrieval of images stored in Firestore presented a variety of challenges:

- **Volume and Size of Images:** These specific activities required the application to fetch and handle a significant number of images, which potentially varied in size. Large image files pose a challenge because they consume more memory and bandwidth, which can lead to slower load time and increased

usage of device resources. This might affect the platform's performance, especially on devices with limited capabilities or low storage.

- **Real-Time Rendering:** The requirement for real-time rendering of these images added another layer of complexity. The user interface needed to display them promptly, as part of the activity, which meant that the image retrieval process had to be not only efficient but also quick enough to ensure a smooth user experience. Any delay in rendering could disrupt the flow of the activity.
- **Network Variability:** Users of the application could be operating under a variety of network conditions. Some might have high-speed internet connection allowing for rapid data transfer, while others might be on slower or unstable networks. The solution for image retrieval had to be robust enough to handle these varying conditions without significant degradation in performance. Slow network speeds should not result in excessively long load times or failure to load images, as this could negatively impact user engagement.

Efficient cache management was important to address these challenges, as proper caching strategies could help in reducing the load times of images by storing previously fetched images locally. This would not only improve performance by decreasing the need for repeated network calls but also ensure a better user experience under varying network conditions.

To handle the simultaneous retrieval of multiple images without blocking the main thread, Kotlin coroutines were used. This allowed for asynchronous loading and processing of images.

```
val deferredList = mutableListOf<Deferred<Unit>>()
// ... process images asynchronously
deferredList.awaitAll()
```

`BitmapFactory` options were used to downsample images, which reduce the memory footprint of each image while maintaining acceptable quality.

```
val options = BitmapFactory.Options()
options.inSampleSize = 2 // Downsample by a factor of 2
```

An LRU (Least Recently Used) cache was implemented to store recently accessed images.

```
val bitmapCache = LruCache<String, Bitmap>(10 * 1024 * 1024)
```

This piece of code creates a cache with a maximum capacity of 10MB, which is used to store and retrieve bitmap images.

LRU caches are beneficial as they automatically remove the least recently accessed items when the cache reaches its capacity limit, ensuring efficient memory usage.

A for loop was then used to iterate over each image URL, to check whether it was already cached. If so, it is retrieved and used directly, otherwise, the code fetched it from Firebase Storage, decoded it into a bitmap and then added it to the cache.

```
val storageReference = FirebaseStorage.getInstance().getReferenceFromUrl(gsUrl)
val localFile = File.createTempFile("tempImage", ".png")
storageReference.getFile(localFile).await()
```

The use of `async` within `deferredList` allowed for concurrent fetching and processing of images, improving the overall performance.

When an image is cached, subsequent accesses to the same image do not require network operations, which reduces the overall network usage.

After processing all images, the resulting `bitmapMap`, containing either cached or newly fetched images, is associated with the corresponding prompt ID and added to the `listPromptImageList`, containing the images used in the reflection activity.

5.4.2 Scenario-Based Game Implementation

The scenario-based game within HabitHero required a design that could handle complex, branching storylines while ensuring readability and user engagement.

The narrative structure of the game revolves around two primary data classes: Scenario and Choice. The Scenario class delineates each story segment, containing a description and a list of potential choices. Each scenario is a distinct part of the story which the player can navigate through. The Choice class, on the other hand, contains the choice text and a link to the subsequent scenario, guiding the story's progression based on player decisions.

The `processGameActivity` function in the `HomeRepository` plays an important role in retrieving the data from Firestore and organising it into a usable format.

Scenarios are fetched and stored in a `HashMap`, where each scenario's ID is the key. This approach enables efficient access and management of story segments. Scenarios with choices are dynamically added to the map, while those without choices mark narrative endpoints.

User interface and player interaction within the game are managed through various mutable states and a history stack. The main states include `currentScenarioId`, `currentText` and `currentChoices`. They are used to track the player's current position, the displayed text, and available choices. On the other hand, `historyStack` records each action the user takes. It allows players to revisit previous scenarios, change choices, and explore alternate narrative paths.

A significant aspect of the game's design is the presentation of the narrative, which is delivered through the Scenario class. To optimize the user experience, the `currentText` taken from each scenario is divided into smaller, more manageable paragraphs. This division is needed as including the entire text of a scenario at once would cover too much screen space, potentially obscuring the associated imagery that enriches the storytelling experience.

The function `getNextTextBlock` covers a central role here. It takes the scenario text and the current index, then returns a substring of the text up to a maximum length (defaulted to 200 characters.

This substring represents a "block" of the scenario text. The function ensures that the text block ends at a sentence boundary, making each block a coherent snippet of the story.

The game also employs tooltips and dialogues to guide players: the former is used to prompt users when necessary, for instance, reminding them to make a choice before proceeding. On the contrary, the dialogue appears when the user attempts to exit the game or complete it. It offers contextual information, confirmation actions and offers feedback on game completion.

5.4.3 The Great Data Hunt and Digital Wellbeing Bingo

One of the core features of the Great Data Hunt challenge was to provide detailed device usage analytics, which meant gaining access to system-level data. The challenge here has two implications: firstly, obtaining this level of access requires various permissions and user consent protocols, which could vary across different Android versions. Each version may have its nuances in terms of what data can be accessed and how.

Another significant problem was implementing a reliable system to manage time-bound activities within the app. Both the Great Data Hunt and the Digital Wellbeing Bingo required mechanisms to conclude the challenge after a pre-set duration, typically six days.

The goal was to ensure that all users, regardless of when they started the activity, received their post-challenge surveys simultaneously. This synchronization was

needed to maintain the integrity of the learning path and guarantee that every student in a class reached the same point so that the teacher could move on to the subsequent modules.

Moreover, as for the Great Data Hunt, the scheduling system had to be also used to trigger daily reports at a specified hour. This was not just a matter of tracking time but also effectively managing notifications and reminders.

In addressing these challenges, the following strategies have been adopted. To gain access to system-level data, I included specific permissions in the app's manifest file, notably `PACKAGE_USAGE_STATS` and `QUERY_ALL_PACKAGES`.

The `PACKAGE_USAGE_STATS` permission allows an application to access detailed statistics about the usage of other apps installed on the device, these include total time in the foreground, app usage frequency, last time used, first time stamp, app usage duration and many others.

Within the scope of the Great Data Hunt, this permission allows us to collect data on how much time users spend on different apps, when these are used, the frequency of their usage, the number of unlocks and category-based usage analysis, which helps to analyse the time spent in each category (e.g., social, games, productivity, video).

On the other hand, the `QUERY_ALL_PACKAGES` permission grants the ability to access a list of all apps installed on the user's device. While `PACKAGE_USAGE_STATS` provides usage data, this permission is essential for a comprehensive understanding of all available apps on a device, not limited by categories or other criteria.

This permission complements the data obtained from `PACKAGE_USAGE_STATS` by providing a complete picture of the apps present on the user's device.

An integral part of the app's architecture is the `ReportWorker`, which is a worker class used to handle data retrieval and processing. It operates in the background and employs the `UsageStatsManager`, which is an Android service that provides access to device usage history and statistics.

It's a key component to track how users interact with different apps over time. In the Great Data Hunt, it is used to:

- Query app usage data, which means usage stats over different intervals (daily, weekly, etc.)
- Retrieve details like the total time spent in each app
- Identify peak usage times and frequency of app accesses, enabling a deeper analysis of digital habits.

The worker also calculates several key metrics, listed as follows:

- **Total Screen Time:** Aggregating the total time each app was in the foreground, giving an overall picture of the user's screen time. The interval of time considered is the one that goes from the report time of the previous day to the current one.
- **App Category Usage:** Mapping each app's usage time to its respective category (like `audio`, `game`, `social`, etc.). This helps in understanding which types of apps are used most.
- **Frequency of App Unlocks:** Counting how often the device is unlocked, which is an indicator of device usage frequency.
- **Usage Per Hour:** Tracking how much each app is used per hour and giving insights into the user's daily app usage patterns.
- **Peak Usage Time:** Determining the hour when app usage is at its highest.
- **Time After Bedtime:** Calculating the total usage time in the hours post the user's bedtime, contributing to understanding sleep-time disturbances due to device usage.
- **Proximity to Sleep Time:** Assessing app usage in the hour leading up to bedtime.
- **Apps Opened:** Listing the apps that were opened at least once during the tracking period.

For `TimeAfterBedtime` and `Proximity to Sleep Time`, we take into consideration the wake-up time and bedtime, either set by default by the application if no information is available or retrieved through the preferences explicitly set by users at the beginning of the challenge.

This user-driven approach ensures that the data analysis is personalized and relevant to each students' routine.

The wake-up, bedtime and report time data serve two primary functions. The first is to analyse usage patterns around the user's sleep schedule. For instance, the `ReportWorker` assesses the amount of screen time in the hour leading up to the user's bedtime and the total screen time after bedtime. This analysis is important for users to understand how their device usage might be affecting their sleep quality.

The second purpose of the information requested at the beginning of the challenge is to determine when the daily usage reports should be provided and when users should be notified.

After processing the device usage data, the `ReportWorker` saves the computed statistics in the Firestore database. This step is important as it allows the data to be stored persistently and retrieved subsequently for analysis and display with the application.

In addition to data storage, this worker also manages the scheduling of these data processing tasks. To achieve this, it works in conjunction with another worker class, the `CountdownWorker`, which is primarily responsible for ensuring that the `ReportWorker` is triggered only once every 24 hours. This systematic approach prevents redundant data processing and ensures that the analytics provided to the user are up-to-date and relevant to the daily usage pattern.

Moreover, the `ReportWorker` is also in charge of notifying users when their daily usage report is ready. This notification process is an integral part of the user experience as it alerts users to review their digital habits and complete the necessary analysis at their convenience.

The notification system within the platform is set up using Android's `NotificationCompat.Bu` which allows for the creation and customization of notifications.

Key considerations have been made to make sure that these notifications are not overly intrusive or annoying for students. To this end, only one alert is sent per day for the duration of the challenge, which is six days. The notification merely serves as a reminder that the report is ready for review, leaving the choice of when to engage with it up to the user.

Chapter 6

Usability Testing

Building on the development phase outlined in the previous chapter, this section of the thesis focuses on the usability testing of the final platform. The main purpose is to evaluate HabitHero's user interface and user experience, especially in terms of ease of navigation, intuitiveness and overall appeal of the gamification elements.
Section 6.1 introduces the methodology and recruitment process for the usability test. This part details the planning behind the selection of participants, the roles and the specific environments in which the tests were conducted.
In Section 6.2, the focus shifts to the objectives and scope of the usability test, especially in terms of the clarity and accessibility of its interface. This section is used to set clear goals for what the usability test intends to achieve and the metrics used to measure the outcomes.
To conclude, Section 6.3 discusses the results and insights gained from the actual tests. This part of the chapter analyses both the strengths and areas of improvement of the platform. It provides a detailed look at how users have interacted with the platform and their reactions to the features offered.

6.1 Methodology and Recruitment

Usability testing plays an important role in assessing the effectiveness and user-friendliness of digital platforms. It is a technique used to evaluate a product by testing it with representative users, who interact with it to identify usability issues and gather qualitative and quantitative data about the user's experience. In this study, qualitative feedback was gathered through open-ended questions and note-taking during the test, while quantitative data was measured using a Linkert scale from 1 to 5.

The testing was structured to include distinct roles, ensuring objectivity and thorough collection of data:

- **Facilitator:** The facilitator's role was to systematically guide participants through the test, provide instructions, clarify doubts, and maintain the flow of the session. More importantly, to avoid any biases or leading questions, the facilitator was deliberately chosen to be someone with no prior knowledge of the platform's development process.

- **Note Taker and Observer (My Role):** My responsibilities included detailed note-taking and actively observing participants during the test. At the end of each session, I asked participants additional questions to gather more direct feedback.

The platform assessment was conducted individually with each student, lasting approximately one hour. This approach allowed for a focused evaluation of each participant's reactions and interaction with the platform.
The recruitment process for the usability test was specifically planned to align with the research's primary focus. Due to time and resource constraints, only students were involved in this phase.

Although a preliminary interface for teachers was also developed, the challenges in finding available interviewees within the thesis's time frame led to the decision to focus exclusively on students. Nevertheless, this choice aligns with the research's main objective, which centers around understanding teenage students' responses to digital wellbeing education. Testing with teachers, while valuable, was left out for future work.

The students selected for the test were from three different high schools in Turin. The participants group included:

- 4 from a scientific high school

- 1 from a technical high school

- 5 from a language high school

The age range of the participants was diverse, covering both junior and senior classes. It included one 15-year-old, six 16-year-olds and three 17-year-olds, ensuring a broad range of experiences and perspectives. The group was almost evenly split in terms of gender, with six females and four males.

To maintain transparency, prior to the beginning of the testing sessions, each participant was provided with a consent form, which outlined the objectives of the thesis, the purpose of the interviews and the usage of the data collected.

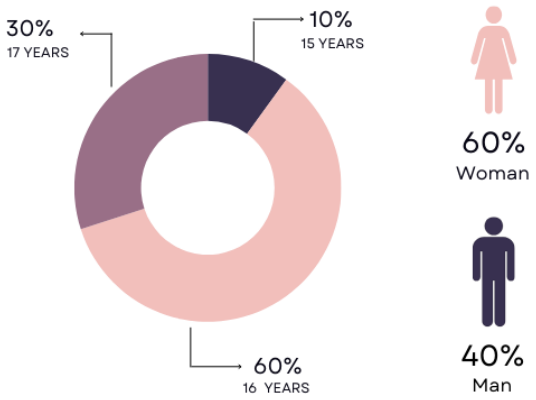

Figure 6.1: Demographic data on usability test participants.

The setting for the usability testing varied to accommodate the schedules and availability of the participants. For half of the group, the tests were conducted within the school environment during regular school hours. For the remaining students, the assessment of the platform was held outside school hours. Some sessions took place in a free classroom at the Politecnico di Torino, others were performed in a more informal setting, like a coffee shop.

The diverse environment where the sessions were held caused some challenges, particularly in terms of ambient noise and auditory distractions. Given these conditions, it was decided not to record the sessions. The presence of background noise and the dynamic nature of these environments would have likely compromised the quality of any audio recordings, making them less useful for the final analysis.

On the contrary, the structure of the usability test was designed to make the process of note-taking easier and more effective. This approach ensured that detailed information was captured without the need for audio recording.

Each testing session was led by a facilitator, who provided a consistent framework for each session, guiding the participants through a series of tasks and questions in a systematic way. This structure allowed me to focus on observing the participants' interactions with the platform as well as their reactions. The notes covered a wide range of observations, from direct responses and comments to more subtle aspects like their body language, hesitations and ease of use with different features of the platform.

6.2 Testing Objectives

The usability test outlined in the previous section was an important component in refining the platform. The main goal of this assessment was to evaluate the

user interface and user experience of students. The script used during the test was structured with clear objectives in mind, listed as follows:

1. **User Interaction Evaluation:** This section aimed to assess how students interacted with HabitHero's interface. Key factors included clarity of navigation, accessibility of various features and the app's responsiveness to user inputs. The intent here was to ensure that users found the app straightforward to use and encountered no difficulties while navigating through its various functionalities.

2. **Appeal of Gamification Elements:** Given the gamified basis of HabitHero, designed to improve the learning experience, it was important to measure its actual impact on user engagement. This involved observing whether these elements succeeded in making the learning process more immersive and enjoyable for users.

3. **Potential Design Improvements:** This part of the test focused on identifying any design inconsistencies, ambiguities and shortcomings that might negatively impact user experience. A thorough evaluation was conducted, analysing the app's visual appeal, logical flow and overall coherence. The goal was to isolate any elements that might prevent optimal user satisfaction.

Complementing these objectives was a systematic feedback collection from the test participants, used to identify the strengths and weaknesses of the platform. It provided a valuable perspective on how the app aligned with the user expectations and needs, an imperative requirement in user-centred design.

To capture a nuanced understanding of these aspects, various metrics were used, these include:

- **Ease of Use:** Using the Single Ease Question (SEQ) questionnaire, each learning activity's intuitiveness was evaluated immediately after the interaction. Each task in the usability test was accompanied by specific questions, measured on a scale from 1 to 5, to assess the ease of completing the task. For example, questions like "How easy was it to access the quiz?" or "How clear were the guiding questions in different reflection sessions?" provided insights into the intuitiveness of individual tasks.

- **Task Duration:** The time taken by participants to complete specific tasks was carefully noted. This metric provided insights into the complexity of each task, helping to identify and refine time-consuming features.

- **Task Success Rate:** This involved monitoring whether participants could complete tasks without assistance. A 100% success rate indicated tasks were

well-designed and user-friendly, whereas lower rates indicated areas needing improvement.

- **User Interaction Evaluation:** This included participants' assessment of the app's interface clarity and intuitiveness. Participants' were asked to rate on a scale of 1 to 5 and provide open feedback on any problems encountered while accessing various functionalities of the app.
- **Appeal of Gamification Elements:** Participants were asked to rate their engagement when interacting with gamified activities and provide open-ended feedback on tasks that did not interest them. This helped in assessing the appeal and impact of gamification in the learning process.
- **Identification of Design Improvements:** Participants were encouraged to note any elements of the application that were confusing or could be improved. They also rated the app's aesthetic appeal and discussed the aspects they liked the most.

The usability testing was planned to assess the main activities offered in the learning path of the first module and the explore screen. To optimize the assessment process, activities with similar interfaces or objectives were tested only once. For example, the summary activities present both in submodules 1 and 2 were evaluated in a single task, since they shared a common format and purpose.

The script, originally in Italian as reported in the Appendix C, was designed to guide participants through a series of tasks within HabitHero. Each task had a specific objective and process, focusing on different elements of the platform to assess their functionality and user experience. The following paragraphs detail the individual tasks and their intended purposes.

Task 1 was structured to assess the ease with which students could identify and interact with the quiz component from Submodule 1. Participants were instructed to locate the activity button within the platform's interface.

The main objective was to test their ability to navigate and identify specific elements. After accessing the quiz, they were requested to read through the instructions, which offered an opportunity to evaluate the clarity of the guidance provided.

Once the preliminary steps were completed, students moved on to interact with the quiz questions, where the focus was on understanding how straightforward it was for them to choose or change their answers within the quiz, offering insights into the flexibility of the interface. Additionally, the task also tried to assess the ease with which students could navigate back and forth through quiz questions

before finalizing their answers.

Task 2 focused on the usability of the reflection activity. The purpose was to verify the clarity of the reflection screen, which offered three distinct guided sessions. In this task, students were first asked to locate the reflection button, testing their ability to navigate to specific activities within the app.

Once they accessed the correct screen, the task then centered on assessing how effectively students could identify the starting point from the three available sessions. Another important aspect of this task was to determine whether students could easily distinguish between completed and pending sessions.

Finally, it was also possible to assess the usefulness of the questions guiding students through the reflection process. It was important to verify whether these prompts were thought-provoking and effective in piloting the reflection.

Task 3 evaluated student interaction with the Bingo challenge. They had to complete a pre and post-challenge survey, explore the Bingo interface and simulate the completion of a habit. The objective here was to measure the appeal of this gamified element and the intuitiveness of how to complete the activity.

Task 4 shifts the attention to the effectiveness of summary questions in consolidating the learning material. Students were asked to locate the activity, respond to the questions and submit their answers.

Task 5 involved using the scenario-based game, which aimed to measure the level of student engagement and ease of navigation in the interactive game. This task had students read the game introduction, navigate through different scenarios and make choices affecting the storyline based on what they would do in real life. Feedback from this task was important in assessing the immersive quality and navigational fluidity of the game.

Task 6 was designed to evaluate the Great Data Hunt challenge. Students were asked to set up their preferences, explore the given reports and reflect on the data presented. The primary goal was to evaluate not only the usability of this feature but also how it compared in terms of clarity to common data displays, such as Apple's screen time reports. Additionally, the task aimed to assess the relevance and helpfulness of the questions provided for report analysis. This was essential to understand whether the platform's approach to presenting and analyzing phone usage data was intuitive and meaningful for users.

The last task aimed at evaluating the explore screen and determining its appeal. Students were requested to navigate to this section and interact with one content of

their choice. They were also encouraged to use the search bar as well as comment on the usefulness of the preview descriptions on each card.

During the entire span of the test, students were encouraged to express their thoughts aloud, allowing me to capture immediate reactions and detailed feedback during their interactions.

6.3 Results

Following the comprehensive usability test, some interesting findings emerged regarding the platform's interface and functionalities. The following sections will present the key insights from the assessments, detailing the platform's strengths and areas for improvement.

In Task 1, the majority of candidates appreciated the videogame-style graphics and the intuitive nature of the navigation. One participant expressed, "The graphics are very much in the style of a videogame. I like it" highlighting the appeal of the visual design. They further noted, "The fact that it was the only coloured button made me guess it was the right one to click", which suggests the interface's colour cues were effective in improving user experience.

The task's simplicity, as stated by another participant, was a common thread in the feedback, especially in terms of the design and implementation of question indicators. One user specifically praised the usefulness of these visual cues, highlighting how clearly they marked each question, thus allowing one to know how far they had progressed and how much of the task remained.

At the end of the task, participants were asked to rate the ease of accessing and completing the quiz, with 1 meaning Very Hard and 5 meaning Very Easy. The results of the questionnaire are reported in Figure 6.2.

Some of the notes they added regarding the activity include: "The aesthetics, colours and graphics are very appealing", "The questions and answers were presented in a clear way, so it was easy to respond" and "The app is well-organized".

Moving to Task 2, the feedback revealed a weak point in the choice of icons, notably the lightbulb, which was intended to represent the reflection activity. In fact, it sometimes led to confusion among users, suggesting the need for a more intuitive graphical representation. For instance, one participant pointed out, "The lightbulb doesn't really make me think of reflections. Perhaps a thought bubble would be better."

However, another user's comment on the iconography remarked that while the lightbulb might not be an immediately obvious symbol for reflection, it does not

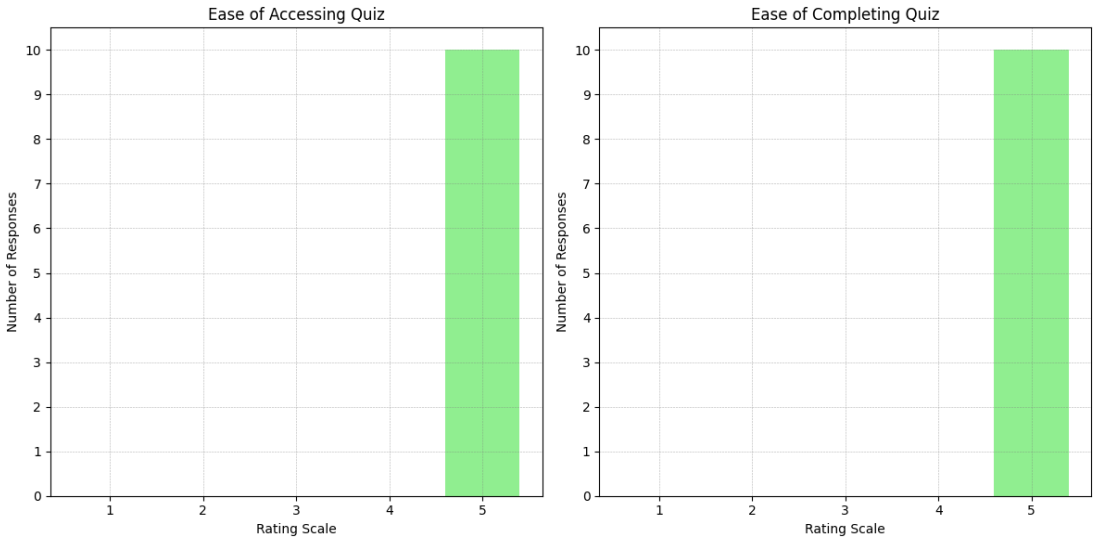

Figure 6.2: Ratings on Quiz Access and Completion Ease.

significantly prevent the task's completion. "The lightbulb makes me think more of suggestions. It depends perhaps on personal interpretation. But it's not that you can't understand what needs to be clicked because the path has advanced." This perspective suggests that despite the initial uncertainty about the icon's meaning, the overall progression and the placement of the active button still managed to guide users through the task.

Alongside the iconography issues, another significant concern was the use of the 'X' button. As one student expressed "The X makes me afraid that what I've done will be lost". This fear reflects a broader user experience issue, where certain universal symbols, like the 'X', carry preconceived meanings, in this case, deletion or cancellation.

Interestingly, none of the participants actually clicked on it due to their fear of losing progress. In fact, had they done so, an alert dialogue would have appeared, reassuring them that their changes would be saved. While this feature partially addresses the concern, it doesn't entirely solve the problem. As noted by one of the participants, sometimes clicking the 'X' leads to the loss of progress without any warning or opportunity for undoing the action. The general feedback points towards an opportunity for redesign to ensure users feel confident and secure about their progress and the choices they make within the application.

Conversely, the session's structure was positively received. The clarity in task order was especially appreciated, as highlighted by one user, "The order of the sessions made it easy to identify where to start and how to continue". The use of coloured buttons and a star-based reward system were also well-received. While

there was some confusion among students regarding the meaning of the number of stars received for completed sessions, there was a general consensus that these visual elements were indicative of success. The stars served as a motivational tool, encouraging students to complete the remaining reflection sessions.

After completing the task, participants were asked to evaluate the clarity of guiding questions in various reflection sessions and the frequency of difficulties encountered during the activity.

The ratings were on a scale from 1 to 5, with 1 being "Not Clear At All" and 5 being "Very Clear". While most participants (8 out of 10) rated the clarity of prompts as very clear, two participants found them somewhat less clear, explaining that at times, for open-ended questions, they were expecting more guidance. The specific ratings can be visualized in the following charts, providing a quantitative perspective on users' experiences.

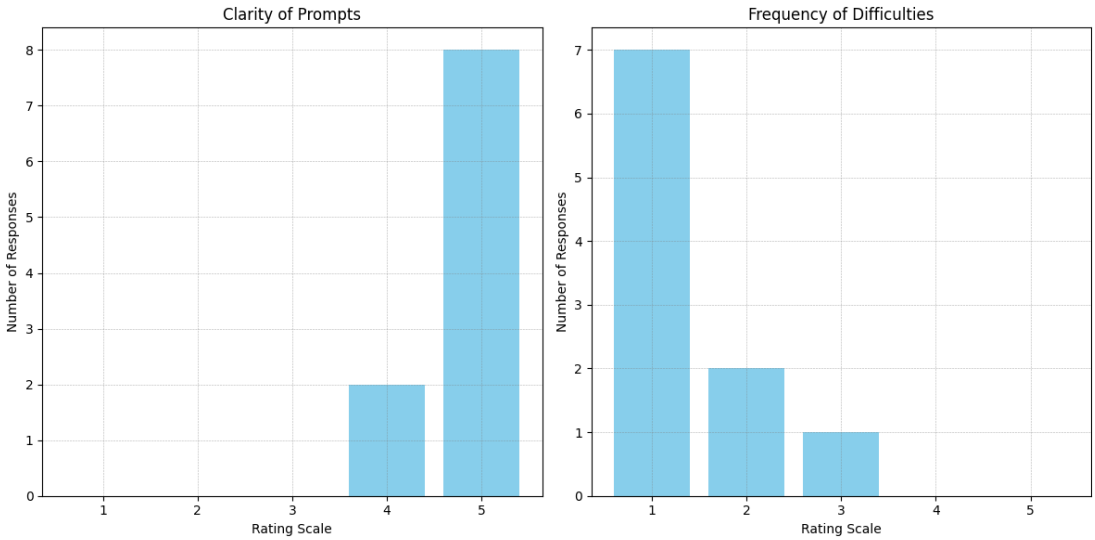

Figure 6.3: User Feedback on Reflection Session Clarity.

Additional comments from the participants include, "Maybe for people who are not very digital, it would be good to indicate that to go back, you can click the 'X' button. Otherwise it's perfect." and "I appreciated the graphics, the activity was very quick to complete."

In Task 3, participants' feedback revealed some important insights in terms of instruction clarity and the use of helpers. One student stated "The shorter answers in the survey make reading simpler and more immediate", which suggests a preference for brevity and clarity in questions. This approach seems to help in keeping users focused and engaged, especially in survey-style tasks where attention

can easily decrease.

Another participant pointed out "I clicked on the instructions, but still, it wasn't super clear what I was supposed to do." This feedback highlights the need for a more explicit and comprehensive set of instructions at the beginning of this task.

As for the cards to be completed in the challenge activity, one user noted that it would have been more useful to write "Have you completed this activity? Describe your experience". In general, many interviewees expressed the need for more structured prompts that provide direction and focus, aiding them in articulating their thoughts more effectively, especially in open-ended questions.

While the core activities requested by the task, such as completing the survey and one card among the ones proposed by the challenge, were not problematic, the general purpose of the activity was not as clear to users. This flaw indicates the need for more contextual information, ensuring students understand how to complete the task as well as why they are doing it.

After interacting with this task, students were asked to provide feedback on the clarity of the survey and ease of marking a bingo card as completed. Most participants (9 out of 10) found it very easy to complete the surveys, indicating that the activity is well structured. However, when it came to marking a bingo card as completed, while the majority (7 out of 10) found it very easy, one participant found it less intuitive and two others rated it as fairly easy, but not completely straightforward.

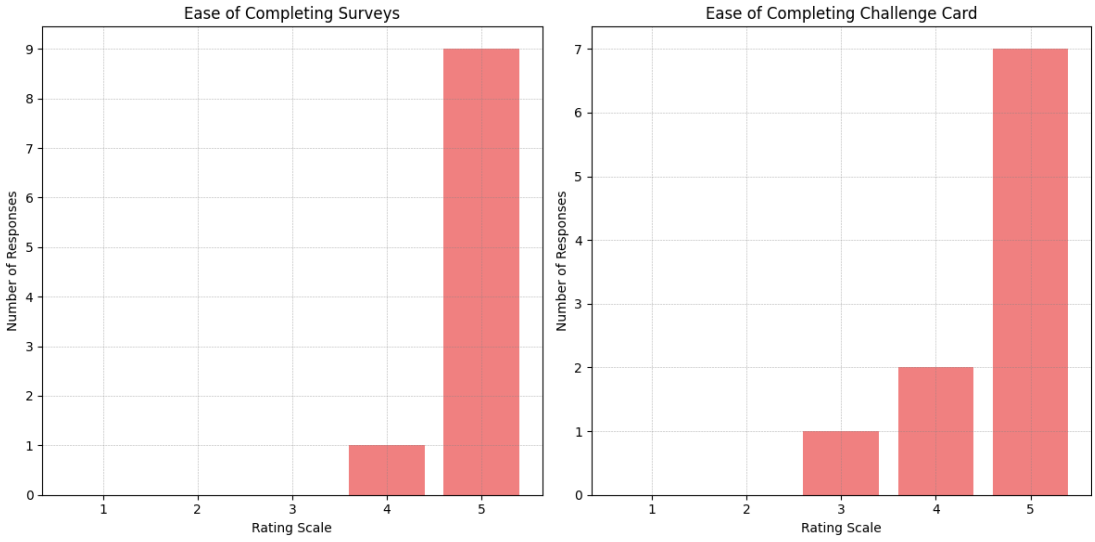

Figure 6.4: Ease of Completing Surveys and Bingo Cards.

As previously mentioned, the main difficulty lied in the fact that some students were uncertain about what exactly they were supposed to write on the bingo cards.

This confusion seemed to stem from a lack of clarity regarding the overall purpose of the challenge. Although the core task of completing the survey and marking a card was not problematic for most, the purpose and expectation of the bingo card activity were not as clear to all users.

Some extra notes shared by participants provided more context to their ratings: "Understanding how to respond to the questions was somewhat difficult" and "The label 'Type your answer' could be clearer, perhaps as 'Type your weekly experience.' Overall, everything is clear and aesthetically pleasing, but the instructions should be made more noticeable." Another user suggested adding a Done/Not Done option where the text input area for describing experiences becomes visible only if "Done" is selected.

Continuing to Task 4, similar observations were made concerning the overall objective of the activity. One student commented "It's not clear that in the summary you need to share your experience to help and be helped". Users' uncertainty about the purpose of the summary section highlights a need for more detailed instructions.

Additionally, the feedback "I would have preferred to click on the text to expand each point, it came naturally to do so" suggests that some users may find it more intuitive to interact with the text directly rather than through buttons.

On the contrary, users responded positively to the checkmark showed upon completion. In particular, one user stated, "The fact that there is a checkmark makes me understand that a specific point has been completed." They further added "It's convenient that I can scroll once I have the cards expanded", which indicates that the navigational elements within the task were well-received.

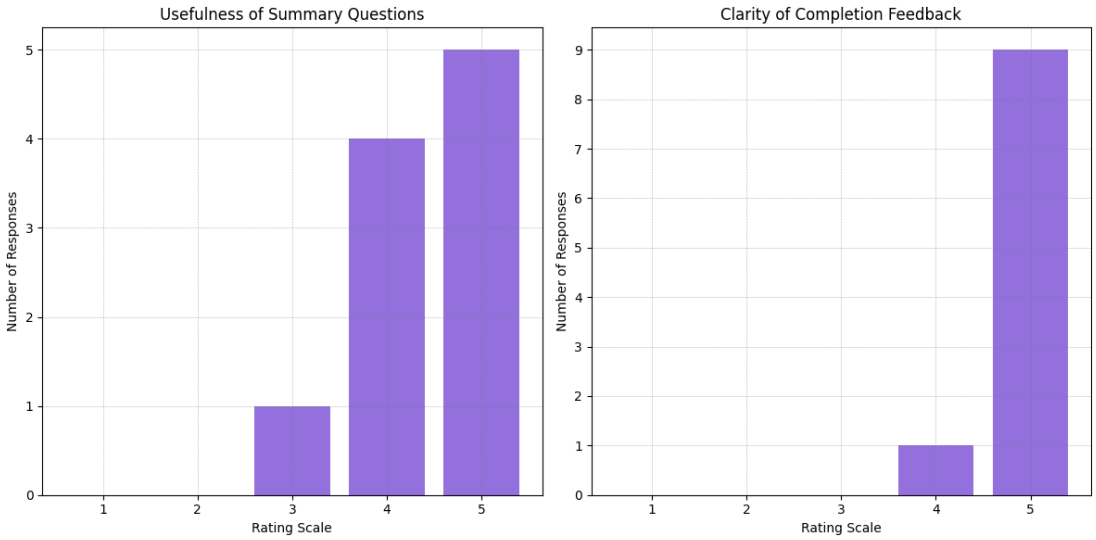

Figure 6.5: Usefulness of Summary Questions Rated by Users.

After interacting with this task, students provided additional feedback on the usefulness of the summary questions in guiding them through the activity and the clarity of the confirmation that the activity had been indeed completed. The feedback was mostly positive, with a majority of users (5 out 10) rating the guidance provided by the questions as very useful. Only one participant rated the usefulness as moderate.

These results reflect that the summary activity was generally well-received and effective in guiding participants, though there is room for improvements in making the purpose and completion indicators more explicit. Some users commented, "It seems like a summary to see how you have improve in a habit", which suggests that the overall intent of the activity was well-understood.

Task 5 stood out as one of the most engaging and well-received activities in the learning path, primarily due to its story-based format. The approach integrated a relatable narrative with interactive elements of decision-making and visually appealing images. All participants rated the activity as very fun and comments like "I am having fun" and "This task was my favourite" further validated the impressions I had on their body language.

The story's format, which allowed users to feel part of the narrative, was often praised. For instance, one participant noted, "It's nice that I can change my choices because in such games one makes a choice and doesn't get the consequence they thought".

The flexibility in decision-making made the experience more interactive and improve the gamification aspect. This aspect of the task not only made it interactive but also thought-provoking, as one student expressed, "It allowed me to explore different scenarios and made me reflect on the consequences of certain choices".

Comments like "I liked the game, it felt very immersive. The story is well-told and covers relatable themes", "The story's lesson is clear: prioritize important things over fun." and "I stayed up late in the story, and in the long run, it won't work out" reflect the narrative's effectiveness in conveying meaningful messages.

As for the ease of navigating from one scenario to another in the game, it was rated as very easy by 9 out of 10 participants.

Despite the general positive reception, there were also suggestions for improvement. For example, one participant stated, "I would change the transition between one scene and another", indicating a desire for a smoother narrative flow. Another used noted, "I would like to know and see somewhere how much is left to the end of the story", suggesting a need for progress indicators.

As one participant remarked at the end of the activity, "The story is certainly a different way of approaching the main subject. I felt involved and would be pleased if there were activities like this occasionally. It would break the monotony.".

This feedback indicates the value of variety in educational content, suggesting that diverse formats can maintain user interest.

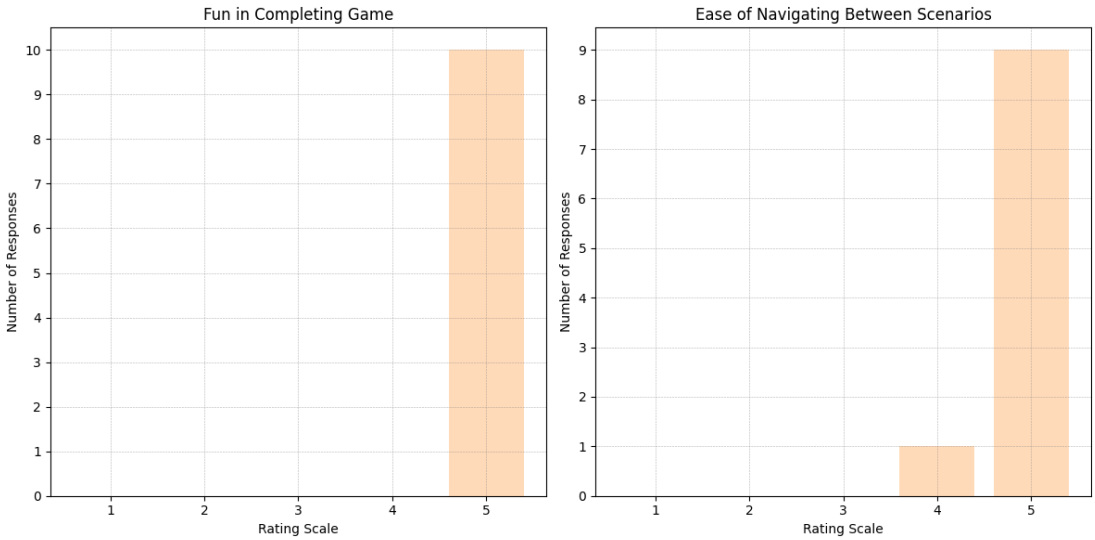

Figure 6.6: Participant Engagement in Story-Based Game.

In Task 6, some interesting feedback were shared regarding the activity's usability and gamification design. Key to this task was the blend of visual appeal and functionality. One user showed appreciation for the settings graphics, while another participant noted, "It seems like a journal, and I like it because then you can see your improvements and what has changed over a week or a month". We can assume the task's intent in creating a sense of personal progress and reflection was successful.

The simplicity and straightforwardness of the questions were also well-received, as indicated by many comments, like the following: "I really like the analysis questions because they are easy to answer. They made me notice that besides social media, I do little else that's non-digital". This suggests that the task offered a balance between being educational and user-friendly.

When asked about the ease of setting preferences and the clarity of the data presented, the responses from the questionnaire were pretty positive. All participants found it very easy to customize the challenge and the majority (8 out 10) rated the data in the daily reports as very clear. The detailed feedback from the questionnaires, as reported in the following charts, offers a clear picture of the user experience in this task.

Despite the general reception being positive, there were also suggestions for improvements. For instance, one participant expressed a desired for varied visual elements, "I would like different background colours for quizzes/surveys", which

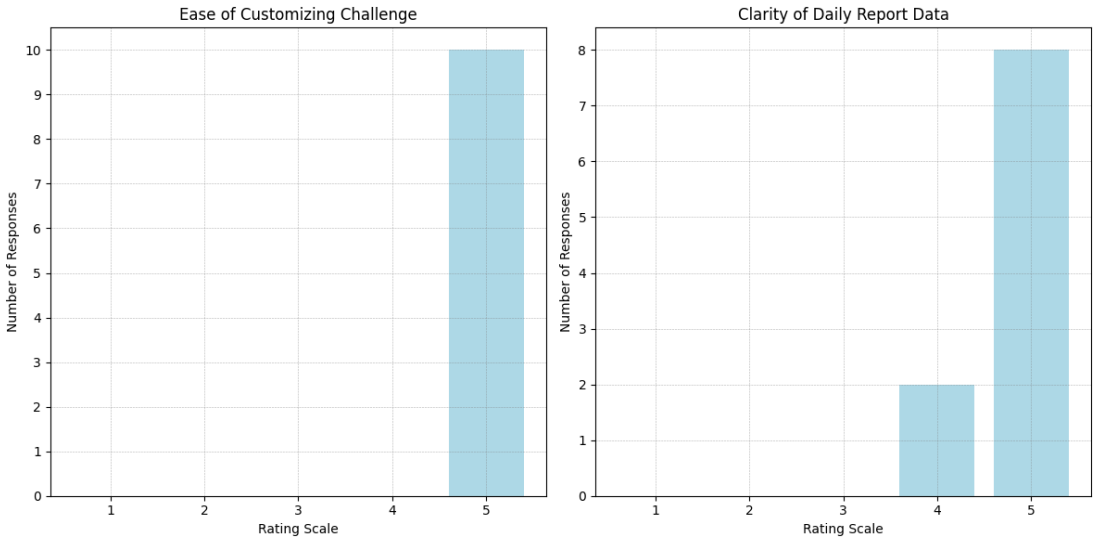

Figure 6.7: Feedback on The Great Data Hunt Usability.

hints at a possible refinement for what concerns differentiating various types of activities.

Task 7 was the last one in the usability test conducted. It involved navigating through the Explore screen and interacting with a card of their choice. Many participants showed appreciation for the practicality of having content durations and types indicated, one of them stated "I like the fact that it tells you the type and how long it will take you to read the content". This comment shows that clear and concise information that helps users manage their time is well-received.

The intuitiveness of the search bar was also praised, with one user stating "The search bar is very intuitive, it finds exactly what you expect." The feedback highlights the effectiveness of the search functionality, which contributes positively to the general user experience as it enables easy navigation and content discovery.

Another user pointed out the need for more visible categorization. "It's better to add something to confirm that there are several categories, beyond the 2 that are clearly visible". Another participant noted "I would use something to highlight keywords in the article. The initial screen is very immediate and the fact that there are different colours helps to organize the view". This indicates that users appreciate visual elements that aid in content navigation.

Both titles and descriptions provided as previews on the cards shown in the Explore screen were pretty clear to every student, with one clearly stating, "From the descriptions and titles, I immediately understand what I am going to read, and the fact that it tells me how much time I need helps me organize myself better."

The results from the questionnaires post-task were quite positive, with the majority of the participants finding the features offered in the Explore screen very easy to use. Specifically, 8 out of 10 users rated the ease of using the search bar as very high. A similar number of participants found the navigation though the content equally straightforward. Only a few rated these features slightly lower, indicating some minor areas for improvement. The following charts report the exact ratings for each question.

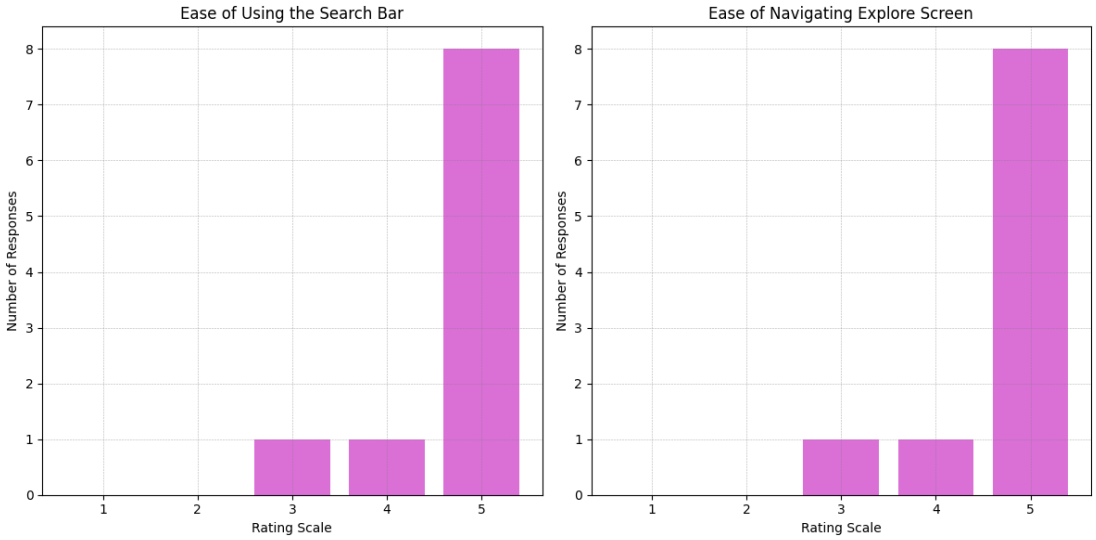

Figure 6.8: Ease of Navigation on Explore Screen.

The general feedback on the system usability, retrieved through a comprehensive feedback at the end of the usability test revealed that a significant majority of the participants (70%) rated the interface of HabitHero as very clear and intuitive. This result indicates a positive reception towards the user interface implemented.

The evaluation of gamification elements employed also received positive ratings, with a substantial number of the participants finding the gamified features as highly enjoyable. The specific data is reported in the following charts.

These results indicate that the integration of gamification strategies in HabitHero had a positive effect on the overall user experience.

In terms of design aesthetics, 90% of the participants rated its design appeal as very high, with only a small fraction (10%) rating it slightly lower (4 out of 5).

Moving on the to last metric used to evaluate the platform, the data on the time taken and success rates for each task provided some insightful observations. Most tasks were completed within a reasonable time frame, with a high success rate.

These results point to a well-structured design that is in line with the capabilities and expectations of the end user.

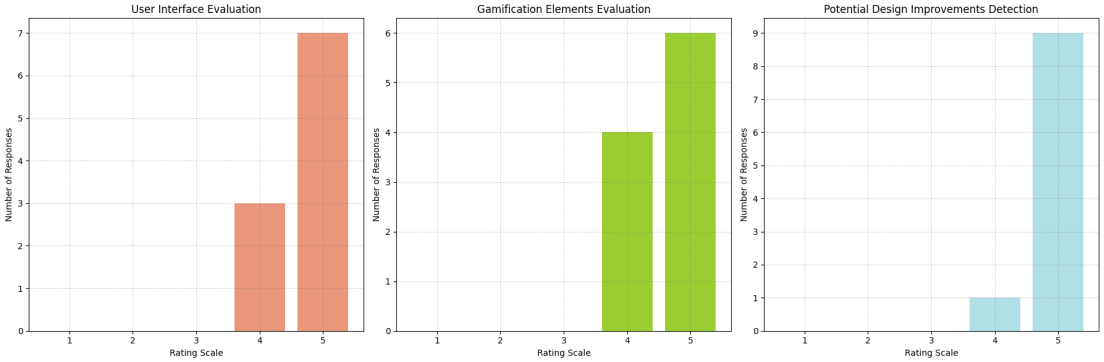

Figure 6.9: Feedback summary on interface clarity, gamification elements and design aesthetics.

However, it needs to be said that for certain tasks, such as Task 3 on Digital Wellbeing Bingo, there was a varied success rate, ranging from 80% to 100%. In fact, the time duration to complete the activity was also considerably higher. This suggests that while the overall design and structure of HabitHero have proven to be effective, there are specific areas where user experience could be further optimized.

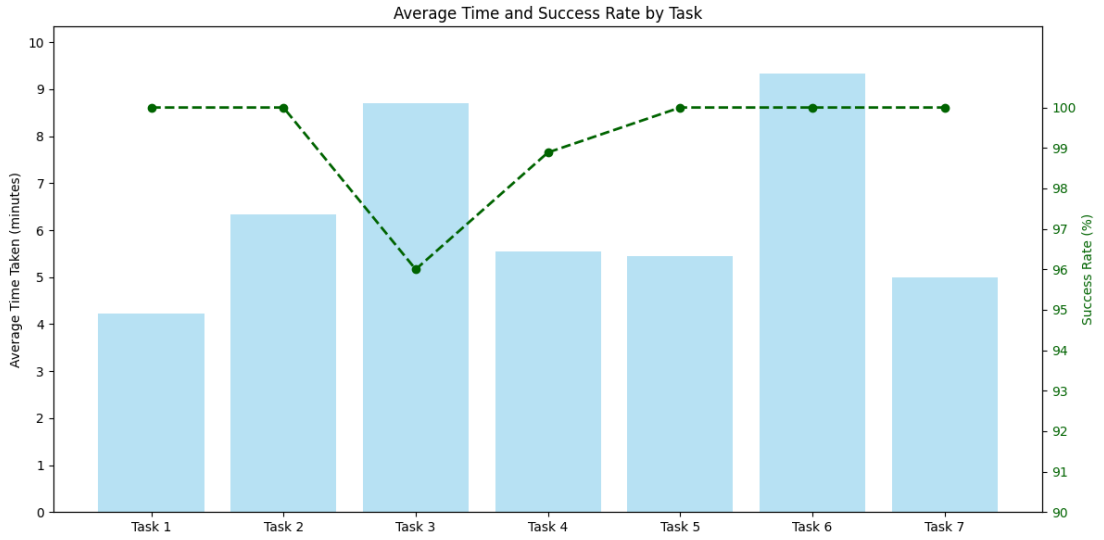

Figure 6.10: Time duration and success rates for each task.

Chapter 7

Conclusions

The primary objective of this research was to develop an educational platform designed to facilitate digital wellbeing education among teenagers.

This platform aimed to engage students in learning about digital habits and wellbeing through an interactive and gamified approach. The core idea was not only to inform but also to provide the necessary tools for teenagers to make conscious choices about their digital lives.

In achieving this, the research drew from several theoretical frameworks, outlined in detail in Section 2.2. Self-Determination Theory (SDT) influenced the platform's intrinsic motivational strategies, such as the Digital Wellbeing Bingo challenge, which allows students to autonomously interact with the tasks offered based on their personal interests and skills. Unlike traditional learning methods, this gamified approach provides students with a choice of digital habits they wish to improve.

The Dual-System Theory as well as Flow Theory also played an important role in the conceptualization of HabitHero. In fact, each activity proposed in the learning module progressively increases in complexity, aiming to keep students in a state of flow as well as appeal to their System 2 thinking.

In fact the platform also provides them with space to reflect on digital behaviours that are typically associated with System 1 processing. A few concrete examples are given by the Digital Wellbeing Bingo and The Great Data Hunt, which prompted students to think critically about their choices and behaviours. This aligns well with the aim of triggering System 2 thinking, that is getting students to reflect and make more conscious decisions.

The platform's design also took into consideration the specific user needs identified in student focus groups and teacher interviews. These were addressed in combination with a strategic use of gamification, which led to the development of

HabitHero.

While initial responses and interactions emerged from the usability test have been promising, the upcoming section will explore how the feedback gathered can be used in refining the platform's user interface and user experience.

7.1 Limitations and Future Work

In evaluating the results of the usability tests in the context of the objectives previously outlined and design principles, it's also important to acknowledge the limitations of the study.

While the usability tests provided valuable insights, they were not designed to comprehensively assess the effectiveness of the educational aspects of the platform, such as its impact on habit formation or the depth of learning regarding digital wellbeing concepts. As such, it's not yet possible to conclusively determine whether the platform has succeeded in these educational goals.

However, the feedback from the usability tests does suggest success in some aspects related to user experience. For example, the games and challenges on the platform, like the Digital Wellbeing Bingo or the scenario-based game, seemed to have caught students' interest.

In fact, they reported finding these elements fun and interactive. This response shows that HabitHero is not just another educational or digital self-control tool, but it's something that students can actually enjoy while they learn. This engagement is important as it helps to keep students interested and motivated.

Moreover, the feedback on the platform's interface and setup of activities was quite positive. Students appreciated the user-friendly design and the clear, straightforward way activities were laid out.

While the platform showed many strong points, the usability test also highlighted some limitations that need to be addressed. For instance, some of the icons used in the platform, such as the lightbulb intended to represent the reflection activity, sometimes caused confusion among the users.

One way to deal with this issue would be to conduct a survey with a group of students and ask them to interpret the meaning of a set of icons. Another possible solution would be introducing a brief iconography guide the first time the platform is being used. This guide can visually present each icon with a brief explanation.

Additionally, some participants expressed concerns regarding the use of the 'X' button, fearing that their progress might be lost if they clicked on it. To address this issue, one practical solution is to offer an alternative navigation option, such as

"Back" or "Save & Return", which explicitly indicate their functions and reduce ambiguity. Another way is to use mini tutorials during the initial usage of the platform.

A significant limitation noted was the lack of clarity in the overall objective of some activities, like the Digital Wellbeing Bingo challenge. More specifically, students expressed uncertainty around the use of the term "Bingo", which may not be familiar to all users, potentially leading to confusion about the activity's purpose.

Additionally, the rules of the challenge were unclear to some, such as what to write on the cards, when to do so and the functionality of the help button located in the top-right corner of the screen, which often went unnoticed.

To tackle these issues, a more descriptive name for the activity could be adopted, such as "Wellbeing Goals Tracker". This change could possibly better convey the activity's purpose. It would be also a good idea to use a short animation at the start of the activity to direct students' attention towards the Help button. It could also visually walk them through the activity's goals, how to complete it and where to find help if needed.

In light of these findings, among other planned improvements, a primary focus for HabitHero's next steps should be refining the user experience, especially in the areas highlighted in the preceding sections.

Alongside this goal, future work on the platform should also include a more extensive, in-the-wild study. This proposed test would involve deploying the platform in a real classroom setting, guided by a teacher, for the duration of ideally one month or at least two weeks. This investigation would provide a more robust evaluation on the platform's effectiveness in educational terms.

Using HabitHero in a live classroom setting for an extended period would offer a deeper understanding of its impact on students' learning. This approach would also provide a real-world context to verify if the gamified activities truly improve understanding and retention of digital wellbeing concepts among students. Another key advantage is the possibility of observing the platform's integration into regular teaching routines. The insights gained from this study would make it possible to assess the true educational value of HabitHero and to make adjustment to optimize its effectiveness.

Appendix A

Focus Groups Questions

The following questions, as well as the general interview script, are written in Italian because the participants of the focus groups were Italian students. The choice of using Italian aims to make students comfortable enough to express themselves fully and effectively.

A.1 Demographic Questions

1. Quanti anni hai?
2. Qual è la tua identità di genere?
3. Quale anno delle superiori frequenti?
4. Che tipo di scuola frequenti?

A.2 Digital Habits Questions

1. Quali dispositivi utilizzi regolarmente in ambito scolastico per svolgere compiti o progetti?
    - **Follow-up question:** Come li usi?
2. Quante ore al giorno trascorrete su ciascuno di questi dispositivi? (Nel caso degli smartphone, chiedere agli studenti di controllare lo screen-time dei loro dispositivi)
3. Quali sono le piattaforme o applicazioni che preferite utilizzare per il lavoro scolastico e perché?

4. Come bilanciate il tempo trascorso sui dispositivi digitali per scopi educativi rispetto alle attività di svago?

5. Ritenete che l'utilizzo di dispositivi digitali influisca sulla vostra capacità di concentrarti sui compiti? Se sì, potreste fornire alcuni esempi?

    - **Follow-up question:** Come gestite queste situazioni solitamente?

6. Quali sono i vantaggi e gli svantaggi dell'utilizzo di risorse online per i compiti e lo studio?

7. Secondo voi, in che modo i professori e gli studenti possono collaborare per creare un ambiente digitale più sano all'interno della scuola?

A.3 School Rules Questions

1. Quali regole ha la vostra scuola in merito all'uso dei dispositivi digitali?

    - **Follow-up question:** Quanto strettamente sono applicate queste regole?
    - **Follow-up question:** question Pensate che queste regole siano efficaci? Se sì, perché? Se no, in che modo potrebbero essere migliorate?

2. Ci sono regole in merito all'uso dei dispositivi digitali che pensate siano inutili o eccessivamente restrittive?

3. Ci sono regole in merito all'uso dei dispositivi digitali che pensate debbano essere aggiunte o modificate?

4. Avete mai ricevuto una "punizione" per aver violato queste regole?

    - **Follow-up question:** In caso positivo, come ti sei sentito/a circa la punizione?

5. Pensate che queste regole sull'uso dei dispositivi tecnologici aiutino a promuovere la salute digitale? Perché o perché no?

A.4 Perceptions of Digital Wellbeing Questions

1. Per iniziare, potete darmi una vostra definizione di cosa sia il benessere digitale?

2. Ora, come pensate che le vostre abitudini tecnologiche attuali influiscano sul vostro benessere digitale?

3. Siete a conoscenza di strategie per promuovere il benessere digitale? Se sì, ne avete provate alcune? Se no, sareste interessati ad utilizzarne? (Questa domanda si riferisce principalmente a strumenti digitali, come le app, per il benessere digitale, e.g. Forest)

4. Quali ostacoli o sfide avete incontrato nel tentativo di migliorare le vostre abitudini tecnologiche?

5. Ci sono alcuni aspetti del vostro utilizzo dei dispositivi digitali che vorreste cambiare per migliorare la vostra concentrazione, le relazioni sociali e il benessere generale?

A.5 Learning Preferences Questions

1. Preferite imparare attraverso strumenti visivi come video e immagini o attraverso la lettura e la scrittura?

    - **Follow-up question:** Potete fornire qualche esempio pratico/concreto?
    - **Follow-up question:** Imparate meglio attraverso attività pratiche o ascoltando le lezioni?

2. Preferite lavorare in modo indipendente o in gruppo?

3. Quanto è importante per voi avere una struttura e routine chiare quando si tratta di imparare ad avere delle abitudini digitali più sane?

4. Quanto è importante per voi ricevere regolari feedback e valutazioni durante l'apprendimento di un certo argomento?

5. Trovereste utile avere accesso a risorse e supporto online?

6. Ci sono specifiche strategie o tecniche di apprendimento che pensate possano essere efficaci o utili in questo contesto?

Appendix B

Teachers Interview Questions

The following questions, as well as the general interview script, are written in Italian because the participants of the interviews were Italian teachers. The choice of using Italian aims to make them comfortable enough to express themselves fully and effectively.

B.1 Demographic Questions

1. Quanti anni hai?
2. Qual è la tua identità di genere?
3. Quali materie insegnate?

B.2 Teaching Practices Questions

1. Quanto spesso usate la tecnologia nelle vostre lezioni? Ci potresti fornire qualche esempio pratico?
2. Avete notato un cambiamento nell'utilizzo della tecnologia nelle lezioni degli ultimi anni? In che modo?
3. Come descriveresti il tuo rapporto con la tecnologia?
    - **Follow-up question:** Secondo te, i giovani come dovrebbero gestire i dispositivi tecnologici nella loro vita quotidiana?

4. Eri a conoscenza del concetto di benessere digitale prima di questa conversazione? In caso affermativo, quale era la tua comprensione dell'argomento?

5. In base alla tua comprensione attuale, quali sono gli aspetti chiave del benessere digitale che gli studenti dovrebbero imparare?

6. Secondo te, quali sono gli ostacoli o le barriere più significative per l'implementazione dell'educazione al benessere digitale nelle scuole?

7. Quali risorse, supporto o formazione pensi sarebbero più utili per te come insegnante per insegnare efficacemente il benessere digitale?

8. Come pensi che l'educazione al benessere digitale potrebbe essere integrata nel curriculum più ampio, attraverso diverse materie o livelli scolastici?

9. Ci sono argomenti o aree specifiche correlate al benessere digitale che ti interesserebbe particolarmente approfondire o incorporare nella tua pratica di insegnamento?

10. Hai notato preoccupazioni o problemi tra i tuoi studenti che potrebbero essere legati alle loro abitudini digitali o al loro benessere? Se sì, cosa hai osservato?

11. Secondo la tua esperienza, come reagiscono gli studenti alle regole o alle linee guida che stabilisci riguardo all'uso dei dispositivi digitali durante il tempo di classe?

12. Hai incontrato sfide o conflitti con gli studenti riguardo al loro uso dei dispositivi digitali in classe?

    - **Follow up question:** In caso affermativo, come hai gestito queste situazioni?

13. Pensi che i tuoi studenti siano aperti a ricevere indicazioni o consigli da te riguardo alle loro abitudini digitali e al loro benessere?

14. Hai osservato impatti positivi o negativi dell'uso dei dispositivi digitali sul rendimento accademico, la concentrazione o il comportamento degli studenti in classe?

15. Hai adottato strategie di gamification nei tuoi metodi di insegnamento?

    - **Follow up question:** In caso affermativo, come hanno reagito gli studenti?

Appendix C

Usability Test Script

INTRODUZIONE

Benvenuto/a al test di usabilità di HabitHero, un'applicazione usata per l'apprendimento del benessere digitale. Oggi avrai l'opportunità di interagire con un prototipo dell'app e il tuo feedback sarà essenziale per aiutarci a migliorare. Ricorda, stiamo testando la nostra app, non te! Per assicurarci di catturare ogni dettaglio, registreremo la sessione. In vari momenti, ti chiederemo di condividere le tue impressioni. Ogni tuo pensiero contribuirà a migliorare l'esperienza utente di HabitHero.

I dati raccolti, trattati con la massima confidenzialità, saranno utilizzati solo per affinare il nostro prototipo e per fini di ricerca accademica.

TASKS

Procederemo attraverso diverse attività. Per ognuna, ti illustrerò la metodologia e lo scenario specifico. Dopo ogni attività, dovrai compilare un breve questionario per raccogliere le tue impressioni. Una volta completate tutte le attività, ci sará un questionario finale più dettagliato.

Task 1 – Completa il Quiz Iniziale
Avviando la prima attività, ti chiederemo di adottare un approccio particolare chiamato "pensa ad alta voce". Questo significa che desideriamo che tu esprima a voce alta le tue osservazioni, azioni, esitazioni e reazioni mentre navighi nell'app. E' importante perché ci aiuta a comprendere come gli utenti interagiscono con HabitHero in tempo reale.

Scenario
Il tuo insegnante ha appena introdotto un nuovo modulo didattico sul benessere

digitale e vi ha chiesto di completare un quiz prima della prima lezione.

Ecco cosa dovrai fare:

1. Individua il pulsante del quiz.
2. Leggi le istruzioni
3. Completa il quiz e invia le risposte

Iniziamo quando sei pronto.

Task 2 – Completa l'Attività di Riflessione

Scenario
Immaginati di aver giá fatto la lezione con il tuo professore dopo il quiz. Ora dovrai riflettere con domande guidate su alcuni temi circa il benessere digitale.

Ecco cosa dovrai fare:

1. Trova il pulsante della riflessione.
2. Prenditi un momento per leggere e riflettere sulle domande proposte.
3. Una volta completate le tue riflessioni, inviale.

Iniziamo quando sei pronto.

Task 3 – Interagisci con il Bingo del Benessere Digitale

Scenario
É il momento di iniziare la sfida della settimana: se completi una o piú abitudini tra quelle elencate nella sfida, aggiungi una nota per descrivere la tua esperienza.

Un riassunto di quello che dovrai fare:

1. Inizia rispondendo ad un breve sondaggio.
2. Esplora l'interfaccia del Bingo.
3. Immaginando di aver completato una delle abitudini elencate, descrivi la tua esperienza e salva il tuo progresso.
4. Completa il sondaggio post-sfida.

Iniziamo quando sei pronto.

Task 4 – Completa l'Attività Riassuntiva

Scenario
Siamo arrivati alla fine della sfida. Completa l'attivitá di sintesi per mettere insieme gli spunti accumulati durante la settimana. Le risposte serviranno a contribuire alla lezione conclusiva.

Ecco cosa dovrai fare:

1. Trova l'attivitá di sintesi.
2. Rispondi alle domande e salva le risposte.

Iniziamo quando sei pronto.

Task 5 – Interagisci con il gioco basato su scenari

Scenario
Quest'attivitá consiste in un gioco interattivo basato su scenari, in cui sarai tu a modellare e scegliere come continua la storia. Sará un'opportunitá per vedere come le tue scelte quotidiane influenzano la narrativa del gioco.

Ecco cosa dovrai fare:

1. Leggi l'introduzione per capire l'ambiente della storia.
2. Naviga attraverso gli scenari proposti. Ogni decisione può portarti su un sentiero diverso.
3. Quando senti che la tua avventura sta per concludersi, e hai raggiunto una storia che ti soddisfa, conferma e invia le tue scelte finali. Puoi modificare le tue scelte se non sei soddisfatto.

Iniziamo quando sei pronto.

Task 6 – Partecipa alla Sfida "The Great Data Hunt"

Scenario
L'ultima attivitá del percorso é una sfida in cui riceverai ogni giorno un report sull'uso del tuo cellulare. Dopo aver visionato il report, potrai riflettere sui dati appena visionati attraverso domande guidate.

Le fasi di questo compito includono:

1. Configurare le preferenze
2. Concedere i permessi necessari all'app per accedere ai dati di utilizzo
3. Esplorare il report
4. Riflettere e completare l'analisi del report

Iniziamo quando sei pronto.

Task 7 – Esplora i contenuti sulla Schermata "Esplora"

Scenario
Nell'ultima attivitá la schermata principale sará "Esplora", dove potrai trovare diversi contenuti che trattano del benessere digitale.

Ecco cosa dovrai fare:

1. Navigare alla schermata "Esplora"
2. Scegli un contenuto che t'interessa

Iniziamo quando sei pronto.

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