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## Executive Summary

The deliverable outlines the comprehensive development of use cases and technical specifications essential for the implementation of SMILE components across varied platforms. The core methodology employed revolves around participatory research, ensuring stakeholder engagement from the initial stages. Key activities included extensive literature reviews, stakeholder mapping, and focus groups to gather critical user requirements and feedback that influenced the technical specifications of the project.

Technical specifications cover various components such as the SMILE Serious Game, Awareness App, Self-assessment and Monitoring Framework, Decision Support System, Middleware API, and more. Each component's description includes its design, functionalities, user stories it addresses, and its integration into the overall SMILE ecosystem.

User requirements and user stories were derived from focused interactions with different demographic groups, identified through participatory workshops. These requirements were meticulously prioritized and translated into technical specifications that align with the objectives of the project. Use cases are detailed with personas representing different user groups, providing a narrative that ensures the solutions developed are user-centric and grounded in real-world applicability. This deliverable encapsulates the strategic approach of the SMILE project towards developing a scalable and effective solution for mental health challenges faced by young individuals.

The deliverable setups up the technical and the non-technical framework for the implementation of the project on various aspects such as who are the users, how they interact with the platform as well as the technical components of the platform and how they are defined to fulfill the requirements laid out by various user architypes. This will act as a starting point the development of the technical components. In the upcoming deliverables in WP2, 4, 5 and 6, will follow up on each of the aspects discussed in this deliverable.

## Abbreviations

Abbreviation	Full form
<b>CBT</b>	Cognitive Behaviour therapy
<b>SAMF</b>	Self-assessment and monitoring framework
<b>GDD</b>	Game design document
<b>UR</b>	User Requirements
<b>FAQ</b>	Frequently asked questions
<b>STEM</b>	Science, technology, engineering and mathematics
<b>PHQ</b>	Patient Health Questionnaire
<b>NPC</b>	Non-playable character
<b>CISA</b>	Cybersecurity and infrastructure security agency
<b>SBOM</b>	Software bill of materials
<b>GDPR</b>	General data protection regulation
<b>FHIR</b>	Fast Healthcare Interoperability Resources
<b>ESM</b>	Experience Sampling Method
<b>GAD-7</b>	General Anxiety Disorder-7
<b>DSS</b>	Decision support system
<b>NLP</b>	Natural Language processing
<b>ASR</b>	Automatic Speech recognition
<b>UI</b>	User interface
<b>TBD</b>	To be discussed
<b>UM</b>	University of Maribor
<b>OKP</b>	Open Knowledge platform

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# 1. Introduction

Deliverable D2.2 'Use cases and technical specifications' provides the use cases, scenarios, design, metrics and technical specifications of the SMILE project.

The section 2 of the deliverable provides an overview of the methodology used for conducting participatory research and the steps followed for it. Furthermore, the methodology about the game development is discussed in this section.

The section 3 of the deliverable includes the work done in literature review and the current state of affairs.

Section 4 mentions the user requirements gathered in the workshops as well as the user stories created by the project partners for the successful implementation of the SMILE components and the platform as a whole.

Section 5 builds upon the work done in Section 4 to showcase the technical specifications of the various technical components of the SMILE platform as a whole. The description, requirements, the logical design, the functionalities and the stories a component addresses are mentioned in this section.

The final section of the deliverable includes the various use cases of the project and the personas of the users as gathered during the workshops.

The deliverable provides a good overview on all the various use case related aspects of the project and how the technical development addresses the user stories and requirements calculated from the use cases.



## 2. Methodology

### 2.1. Participatory methodologies

In order to reach the use cases, scenarios, design metrics and the technical specification, the SMILE project followed participatory methodologies and research actions.

Participatory design it's a research based on participatory action where the individuals who are immediately affected by the condition in question [1] [2], are involved in the development of the concepts and tangible products. This methodology involves the participant as an active researcher and agent of change, instead of a mere subject of research [2]. The involved parties guarantee that the participants are taken into account and tacit knowledge is followed. One of the best benefits is that conclusions and developments extracted from this collaborative work are taken as something positive and accurate to reality.

The participatory methodology highlights co-research, co-design and co-creation. These methods comprehend iteration between researchers and users, working together towards concepts, workflows and products [3]

In SMILE project, participatory methodologies in the direction of social and health innovation. To work with and to the health systems promotes the capabilities of individuals and social groups [4]. Herein, public and patient involvement takes a crucial role. Research and practitioners work in collaboration to produce knowledge [1] to deliver a meaningful contribution to the mental health of young people.

In this framework, the interfaces of the technologies are of special importance, seeing that these will facilitate end-users, such as young person and healthcare professionals, in the improvement of their condition. For this reason, design thinking techniques assumed a great significance, and were used to guide this process on user requirements elicitation.

To achieve this, the Participatory Design methodology defines three main stages [5]:

1. Initial exploration

In this stage, the researchers learn how to work together.

2. Discovery processes

Application of techniques to explore problematics, goals, future works and prioritize information. This involves systematize, analyse and validate experiences with the users.

3. Prototyping

Developing the service or product, which includes consulting with users and refine according to feedback. In SMILE project, the T7.2 'Living Labs testing', will centralize this work.

As described in the following chapters, the consortium resorted to design thinking techniques and methods. Design thinking is widely used in healthcare system's products and services. The approach can be divided in three stages [4].

1. Inspiration

The stage where the SMILE team empathizes with the end-users, contemplating the problem. Herein, the relevant information in the context of young people was collected. This included concerns, problems faced, protection factors and game preferences, in the format of focus groups.

2. Ideation

This step concerns the concept generation and validation, where the user needs are translated to user requirements. Following the initial literature review and feedback provided in the focus groups, the inputs gathered were conceptualized and mock-ups and prototypes were created.

3. Implementation

The final stage includes the refinement of the product and services developed. This is foreseen to be implemented in later phases in the Project.

## 2.2 Steps followed.

In this chapter, the steps followed to reach the task objectives are described.

### Initial plan shared with key partners.

M6 marked the beginning of T2.4 'Case studies and scenarios requirements. For this initial plan (), the task leaders presented an initial plan that was followed, although with modifications to the timeline and sub-tasks, in order to adjust to the amendments under T2.1 and T2.2, the developments of the technologies and other timelines within other tasks. The diagram describes the process followed to reach the real-world scenarios that include the synthesis of problems, users' behaviour and system context. These expected outcomes are divided in three main points herein delivered: the unsatisfactory state-of affairs, the operation of the gamification system (that includes SMILE tools and not just the game), and the usage and behavioural scenarios. The first topic, unsatisfactory state-of-affairs, initially explored the stakeholders needs with a literature review, focus groups and surveys, conducted under T2.1 and T2.2. The initial outcomes of these tasks feed the SMILE's knowledge on the needs and relevant contexts and marked the *Personas* to be ideated. With the validated *Personas*, the gamification systems were optimized and refined to deliver an appropriate structure to fulfil the unmet needs. In a final stage, the knowledge produced was used to structure the use cases that comprehended how these systems will be applied in the real-world scenarios. Once completed, the proposal of the use cases will feed the technical work packages (WP4, 5, 6) and the clinical piloting work package (WP7).

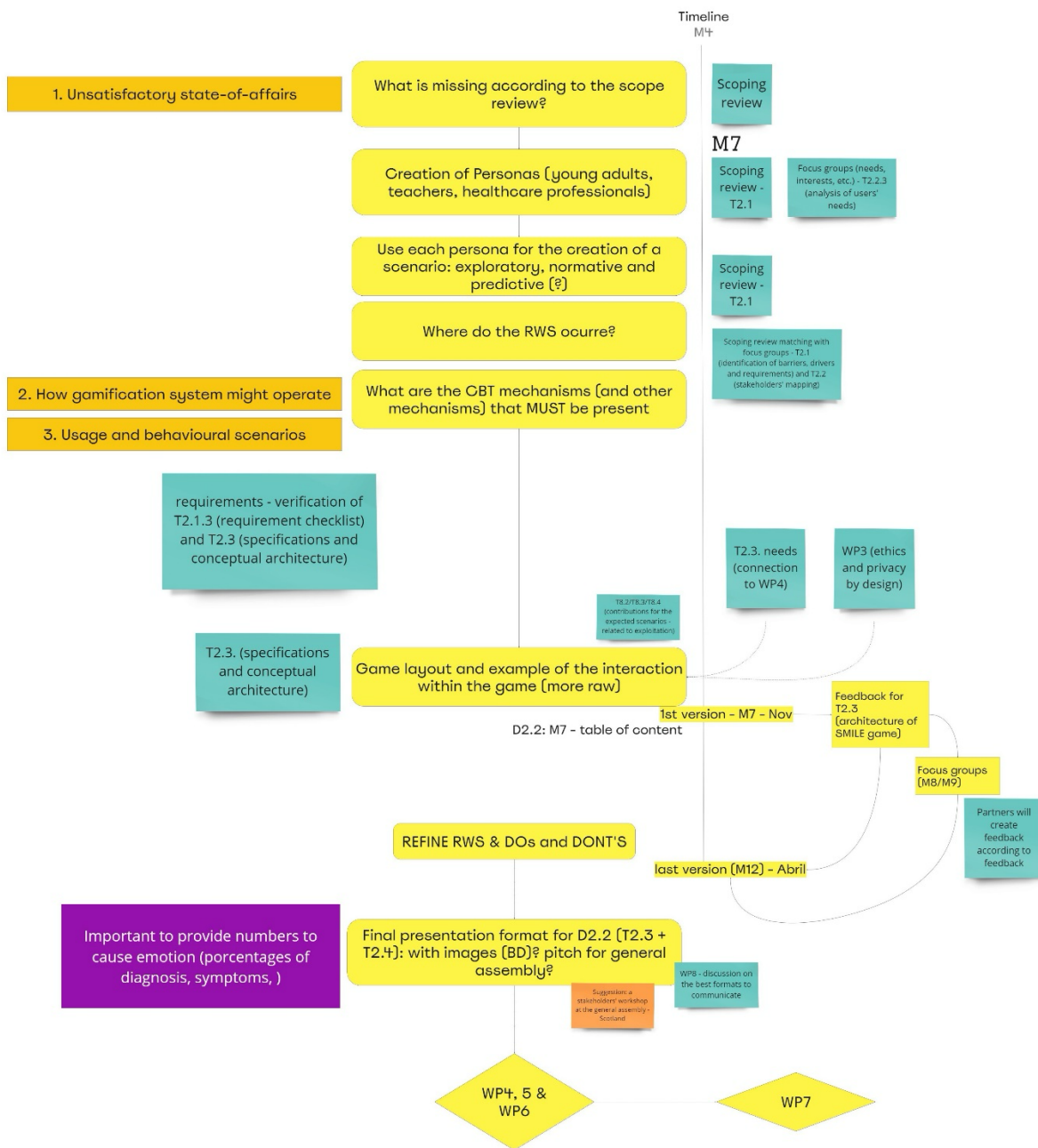


Figure 1 Initial plan for the completion of T2.4 objectives.

## The literature review under T2.1 and T2.2

Task 2.1 'Identification of Barriers, Drivers and Requirements' and T2.2 'Stakeholders Analysis and Mapping' conducted a scoping review following a list of research questions that served as basis of the SMILE knowledge. The research questions established were the following:

- What are applicable digital biomarkers of anxiety disorders/psychological distress [Which observable cues offer a valid insight into individuals' anxiety?]
- How to assess/monitor anxiety disorders/psychological distress using technology [How to objectively measure meaningful cues of anxiety?]
- What serious games or digital interventions have caused harm and why?
- Identify the supportive or detrimental role of interacting with peers and the social network of adolescents, including their communication technology, and related needs and challenges affecting their mental resilience.
- Identify the supportive or detrimental role of interacting with peers and the social network of adolescents, including their communication technology, and related needs and challenges affecting their mental resilience.
- Identify the strongest evidenced CBT and eCBT tools for adolescent mental health?
- Adolescents and digital health: What are facilitators & barriers in using serious games for adolescents (to prevent dropout and increase engagement)?
- Which individuals and groups are likely to be affected by the research findings in the field e-mental health?
- Who, although not directly affected, may be interested in the results of the research?
- What strategies have been used to foster stakeholder participation/engagement in e-mental health project?
- Identify barriers and facilitators to stakeholders' engagement in mental health projects.
- What are the most engaging games?
- What are the best methods of communication with stakeholders accordingly with their relevance?

From these questions, the consortium was able to extract **user requirements** that contributed to the technical developments and to the pilot setting. The requirements included were mainly extracted from the research questions “What are the most engaging games?” and “Adolescents and digital health: What are facilitators & barriers in using serious games for adolescents (to prevent dropout and increase engagement)?”.

The **master list** of the user requirements is shown in Section 4.

The results also contributed to define the six main groups of external stakeholders: youngers from 10 to 14 years-old; youngers from 15 to 18 years old; youngers from 19 to 24 years old; clinicians; teachers; and parents. With these main groups, six Personas were defined.

### Preparation of the first focus group

The literature review allowed us to better identify the gaps within the mental health of youngers and further delineate the questions to a deeper understanding of the external stakeholders' perspectives. This was delivered with a qualitative methodology: focus group.

The script for this activity was developed under the clinical workshops' sessions. A common main script was created in English, following the translation and modifications according to the pilot site language.

The following table (country Table) reports on the countries and respective stakeholders' groups that were conducted.

*Table 1 Participation in the focus groups by country*

	Younger group 1	Younger group 2	Younger group 3	Clinicians	Teachers	Parents
<b>Cyprus</b>	10 (10-14)	7 (15-19)	8 (20-24)	7	7	5
<b>Germany</b>	9 (10-14)	5 (15-18)	6 (20-24)	4	6	5
<b>Italy</b>	6 (10-14)	5 (15-19)	5 (20-24)	0	8	5
<b>Poland</b>	9 (10-14)	10 (15-18)	6 (19-24)	3	3	4
<b>Slovenia</b>	7 (10-12)	7 (15-18)	4 (19-24)	8	6	5
<b>Spain</b>	8 (10-14)	6 (15-18)	6 (19-24)	4	6	5
<b>UK</b>	0	6 (16-18)	5 (19-24)	0	0	0
<b>Total</b>	<b>49</b>	<b>46</b>	<b>40</b>	<b>26</b>	<b>36</b>	<b>29</b>

#### Focus group analysis.

To organize and harmonize the focus groups results in user requirements for the Personas and technical requirements, two templates were provided: one for the younger groups inputs and another for the adults groups.

The templates served as a guideline, being subject of small modifications to adjust to the adaptations carried out by each country. The tables were fulfilled with sentences that summarized the stakeholders' inputs.

*Table 2 Focus Groups analysis for Personas and requirements elicitation - youngers*

Worries							
Recent worries	General topics - worries	Importance attributed	Influence of worries in daily life	Perception of worries (individual or group)	Channels of communication	Locus of control	Internal locus of control
<ul style="list-style-type: none"> <li>When you think about your last week, what was good about it? Why?</li> </ul>	<ul style="list-style-type: none"> <li>Tell us the three most important issues that were relevant for you over the last year</li> <li>What would someone your age feels worried or concerned about?</li> </ul>	<ul style="list-style-type: none"> <li>Why were these important to you?</li> </ul>	<ul style="list-style-type: none"> <li>Do you find that you are so preoccupied with these issues that everything else suddenly becomes unimportant?</li> </ul>	<ul style="list-style-type: none"> <li>What do you think might be important for other people your age but maybe not for you so much?</li> </ul>	<ul style="list-style-type: none"> <li>Where do you usually get most of the knowledge about what is happening in the world? How? Do you speak to someone else?</li> <li>How do your friends/peers communicate these things?</li> </ul>	<ul style="list-style-type: none"> <li>What kinds of things would make people more or less likely to become worried about every day issues do you think?</li> <li>Do you think you can have influence on these topics?</li> </ul>	<ul style="list-style-type: none"> <li>How much influence over these issues do you think that you and people your age have?</li> </ul>

Strategies		Help-seeking		Perceived barriers of the system		Sources of happiness	
Strategies used	Efficiency and usefulness	Perception of help-seeking in adults	Profiles for help-seeking	Efficiency of the help requested	System's barriers	Sources of happiness - recent weeks	Sources of happiness - main strategies
<ul style="list-style-type: none"> <li>What do you think you or others your age would do to help to deal with any worries you have?</li> </ul>	<ul style="list-style-type: none"> <li>What do you find really useful?</li> </ul>	<ul style="list-style-type: none"> <li>Do you think you could ask an adult for help?</li> </ul>	<ul style="list-style-type: none"> <li>Who would you generally talk to about problems and is this the same for other people your age does you think?</li> </ul>	<ul style="list-style-type: none"> <li>Do they help you and do you feel they always know how to do it?</li> </ul>	<ul style="list-style-type: none"> <li>What kinds of things might stop people from getting help if they need it?</li> <li>Mental health/ general concerns/ issues identified</li> <li>What kinds of help are you aware of for feeling worried or not feeling positive about things?</li> </ul>	<ul style="list-style-type: none"> <li>When you think about your last week, what was good about it? Why?</li> </ul>	<ul style="list-style-type: none"> <li>What would someone your age feels hopeful or good about?</li> </ul>

Games								
Games engagement	Preferences for games UI	Games played	Game as a strategy	Game features - positive	Game features - negative	Individual or multiplayer	Monitoring health apps known & feedback	Desired features
<ul style="list-style-type: none"> <li>Do you like to play on your mobile or on your computer or console?</li> </ul>	<ul style="list-style-type: none"> <li>What devices do you play games on (i.e. phone, tablet, laptop, console?)</li> <li>What do you prefer playing on?</li> </ul>	<ul style="list-style-type: none"> <li>Can you think of any games in particular that you enjoy?</li> <li>What games do your friends or colleagues usually play?</li> </ul>	<ul style="list-style-type: none"> <li>Does play games ever help you to feel better when you have any worries?</li> </ul>	<ul style="list-style-type: none"> <li>If so, what aspects do you most like?</li> </ul>	<ul style="list-style-type: none"> <li>Are there any aspects that you don't enjoy when playing games?</li> <li>If so, what would you change about this?</li> </ul>	<ul style="list-style-type: none"> <li>Do you prefer playing games on your own or with friends?</li> <li>Why?</li> </ul>	<ul style="list-style-type: none"> <li>Have you been aware of games that are used to help to improve wellbeing in young people?</li> <li>Have you used any?</li> <li>Have you found them beneficial?</li> <li>If so which aspects?</li> </ul>	<ul style="list-style-type: none"> <li>What features would you like to see in a new digital wellness game?</li> </ul>

Table 3 Focus Groups analysis for Personas and requirements elicitation - adults

Worries							
General topics - worries	Importance attributed	Verbalization of worries	Efficiency of strategies used	Channels of communication	Insight of this worries	Differences - gender and age	Threats (adults' perception)
<ul style="list-style-type: none"> <li>What do you think are the pressing issues that are on young people's minds today?</li> <li>What do they feel worried or concerned about?</li> </ul>	<ul style="list-style-type: none"> <li>Why are they important to them?</li> </ul>	<ul style="list-style-type: none"> <li>Do you have the impression that they talk about them with other people?</li> </ul>	<ul style="list-style-type: none"> <li>Do you have the impression that your patients/young person: do they feel they can cope with them?</li> </ul>	<ul style="list-style-type: none"> <li>How do young people talk about these issues, what channels of communication do they use (social networks, do they talk about them with others) with whom?</li> </ul>	<ul style="list-style-type: none"> <li>Do you have the impression that your patients: are they aware of these concerns?</li> </ul>	<ul style="list-style-type: none"> <li>What factors do you think make them more or less likely to become worried about everyday issues?</li> </ul>	<ul style="list-style-type: none"> <li>What do you think are currently the biggest threats to young people's mental health?</li> </ul>

Strategies			Help-seeking						
Strategies used	Efficiency and usefulness	Differences	Perception of help-seeking in adults	Profiles for help-seeking	Triggers for help-seeking	Healthcare system for help-seeking	Educational system for help-seeking	Family system for help-seeking	Differences
<ul style="list-style-type: none"> <li>• How do young people deal with any worries they have?</li> <li>• What tends to help?</li> </ul>	<ul style="list-style-type: none"> <li>• Are these strategies always appropriate/constructive?</li> <li>• Do you find this approach useful?</li> </ul>	<ul style="list-style-type: none"> <li>• Are there differences or particularities between certain age or gender groups?</li> </ul>	<ul style="list-style-type: none"> <li>• What do you think is missing in terms of mental health support for young people?</li> </ul>	<ul style="list-style-type: none"> <li>• Who do your patients/pupils/young person usually talk to first when they face these concerns or difficulties?</li> <li>• What kind of help do you think young patients seek when they experience emotional difficulties?</li> </ul>	<ul style="list-style-type: none"> <li>• What issues often trigger them to seek help?</li> </ul>	<ul style="list-style-type: none"> <li>• Do you think that the support of the medical staff is sufficient?</li> </ul>	<ul style="list-style-type: none"> <li>• Do you think the support from schools/colleges is sufficient to manage the difficulties described above?"</li> </ul>	<ul style="list-style-type: none"> <li>• Do you think the support from families is sufficient to manage the difficulties described above?</li> <li>• If your children talk to you, do you always know how to help them with these concerns?</li> <li>o in which areas do you think parents don't know how to help or don't have the answers?</li> </ul>	<ul style="list-style-type: none"> <li>• Are there differences or particularities between certain age or gender groups?</li> </ul>

Perceived barriers of the system			Protective factors	
Efficiency of the help requested	System's barriers	Differences	Protective factors	Differences



<ul style="list-style-type: none"> <li>Describe the ways to access help, which ones are easily accessible, which ones are very difficult?</li> </ul>	<ul style="list-style-type: none"> <li>What kinds of things might stop people from getting help if they need it?</li> <li>Mental health/ general concerns/ issues identified</li> </ul>	<ul style="list-style-type: none"> <li>Are there differences or particularities between certain age or gender groups?</li> </ul>	<ul style="list-style-type: none"> <li>What would young people feel hopeful or good about?</li> </ul>	<ul style="list-style-type: none"> <li>Of these protective factors, are there differences or particularities between certain age or gender groups?</li> </ul>
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Games									
Presence of games in youngers life	Game influences on daily life	Games played	Preferences for mental well-being games UI	Monitoring health apps known & feedback	Game features - positive	Game features - negative	Expectation	Differences	Setting for pilot
<ul style="list-style-type: none"> <li>Are mobile/computer/console games a problem in your clinical practice?</li> <li>Are mobile/computer/console games an issue at school/university?</li> <li>Are mobile or computer/console games a problem in your family?</li> </ul>	<ul style="list-style-type: none"> <li>What influence do these games have on the daily life of patients/students/young person?</li> <li>What is your opinion of games?</li> </ul>	<ul style="list-style-type: none"> <li>Which mobile/computer/console games do your students use?</li> <li>What mobile/computer/console games do your young person use?</li> </ul>	<ul style="list-style-type: none"> <li>What mobile or computer games do your patients/students/young person use?</li> </ul>	<ul style="list-style-type: none"> <li>Do you know of any games or programmes that are used to improve the well-being of young people?</li> </ul>	<ul style="list-style-type: none"> <li>What functions/features do you value most? Why?</li> <li>What features should a game have in order to be accepted by parents?</li> </ul>		<ul style="list-style-type: none"> <li>Do you think a game could be developed that would benefit young person's mental health?</li> </ul>	<ul style="list-style-type: none"> <li>Are there any special characteristics with regard to certain age groups or gender?</li> </ul>	<ul style="list-style-type: none"> <li>The future SMILE game, should be applied... School or at home?</li> </ul>

### Participatory activities definition

As a result of the requirement elicitation in the beginning of 2024, there was an expressed need to conduct workshops with younger people in order to:

- Persona's validation and refinement
- Get feedback on the game scenarios and storyline.
- Development of data capture mechanisms
- Visualization of results (SAMF)
- Development of risk assessment models
- Development of medical device assessment framework
- Get feedback on the app initial features.
- Improve the initial UX/UI design.

In respect to adults' profiles, new activities were foreseen in the future, however, not a priority to the consortium.

The workshop's script can be found in **Annex A: Main script – Workshop – Young (10-24 years) – April/May 24.**

### Prioritization of the user requirements

Parallel to the workshop script definition, with the first version of the user requirements' master list, that comprehends the literature review and first focus group with external stakeholders, the SMILE consortium proceeded to the prioritization of the user requirements. For this, the face-to-face General Assembly held an opportunity to gather the representatives of the entities to discuss the priority and risk of each user requirement. In this sense, a workshop was organized where it was possible to wage the expectations between clinical expertise and the developing expertise and resources. This activity enabled the consortium to open the space for dialogue and agreement on the needs and perceptions of the external stakeholders.

The final user requirements' table is shown in Section 4.

### Prioritization of the requirements

The final table (see Section 4) is currently with the entities that are responsible for the developments in the SMILE project to enable the clustering, categorization, and translation to technical requirements.

### Development of internal user stories

The initial user stories were created by the internal clinical partners based on the feedback from initial workshops and the needs of the project to properly conduct the clinical studies. The list of the user stories is included in the Section 4.2 of this deliverable. The collection used a basic structure of identifying a need of a particular set of users and the component in SMILE that can address the need.

## 2.3 Methodology for game development

The methodology of game development includes 4 major steps.

1. Stakeholder engagement for scenario designs and requirements
2. Game design and documentation.
3. Technical Development
4. Testing and Quality assurance

Following these steps help in the definition of the serious game for SMILE. The steps are elaborated more in Deliverables of WP4.

### Stakeholder engagement

Stakeholder engagement is an essential component of any serious game, particularly in the development of interactive games like "SMILE Serious Game," where the product's success is determined not only by its technical prowess but also by its impact on users' well-being. Engaging stakeholders such as mental health professionals, users (in this case, young people), parents, educators, and technical staff ensures a multidimensional perspective that enriches the game's development at every stage. Mental health professionals provide clinical insight, validating that the game's content is ethically sound. Their expertise ensures the game's scenarios are designed to effectively incorporate Cognitive Behavioural Therapy (CBT) principles, which are fundamental for aiding players in managing mental health issues like anxiety and depression.

User involvement, especially from the young audience, is crucial as it grounds the game's design in real-world preferences and usability, ensuring the game resonates with its intended demographic. It fosters a sense of ownership and relevance among users, increasing engagement and the likelihood of positive outcomes. The workshops being done by the partners will be crucial in this context. Furthermore, parental and educational stakeholder input ensures that the game is supportive of the environments in which young people will play it, facilitating a supportive ecosystem around the player.

Clinicians will be integral throughout the development process. They will participate in regular meetings to review progress, provide insights into psychological theory, and help design scenarios that are both engaging and provides input needed for analysis. This involvement ensures that the game mechanics and content are scientifically sound and that they effectively promote mental wellness without inadvertently causing distress.

### Game design and documentation.

Game design and documentation are the backbone of any successful gaming project. This meticulous process serves as a roadmap, guiding the development team from the conception to the execution of the game. It acts as a comprehensive reference point that ensures all team members, from programmers to artists, share a unified vision of the game's objectives, mechanics, narrative, aesthetics, and user experience. For "SMILE Serious Game," which aims to provide interventions, the game design document (GDD) must articulate how Cognitive Behavioural Therapy (CBT) principles are woven into the game's fabric. It details the scenarios, characters, and interactions that will facilitate the desired outcomes, such as reducing anxiety or combating depression. For the SMILE serious game, it will also act as an overarching storyline which can connect all the scenarios developed by the clinical partners.

### Technical Development

Technical development is the crucible where game concepts are transformed into interactive experiences. It is an intricate dance of engineering and artistry, where programmers and developers bring to life the

vision outlined in the game design documents. For "SMILE Serious Game," technical development is not just about coding and building features; it's about constructing a digital environment that can positively influence the mental health of its users. The technical team must ensure that the game is intuitive, engaging, and accessible, all while embedding therapeutic principles into its core mechanics.

Robust technical development allows for the creation of a stable and seamless user experience, which is particularly critical in a game intended for users who might be dealing with anxiety or emotional distress. It needs to run smoothly across various devices, maintain user data securely, and handle potentially sensitive interactions with care. The Nuroengine built on top of Unity3D engine, in this context, offers powerful tools for creating complex scenes and characters that can respond to the player's input in meaningful ways—essential for a game where player choices have therapeutic implications.

Moreover, technical development is also about future-proofing the game. It involves setting up a flexible architecture that can adapt and grow, allowing for the incorporation of new scenarios, research findings or techniques without overhauling the entire system. This agility ensures the game remains relevant and effective over time. Effective technical development encapsulates not only the immediate need to create a functional game but also the foresight to anticipate and adapt to the evolving landscape of technology, therapy, and user needs.

### Testing and Quality Assurance

Testing and quality assurance are critical pillars in the development of any software application, and they take on an added layer of importance in the context of "SMILE Serious Game," where the stakes include the mental well-being of its users. This phase is the safeguard against potential issues that could disrupt the user experience or, worse, negate the intent of the game. Rigorous testing ensures that the game is not only bug-free and technically sound but also that the game mechanics effectively support the mental health outcomes it promises.

Quality assurance involves a cyclical process of testing, feedback, and refinement that examines every aspect of the game—from the accuracy of the CBT scenarios and the responsiveness of the gameplay to the security of user data and compliance with privacy regulations. It's a meticulous process that validates every line of code, every user interaction, and every outcome against the high standards set in the design phase. By employing both automated and manual testing strategies, quality assurance teams can identify any discrepancies between the game's intended function and its actual performance.

## 3. Current state of the art

### 3.1 Literature Review

The conclusions gathered in the literature review performed are described under D2.1 “Barriers, facilitators and stakeholders’ analysis”. The user requirement list from this activity is included herein section 4 and represented in the Personas section 6.

FOCUS GROUPS – Facilitators reporting on perceptions.

As a complement to the literature review, follows a soft analysis on the perceptions of the facilitators that were present in each external stakeholders’ group. The content is, consequently, included in the personas and use cases.

#### Focus group from Cyprus.

- ➔ Youngers 10-14: Worries about school performance/peer issues; Strategies: They seek support from peers and parents; Negative perception of the system: Fear of expressing themselves in a stranger (mental health professional); fears of being judged by others; fear of being bullied by peers if they express their concerns.
- ➔ Youngers 15-18: Worries about the development and maintenance of peer relationships; academic pressure; negative evaluation by peers; Strategies: cognitive reappraisal, seeking support from peers and adults; executive skills; compromise their needs to fit in the group; Negative perception of the system: Concerns that parents couldn’t understand the youth needs because of the age gap; suspicion about the competency of mental health professionals to support them (trust issues); invalidation by others; negative evaluation by others; lack of understanding by others, mostly adult figures; fear of burdening the family members by sharing their concerns/mental health issues.
- ➔ Youngers 19-24: Worries about the future; work stability; socio-political concerns: wars/femicides/sex education at schools; Strategies: positive self-talk; seeking instrumental and emotional support; listening music; cleaning the house; walk in nature/beach; Negative perception of the system: limited free mental health services provided by the state; financial burden in seeking mental health support; they “should” navigate the challenges by their own selves as independent individuals; Fear of being misunderstood and judged by others.
- ➔ Clinicians: Low self-esteem, the adolescence as a period characterized by many challenges; Strategies: Seeking support; distraction; engaging with online games; Negative perception of the system: Lack of mental health services in all districts; the support provided by school is not sufficient to aid youth in dealing with challenges; Financial burdens in receiving support; In the case of minors, parents could consent to receive mental health support; The fear of stigma.
- ➔ Parents: Peer pressure/sexual identity issues; body image issues; low self-esteem; Strategies: talk with parents; engaging in entertaining-creative activities/sports; Negative perception of the system: The mental health support provided by school is limited; Lack of mental health awareness in communities/society; Stigma of mental illness; Lack of a system that provides information about the mental health professionals/ their expertise etc. (struggling to find the appropriate therapist

given the needs and difficulties of youth); There is a lack of communication and collaboration between parents and psychologists at school.

- ➔ Teachers: Low quality of peer relationships; Tight timetables; Low engagement and motivation at school; Strategies: perseverance; love of learning; engaging in activities; express aggression to others; Negative perception of the system: low parental engagement; Low engagement and lack of collaboration between school psychologists and teachers; bureaucratic barriers at school; the provision of mental health services is disproportional of the youth population. Fear of stigma.

#### Focus group from Italy.

- ➔ Youngers 10-14: Very concerned about school, main coping strategy is distraction.
- ➔ Youngers 15-18: Very concerned about school and feeling like they have no time for anything outside of school. Main coping strategies are distraction and talking with others. There is a lack of trust towards some healthcare services.
- ➔ Youngers 19-24: Main concern is the future (what they'll do, their future job, how society is going). They highlight a lack of education in "getting help" as a cultural problem: fear of appearing weak or being judged for needing help. The main coping strategies mentioned are talking with significant others and experts, however one of the barriers to getting help is the fear of having to think more about the problem, so avoidance is also a prevalent strategy.
- ➔ Clinicians: Not carried out
- ➔ Parents: Communication with young person is a valid tool to help them for everyone except the parent with kids in 20-24 age, who mentions communicating with friends. The only mention of external help (e.g., healthcare professionals) happens if asked by the facilitator, otherwise they are confident they can help their young person by simply talking things through with them.
- ➔ Teachers: Cannot explain why kids seem to be so worried about school to the point they are constantly checking if there are updates on the online registry (where they upload homework instructions and grades so that kids and parents can see them). However, they don't seem to realize that the fact that they could actually assign new homework anytime during the day could be a source of anxiety for the young person, who end up having to check repeatedly if there are any updates during the afternoon when they are home. There is a tendency from some to blame parents' expectations entirely for young people's distress.

#### Focus group from Germany.

- ➔ Youngers 10-14: Sports and school are major topics for this age groups; they feel high performance pressure from parents, teachers, and themselves; from early on, the fear of not getting a good job in the future is an urging issue; conflicts with adults from their social environment and with peers/friends are important.; think less about the opinions of others (e.g. how you dress) is helpful as a strategy; free time and own money is valued.
- ➔ Youngers 15-18: High emotional load; preoccupation with personal development, creating self-acceptance though high pressure to perform; school in general is important to them, including concerns about whether you will graduate well, have a good career choice; worries of getting a driver's license; speaking with friends is a resource, listening to music, watching series or doing sports is appreciated.
- ➔ Youngers 19-24: Uncertainty in the choice of vocational training/study field, study planning, working on thesis has a big impact on the one hand, balancing studies with jobs and social contacts

is needed on the other hand; high uncertainty about future career choices; desire for finding new social contacts after moving to a new city; most helpful is distraction (e.g. Instagram), sports, or speaking to others.

- ➔ Clinicians: Main issues of young people are loneliness, insecurity with oneself, self-esteem, identity-seeking due to social comparisons and individualization processes (“where is my place in life?”); worries relate to climate change, gender identity (LGTPQAI+); they moreover observed a high pressure in young people related to performance, work-life-balance, procrastination and an over-use of smartphone/social media.
- ➔ Parents: They observe main topics of their young person are related to social relationships, friendship and honesty in all ages. Worry about global political situation (e.g. worries about the climate) preoccupies young adults more than young person/adolescents. All ages again, are concerned with high workload due to school/studies/exams, accompanied by having little time due to homework; media consumption is a major topic, as well as the process of disconnection from parents. Early adolescents feel anxious about mass shootings.
- ➔ Teachers: Young people are seeking recognition within their social environment, searching for a stable self-identity. They are driven by the fear of being alone on the one hand, but conflicts with their peers on the other hand; worry about grades is a major concern; absenteeism and fear of school are perceived to have increased, but it is unknown why.

#### Focus group from Poland.

- ➔ Youngers 10-14: Younger young person expressed the importance of social connections and leisure, valued understanding and flexibility from educators, and sought personal time for hobbies and relaxation. Older young person discussed the challenges and stresses of school life, including the impact of numerous tests and projects, alongside the relief and excitement brought by social events and extracurricular activities.
- ➔ Youngers 15-18: High school students discussed the enjoyment of social interactions and trips as highlights of their year, contrasted with the academic pressures and challenges faced from specific subjects and teacher interactions. Older youth discussed their social activities, academic challenges, and the value of strong friendships. They highlighted the importance of extracurricular engagement, such as sports and music, in enhancing school life and forming lasting bonds beyond the classroom.
- ➔ Youngers 19-24: University students reflected on significant recent events such as achievements in personal goals, social interactions, and educational milestones. They also discussed the importance of mental health awareness, the challenges of accessing therapeutic support, and various strategies for emotional and stress management.
- ➔ Clinicians: Clinicians’ focus was on incorporating practical insights from their experiences into the game, to ensure it addresses real-world issues effectively and ethically.
- ➔ Parents: Parents discussed their young person’s school-related stress, highlighting challenges like academic pressure and social relationships. They emphasize the lack of communication and support from schools and explore the need for external resources like psychological help to manage these issues effectively.
- ➔ Teachers: Teachers expressed concerns about the pressures of academic performance on students, emphasizing challenges like lack of support at home, excessive school duties, and social isolation. They discuss the increasing instances of mental health issues like anxiety and depression,

and the need for effective communication skills and support systems within the school environment.

Focus group from Spain.

- ➔ Youngers 10-14: Negative feelings, concerns; They reach to friends; Internal emotional regulation is more challenging.
- ➔ Youngers 15-18: Greater need to talk with respect to worries and negative feelings; Perception of no understanding from others and an additional worry to share these worries for the reaction of people. However, there is an evident need to connect (mentioned in games, in sources or happiness).
- ➔ Youngers 19-24: Internal emotional regulation is adequate; Good insight about the problems and the source of the negative feelings. Social media and the fact that they have access to so many peers, leads them to comparison. This comparison brings negative feelings.
- ➔ Clinicians: They detect a lot of self-harm cases. In case of doctors, they are the first line that detects physical consequences. Young people do not ask themselves if their acts are good or not (for themselves and others). Youngers, most of the times arrive too late to professional help, when the problem is more serious.
- ➔ Parents: Communication with young person is a valid tool to help them. They have an incorrect idea that they help their young person by receiving and solving their problems. It may exist a need to provide knowledge on how to teach young person about adequate coping mechanisms.
- ➔ Teachers: Detect the need to acquire knowledge about mental health to support younger people.

Focus group from Slovenia.

- ➔ Youngers 10-14: Worries about school and grades, unwillingness to talk about their issues with other persons in their lives, they spend a lot of time on social media and playing video games, this is also a stress relief.
- ➔ Youngers 15-18: They also reported experiencing anxiety regarding school, challenges in managing many responsibilities (family, school...), they talk to their friends for stress relief.
- ➔ Youngers 19-24: Issues with doom scrolling, reported experiencing stress at university, seek support in friends.
- ➔ Clinicians: They reported isolation as biggest challenge youth is facing, also the negative impact of social media and issues with avoidant, self-harming behaviour (in clinical population of young people).
- ➔ Parents: They report young person having most worries regarding school, managing different responsibilities (school, sports), they report their young person not talking to them and opening up.
- ➔ Teachers: Young person are facing challenges with school anxiety; they highlighted the importance of supporting young person and young person being able to talk about their problems.

Focus group from UK.

- Youngers 15-18: Youngers 19-24: Clinicians: Parents: Teachers:
- ➔ Youngers 10-14: Not carried out.



- ➔ Youngers 15-18: Key issues included isolation/loneliness, housing insecurity, issues at home/with family, poverty/money worries, and mental health problems. They described difficulties seeking help and uncertainty about the future.
- ➔ Youngers 19-24: Key issues included social pressure, harassment, money worries, loneliness/isolation, mental health and emotional problems. They talked about the need for more support including learning how to cope with emotions, social support.
- ➔ Clinicians: Not carried out.
- ➔ Parents: Not carried out.
- ➔ Teachers: Not carried out.

## 4. User requirements and stories

### 4.1. User requirements

From the process described of the user requirements elicitation, a list of 113 user requirements was extracted. Following is the list with the user requirements ID, description, mentions in literature review and further analysis by the internal stakeholders. This helps us understand the different needs of the users and which ones we should address with SMILE platform as a whole. The table also gives us an overview into creating the user stories that includes the user requirements as well as additional requirements needed in the context to fulfil the project goals.

Table 4 User requirements

SMILE tools	Requirement			Background (priorities according to literature review and focus groups)			Prioritization (0-N/A; 1-Low; 2-Medium; 3-High; 4-Mandatory by DoA)	Risk (1-Low; 2-Medium; 3-High)
	Requirement ID	Requirement title	Description	Literature review	Mentions in Focus groups	Number of eginari that mention the requirement	Internal stakeholders	
SMILE tools	UR_01	virtual reward	<p>(desired features): “to have ‘lives’ or stamina and it goes low if you do something or don’t eat etc.”</p> <p>(desired features): “to receive rewards (e.g. nice piece of clothing, a vehicle, game money)”</p> <p>(liked features in previous games): “receiving points, but these points need to make sense (e.g., exchanging them for rewards)”</p> <p>Units or other indicators (time or lives left) indicating progress</p> <p>Example: Points are earned daily for gratitude journal entries and for completing challenges on other islands. Points accumulate and user can save or spend them on customisation of the ‘home island’. Progress is visible through ‘leveling’ on each island and by being able to unlock the next available island (when it appears from out of the volcanic ash). Visual icons or game tokens signifying achievements.</p> <p>Example: Completing three levels of each island (‘minimum dose’) earns the player a badge in the form of a eginarional poster (whakatauki).</p>	High	4	3	4	2

			All badges are displayed on the user's dashboard. Unlock content based on achievement.					
	UR_02	Minimize text and lengthy videos	To reduce excessive text and lengthy videos in the game, ensuring a balance that maintains engagement and avoids overwhelming players with information, contributing to a more dynamic and immersive gaming experience. too much reading and writing content was also seen as a limitation of tech-assisted CBT.	High			3	3
	UR_03	Inclusivity: Pronoun inclusivity	To ensure the availability of pronoun choices within the game, allowing players to select and display their preferred pronouns, fostering a more inclusive and respectful gaming environment	High			3	1
	UR_04							
	UR_05	Offline mode	allows users to use the mental health app in the emergency or panic situations even when offline. Designers can catch and locally save use history and data during offline use and upload them once the user goes online.	Medium	2	2	1	3
	UR_06	Awareness and monitoring_Adapt some app features such as the font size, font colour, background, and layout to suit their preferences.	Adaptive functionalities that allow users to adapt some app features such as the font size, font colour, background, and layout to suit their preferences.	Medium			3	1
	UR_07							
	UR_08	Roleplay	Players enjoy roleplay aspects in previous evidence based DMHIs	Medium			3	2
	UR_09	Recap of learning	Final session in game should provide a recap of all skills learned throughout intervention/game	Medium			4	2
	UR_10	Configurable passive data	Location, Step count, Background noise levels, Ambient light, Battery level ,App usage on the phone	Medium			2	2
	UR_11	tools_learning	Games that shape knowledge and provide self-monitoring tools. "I think it's cool if you learn something new."	X	1	3	3	1

			"Games with surprising tasks and material/Learning new things." "I think it's cool if you learn something new." (liked features in previous games): "either I have to learn something from it, or it has to make me feel good"					
	UR_12	Price_free	That there is no premium option...that it is free of charge. (liked features in previous games): "free games" "Free", or "that it is under 5 Euros." "Shouldn't be too expensive."		5	3	4	1
	UR_13	Tools_advice	"Be able to ask questions and have advice for those questions" "Solutions of what we can do about problems" "Helpful advice and not positive phrases such as smile at life" "Give emotional education tips/tools" "write like a diary and have the AI system give you advice"		2	1	0	3
	UR_14	Contact professionals_anonymous	"Be anonymous if you ask for help"		1	1	0	0
	UR_15	Contact professionals_chat	"Can communicate with specialists" "Chat room, where they can communicate with specialists. For example, they can talk to a psychologist if they are very distressed. They want this professional to act as a friend. They would like to get useful advice from these professionals." "That there is a contact number for help (telephone number of hope...)"		3	1	0	3
	UR_16	Awareness_alert user with changes	"Have an alarm or alert you if something changes when it is monitoring you one day that advises you to be careful or seek help. Make you aware that something is happening (for example, if you haven't slept for several days)."		1	1	0	3
	UR_17	Tools_active listening	"That you are listened to and feel listened to"		1	1	0	3
	UR_18	Tools_goals definition	"Follow up on your goals and encourage you to achieve them (like a friend)."		1	1	2	3
	UR_19	Psychoeducation	"Tools for life: What has happened to you? What feeling has it generated in you? And to be able to analyse it"		1	1	4	1

	UR_20	Tools_diary	"Create your diary by writing"		1	1	2	1
	UR_21	Chat_peers_limited number	"That the number of people in the forum is limited."		1	1	1	1
	UR_22	Users_follow-up	"After 1 year ask the users what they would improve after 1 year."		1	1	0	1
	UR_23	Awareness content	"That there are awareness raising videos."		1	1	3	1
	UR_24	awareness_chat_peers	"(SMILE ROOM) Have a peer-to-peer forum like Telegram. To talk about concerns and give advice (in an app it's colder) and to be able to choose whether it's anonymous or personal. It would be good to veto some words to avoid harassment (cyberbullying). Another suggests that the word suicide should not be vetoed. There are other participants that there are sensitive topics like this that are better left out."	X	1	2	2	3
	UR_25	awareness_chat_peers_alias	"The forum would be easier if you enter the forum anonymously with an alias. There has to be a control"		1	1	2	1
	UR_26							
	UR_27	Timing exercise length	The pressure of having a busy schedule also made exercise length an important question. In general, shorter and easily accessible exercises were more appealing	X			3	2
	UR_28	Appropriate language	to ensure any information provided is accessible to young people	X			4	1
	UR_29	rewards_progress_social engagement	Sharing of progress and/or gameplay with social media contacts. Example: At this stage of the project, this feature is not available on account of cost and also to protect the anonymity of trial participants but feedback to date suggests that some would like to post their game's progress, compete against other or display on social media their collected badges or other achievements.	X			0	3
	UR_30	technical support	Provide technical support to address player inquiries, concerns, and technical issues promptly, ensuring a smooth and enjoyable gaming experience	X			3	2

	UR_31	parental involvement features	Features that facilitate parental involvement, offering tools and information to engage parents in the gaming experience of their young person, promoting a supportive and informed gaming environment.	X			1	2
Technical – general	UR_32	data_privacy_security	assure data privacy and security have guarantee on data protection, confidentiality “Explicit encryption on data stored on my mobile device and the data transmitted to a remote server”	High			4	3
	UR_33	User authentication		High			4	1
	UR_34	Remote removal of my personal data on a lost mobile device.		High			3	3
	UR_35	Regular password update		High			0	1
SERIOUS GAME	UR_36	game_challenges and quests	Games that contain challenges, goals and rules, rewards, and feedback. Games that are both educational and entertaining (Prensky, 2003). Stories or tasks that organise character roles, rewards and guide action. Example: Through onboarding and gameplay, a story of mythical islands and their guardians (kaitiaki) that hold knowledge of wellbeing is used to provide an overarching narrative and context for the game. (liked features in previous games): “nice to have specific missions” (liked features in previous games): “challenges and quests in games” (desired features): “to drive to a mission or a building across town – just to go from door to door in a building is too boring” (desired features): “to have an ‘inventory’ and to get a certain piece, you have a task to complete” “The game has an ultimate goal that the player is working toward”	High	4	3	4	3
	UR_37	game_connection and extrapolating to life	“To prepare you and put you in conflict with things that may come up in your life that you	High	3	3	3	2

			<p>don't have the tools and practice it through play (training) so that the day it really happens to you, you know how to act."</p> <p>(liked features in previous games): "live events"</p> <p>Players need to feel a connection between their daily task and the game, and thus the story of The Guardians (game valorated) is tailored to echo the goals and lessons of behavioural activation.</p> <p>"Story based on reality"</p> <p>If storylines are not engaging or relatable enough, this will affect engagement and attrition rate</p>					
	UR_38	game_customize	<p>use of personalized avatars, child-friendly narratives, and computer game-based designs, with some young people specifying these factors as relatable ("he [referring to character] was kind of going through some anxiety too"). A personalised and customisable representation of player.</p> <p>Example: Player is invited to customise their avatar upon onboarding and can update it throughout the game. The aesthetic of the avatar reflects the style of the game.</p> <p>(desired features): "Make it personalized"</p> <p>(liked features in previous games): "to be able to create your own character you can identify with"*</p> <p>(liked features in previous games): "Game 'skins' (Fortnite)"</p> <p>"Personalized games/ flexible games that allow youth to create avatars and roles (youth acquire a sense of agency in the game)"</p>	High	5	3	4	2
	UR_39	game_appropriate_difficulty	<p>To Integrate a flexible difficulty system that enables players to customize the challenge level according to their skill and comfort, fostering a more inclusive gaming environment by accommodating a broad spectrum of player expertise and preferences.</p> <p>"too difficult games or in-game challenges"</p> <p>"if a game is too easy (e.g. finish the entire game</p>	x	5	3	0	1



			in 20 mins) or too difficult (stuck on an impossible task)" "If I have to make an effort in the game, and it works, I am happy." "It should be a challenge, but it should definitely be done in such a way that it is feasible."					
	UR_40	game_storyline	Develop features that facilitate sustained interest in the narrative or ending, ensuring a captivating and immersive storytelling experience (desired features): "Good and interesting storyline" (desired features): "maybe something similar to the Inside out movie" worlds or something like that and a storyline"	Medium	5	2	3	3
	UR_41	game_emotion plot and characteristics	To infuse the game with emotional plot characteristics, aiming to evoke a range of feelings and responses from players, contributing to a more enriching and impactful gaming experience. "And sometimes I also need something to let out my anger. [...] [ for example, if someone who was mean to you briefly in the game and you can tease them back a little." (liked features in previous games): "that it is exciting"	X	2	2	3	2
	UR_42	game_multiplayer	Fellowship: Users are part of a community, engaging with other users/avatars (multiplayer games). "That you could play solo mode and multiplayer mode" (desired features): "including the option to connect and play with others (although it is important that you can also play alone if you want to)" (single/multiplayer): "preferable there are both options available" (desired features): "to have a multi-player mode, to play with friends" (single/multiplayer): "Preferences: with friends (or siblings/cousins)" Why: "playing alone can become boring", "it's more fun", "comparison with them", "we can talk during playing (about the game but also, perhaps even more, about	X	7	4	0	0

			other things)" (liked features in previous games): "playing the game together with friends (online, not together in-person)" "I like playing games with friends." "If I play with friends, it is something I enjoy." "what automatically makes a game better is when you can play it with friends and there is an online mode."					
	UR_43	game_type_adventure	Games that contain action and adventure.	X	1	1	2	2
	UR_44	game_graphics	Realistic and three-dimensional graphics/real movement/animation on the background/integration of music and sound. (desired features): "good graphics are very important (shading, texture)" (negative features of previous games): "Bad graphics (Minecraft)" High quality graphics and soundtrack "A game is more fun if it has a nice design." "For me, the design or graphics are extremely important."	X	6	4	3	2
	UR_45	game_scenario_Fantasy	Fantasy: Users engage in an imaginary world. (Schwarz et al., 2020) CBT-techniques translated well into interactive fantasy game environment in previous literature (liked features in previous games): "a fantasy game"	Medium	1		1	2
	UR_46	game_use of music	(desired features): "Fitting background music"	X	3	3	1	2
	UR_47	game_music_changing_effects	Integrating music listening patterns (desired features): "it would be nice if it included music that changes depending on what you are doing, especially sound effect (e.g., sounds of walking when you are walking)"	X	1	1	1	2
	UR_48	game_levels_progress	Exercises were also most beneficial when users clearly understood their purpose and saw their progress (liked features in previous games): "that you progress through the game" Milestones in the game indicating progress or	X	3	2	3	1

			providing. Example: Islands get revealed one by one as the user levels up. Guardians (kaitiaki) are revealed after 3 levels on each island. Each island is visually transformed after the kaitaki reveal to symbolise achievement, happiness and wellbeing. Increasing difficulty of activities. (liked features in previous games): "growth of the character"					
	UR_49	game_competitiveness_Leaderboards, ranks and status	Display of ranks for comparison or monikers indicating progress. Players can compete with each other "Competitive games" "I like games with competition, that you can play with friends."	X	3	3	2	2
	UR_50	game_world_customization	A focus on delivering a personalized user experience, incorporating features that adapt to individual player preferences, playstyles, and progression, ensuring a more tailored and enjoyable gaming journey. (liked features in previous games): To be able to play story-mode, and also free play. (desired features): "free roam mode next to story mode, to upgrade the city houses, make them pretty," (desired features): "to have some freedom of choice in the game" (liked features in previous games): "open world games (you can do anything you want)" (negative features in previous games): "only one option available where you are forced to do something. It feels like I can't decide on my own." Positive game features: "Open World"	X	4	2	2	2
	UR_51	game_simplify navigation	Intuitive and straightforward navigation within the game, prioritizing ease of use to enhance player enjoyment and reduce frustration associated with complicated or confusing interfaces. (desired features): "User friendly, easy, if there are too many options it can be overwhelming, especially at the beginning."	X	1	1	3	2

	UR_52	game_customize and other elements_minorities	Customization: adaptations for different minority groups, where character relatedness was a recurring subtheme discussed within young people's positive experiences. Elements: To incorporate culturally diverse elements, such as characters' appearances, to authentically represent a variety of cultures and backgrounds, enhancing the richness and inclusiveness of the gaming experience	Medium			2	
	UR_53	game_CBT principles	Game must be based on the core principles of Cognitive Behavioural Therapy (however it is not delivering CBT)	High			4	1
	UR_54	engaging gameplay	In-game challenges, mini-games, and guiding characters to create a dynamic and immersive gaming experience, encouraging player exploration and interaction.	High			3	1
	UR_55	game_relatable pets	For pets to be likeable they should be easily recognisable and based on concepts that players are familiar with, e.g., "it's a tree-turtle!", or "I want to level up the strawberry-hedgehog!".	Low			2	2
	UR_56	game_villain (or something related to) to fight	The evil Scorians were added after overwhelming feedback that players wanted some villain to fight, even in an otherwise peaceful game.	Low			2	2
	UR_57	game_include a progress bar in some exercises (to indicate elapsed/remaining time).	In activities that could be unfamiliar to the child, such as mindfulness, a progress bar (to indicate elapsed/remaining time) can be included to reduce uncertainty.	Low			2	2
	UR_58	game_inclusivity_genuine LGBTQ+ representation	To commit to genuine and positive representation of LGBTQ+ characters, storylines, and relationships within the game, contributing to a more inclusive and accepting virtual world.	X			3	2
	UR_59	game_avoid repetitiveness	Design the game to steer clear of repetitive elements, fostering variety and maintaining player interest throughout the gaming session for a more enjoyable and stimulating experience.	X			2	2
	UR_60	game_alleviate boredom	Implement features that mitigate potential boredom, introducing dynamic elements, diverse challenges, and engaging content to sustain player interest and enthusiasm throughout the gaming experience.	X			3	2
	UR_61	game_clear design	Emphasize clarity in design elements to facilitate a better understanding of game mechanics,	X			3	2

			objectives, and interactions, enhancing overall player comprehension and enjoyment.					
	UR_62	game_voice input	To include voice input functionality to enhance accessibility and user interaction, providing an alternative method for players to engage with the game and contributing to a more inclusive gaming environment.	X			1	3
	UR_63	game_retrospective	<p>“Something that changes your perspective, that brings you back to your actions.”</p> <p>“That it raises situations that maybe don’t happen to you now, but happened to you in the past and you can pass to the next level and realise that maybe you could have done it that way at the time and for the next time you will have the tools to know how to do it. In this sense there is a game Beyond two souls that with your answers you face different situations and if it goes wrong it gives you the opportunity to go back and change it.”</p> <p>(desired features): “Option to move back in the game (go back and repeat the previous level for example or to be able to go back and choose a different option and see how the game plays out in that case)”</p> <p>(desired features): “to be able to try over a mission or a task – to go back and make a better play. To be able to save the game at multiple points and then go back on these saves or to delete the last save.”</p> <p>“That you can develop your own playstyle and see how different actions have different consequences.”</p> <p>(desired features): “situations incorporated into the game, in which you can react to “some situations in different ways and monitor whether your reaction was good/bad”</p>		5	3	3	1
	UR_64	game_relaxing	<p>(relaxing game): “Learning games are not popular because young person already learn in school so when they come home, they want to relax.”</p> <p>(desired features): “Relaxing”</p>		4	3	3	1

			Positive game features: "For me, it's that I can switch off quite well." "It is just relaxing for me."					
	UR_65	game_scenario_real life vs fiction	(liked features in previous games): "going into a new world that is not your reality" (negative features in previous games): "too realistic, so you don't know if you watch a movie or play a game" (liked features in previous games): "animated games, not eginarily those that try to seem real, are preferred"	3	1	1	2	
	UR_66	game_activities	(desired features): "to be able to do the things you like in the game (e.g. downhill, skiing,)" (liked features in previous games): "Building (Minecraft)" "Levels should not all look the same, but you have to get ahead."	2	2	1	2	
	UR_67	game_creativity	(liked features in previous games): "the potential to think creatively (such as in escape games)" "Games are fun if I have to puzzle a bit or be creative."	2	1	2	2	
	UR_68	game_first person player	"That you are a "protagonist" (liked features in previous games): "to be able to create your own character you can identify with" (desired features): "That you identify with the character in the game (you feel like it is you in the game)"	3	1	3		
	UR_69	game_technical_improvements	(desired features): "that something changes every now and then (also to make fixes)" (liked features in previous games): "changes to the game (updates) from time to time are nice (but small changes to keep things interesting)" "There are no bugs, or the bugs are being fixed on an ongoing basis"	3	2	0	2	
	UR_70	game_language	(desired features): "to be able to change language of the game (to practice foreign languages) – and to be able to reverse it as well. Even if it is just subtitles, maybe even better." (desired features): "language not so important;	2	1	2	2	

			even though some would prefer to have it Slovene, the translations need to be prepared well in this case (without mistakes)”					
UR_71	game_free_of_violence_blood		(negative features in previous games): “too much violence” (negative features of previous games): “When a game is too bloody”	2	1	3	3	
UR_72	game_cocreating_storyline		(negative features in previous games): “just moving from one place to another – it should be more open world, that you can explore on your own and contribute to the storyline or live out the storyline with your character” (liked features in previous games): “to have an influence on the game, co-creating a game”	2	1	2	2	
UR_73	game_free_of_negative_reinforcement		(negative features in previous games): “downgrading if you don’t play it often enough”	1	1	0	2	
UR_74	game_free_of_time_limits		(negative features in previous games): “time limit”	1	1	1	2	
UR_75	game_limitations_to_play		(negative features in previous games): “limited resources e.g. food – if you use it, you can’t play anymore until you either wait for some time or buy it”	1	1	1	2	
UR_76	game_progress_time		(negative features in previous games): “too much time needed to advance to the next level”	1	1	2	2	
UR_77	game_short_waiting_times		(negative features in previous games): “too much waiting time (i.e., time needed to recharge energy/lives)”	1	1	0	2	
UR_78	game_activities_diversity		(liked features in previous games): “diversity of activities you can do in the game (e.g., driving and shooting)”	1	1	2	2	
UR_79	game_cooperative		Cooperative: solve it as a team – that the game allows that, even if it is the mission of participant A, participant B can go and help if participant A doesn’t succeed.	1	1	1	2	
UR_80	game_self-knowledge		That the game has self-knowledge activities.	1	1		2	
UR_81	game_instructions		Negative: “If it is not understandable. For example, you are told to go somewhere and you don’t find anything there.”	1	1	4	2	
UR_82	game_technical_feature_bugs		(negative features in previous games): “if the game stutters a lot” (negative features of previous games): “lagging”	1	1	3	2	

		(negative features of previous games): “when the game is crashing (due to low computer CPU)” (liked features in previous games): “game needs to run smoothly” (negative features in previous games): “bugs that make it difficult to play the game properly”					
UR_83	game_technical_feature_change controls	(negative features of previous games): “When you are not able to change ‘controls’ (on the console or keyboard)”		1	1	0	2
UR_84	game_storage_options	“And that you can pause it in between, e.g. when getting off the train.” “I agree. For me, storage options are also important.”		1	1	3	2
UR_85	game_technical_diverse user interface	“It shouldn’t be bound to a special console.”		1	1	0	2
UR_86	game_characters_pleasant_voices	(negative features in previous games): “when the voices of in-game characters are annoying”		1	1	0	2
UR_87	game_without_adds	(negative features in previous games): “adds”		1	1	4	2
UR_88	game_scenario_adventure	(liked features in previous games): “Adventure games”		1	1	1	2
UR_89	game_type_social_media	(devices used and preferred ones for games): “social media/community games”		1	1	0	2
UR_90	game_offline	(liked features of previous games): “Games that don’t require internet connection are nice.”		1	1	0	2
UR_91	game_play_when_you_want	(desired features): “You play it when you want it – not e.g. everyday.”		1	1	3	2
UR_92	game_different_worlds	(desired features): “maybe something similar to the Inside out movie. Worlds or something like that and a storyline”*		1	1	1	2
UR_93	game_changing_characteristics	(liked features in previous games): “‘Season change’: new map, guns, worlds, ... (Fortnite)” (desired features): “seasons changing” (liked features in previous games): They like freedom in the game but also a bit of direction		1	1	1	2
UR_94	game_gradually_adding_information	(desired features): “Information added gradually – not all at once.”		1	1	1	1
UR_95	game_structure	(negative features in previous games): “I don’t like too many choices/no structure to the game”		1	1	1	1
UR_96	game_realistic_graphics	(desired features): “realistic graphics (slippery floor if raining)” (liked features in previous games): “when you		1	1	2	1



			can see the inside of a car when playing racing games" (liked features in previous games): "Physics (when you crash a car at a high speed, it is appropriately damaged)"					
	UR_97	game_fun	(liked features in previous games): "it has to be fun" (desired features): "Feature important for a wellness game needs to make a good first impression and be fun, engaging straight from the beginning"		1	1	2	1
	UR_98	game_immersive	(desired features): "That playing the game isolates you from the rest of the world, that you forget about your worries"		1	1	1	1
	UR_99	game_interactions	(desired features): "to have a phone in the game so you can call people, take photos, receive instructions on how to proceed in the game"		1	1	2	1
	UR_100	game_content_relationships	(desired features): "The game could include how to talk with others about struggles and how to avoid judging others"		1	1	2	1
	UR_101	game_skills_anxiety	Games that nurture skills in dealing with anxiety (problem-solving skills/critical thinking).		1	1	2	1
CON-TEXT – APPLI-CATION OF IN-TERVEN-TION	UR_102	provide a youth-centred measurement to capture outcomes – check outcomes in the workshops!	This study may be used to inform future work as well as the development of youth-centred mHealth tools that can be implemented and sustained over time for diverse types of youths. Implementation science research that prioritizes youths' engagement is needed to advance the current understanding of mHealth implementation. Moreover, core outcome sets may support a youth-centered measurement strategy to capture outcomes in a systematic way that prioritizes equity, diversity, inclusion, and robust measurement science. Finally, this study suggests that future practice and policy research are needed to ensure the risk of mHealth is minimized and that this innovative health care service is meeting the emerging needs of youths over time.	High			4	3
	UR_103	App should not interfere with users' daily life or primary tasks unnecessarily		Me-dium			1	1

	UR_104	Provide a quick and easy to use guide on how to use the app	A user guide or 'how to' should be provided in the various form to serve diverse audience needs – text, video, and picture illustration. Designers should also include responses to frequently asked questions as part of their app.	Me- dium			3	1
	UR_105	inclusiveness of the LGBTQ+ group (e.g. characters that are not only stereotypically female or male)	Queer people are at higher risk of developing mental health problems (especially Anxiety and depression) This group can be extended.	Me- dium			3	2
	UR_106	encourage social connectedness and peer support for well-being	Studies outlined the potential benefits that social media has for adolescents: these involve social connectivity and peer support	me- dium			0	0
	UR_107	intervention content_breathing exercises in public	Avoid exercises, such as deep breathing or closing eyes, in public. performing various exercises, such as deep breathing or closing eyes, as these activities were seen as uncomfortable in public.	Low			0	0
	UR_108	Delivery: Detailed advertisement	Detailed advertisements that effectively communicate the game's features, benefits, and educational aspects, fostering transparency and informed player expectations To emphasize the serious game aspect in advertisements, highlighting the educational and skill-building elements to attract users seeking purposeful and enriching gaming experiences	X			3	1
	UR_109	Delivery: Serious game emphasis in advertisements:	To emphasize the serious game aspect in advertisements, highlighting the educational and skill-building elements to attract users seeking purposeful and enriching gaming experiences	X				
	UR_110	Delivery: Flexibility in time and place engagem	Flexibility to allow users to engage with the educational content at their preferred time and place, accommodating diverse schedules and preferences	X			3	1
	UR_111	Delivery: Clearly stated mental health improvement purpose	Clear articulation of the game's purpose in improving mental health, providing a transparent understanding of how the game contributes to well-being and emphasizing its positive impact.	X			0	0

	UR_112	Temporal dynamics in user engagement	To consider temporal factor when thinking about means to engage game users; 1. Pre-Onboarding: Emphasize clear communication and effective delivery for a compelling first impression; 2. Game Onboarding: Prioritize ease of use and inclusivity features for a smooth and welcoming user experience; 3. Gameplay Stage: Focus on the narrative and incorporate social support to influence user decisions for continued engagement.	X			3	2
	UR_113	Communicate_usefulness	Perceived usefulness: To explain why engaging in such a game is essential. Bridge the mental health needs of youth with the features of the game.	X			0	0
	UR_01	game_perception_of_peers	(desired features): "it is useful if the game is popular among their friends; they will more likely test it out in this case"		1	1	0	0
	UR_02	game_preview	(how they choose games): "Play a demo of the game"		1	1	0	0
	UR_03	game_promotion_not_mentalhealth_app	(desired features): "some mentioned that it could be better if the game is not promoted as a wellness game, as some might think that they are doing fine and not play it or think that the game will not be fun"		1	1	0	0
	UR_04	game_dissemination	Make a trailer		1		2	1

## 4.2 User Stories

Based on the user requirements, the clinical partners created a master list of user stories which will help in the initial technical definition of the SMILE components and implementation plan along with technical requirements. User stories are short, simple descriptions of a feature told from the perspective of the user who desires to use it. These typically follow a simple template: "As a [type of user], I want [some goal] so that [some reason]."

Table 5 User stories

ID	SMILE Tool	Role (As a ....)	Requirement (I want to ....)	Identified – User perspective
1	Serious game	end users, parents, teachers/therapist/school counsellor	have clear instructions, well edited, visually explained about how the game works ( video-tutorials, or paper materials, FAQs)	
2	Serious game	End-users	play the game by myself or with friends?	
3	<b>Serious game</b>	teachers/parents' end-users	have a demo on social media from other players	
4	Serious game	psychologist/therapist, parents	Age appropriateness event scenarios (I.e. avoiding cartoons features for young adults, but show cartoon for kids)	
5	Serious game	teachers/parents s	and to have a verbal channel enabling adolescents to freely discuss different things that happen in their daily life (important for gaming scenario)	
6	Serious Game	Teachers' educationalist	be able to help identify negative feelings, learn how to regulate them and to improve social skills in students by playing this game,	
7	serious game	psychotherapist	have psychoeducational explanation for parents about distorted thinking (to be included in web sources or in video tutorial i.e. how you look is not real)	
8	serious game	psychologist therapist, re-researchers	avoid to many thinking traps in the same scenario (gaming scenarios)	
9	serious game	young people, young people	have a game interface with good aesthetics and appealing design (I.e. have some reminder to famous singer or influencer, what is trendy)	
10	serious game	school psychologist	avatars have to be customized in the way students may identify themselves I.e. what adolescent read or eat or the way they wear youth dress	

11	serious game	school psychologist	have a wide representation of cultures and races and not just “Eurocentric” (e. avatars, story.....characters from the international world)
12	serious game	psychologist mental health care professionals	make young people able to identify an event, express their feelings solicited by questions providing during the game (gaming scenario, using emoji) at X frequency
13	serious game	End-users	to have many different options of games so to play all sorts and not get repetitive (many original stories and options, you can choose according to personal preferences)
14	serious game	parents/therapist psychologist	Point out that this is not a therapy, but this is a fun (see benefits of CBT fun rather than a “therapy”, to put in instructions and psychoeducational materials, stressing the concept that CBT will be administered by “funny” features so to avoiding the stigma of therapy)
15	serious game	end users	able to share my results of task (but not for personal thoughts) just final score for other users (after checking with question: do you want share with others your results) yes or not? )
16	serious game/other SMILE tools	mental health care professionals	have a detailed guidance booklet with practical suggestions of how to combine therapeutic game with parental guidance counselling and therapy (only for the business version and marketing)
17	serious game	psychologist	to be able to bring consciousness about actions emotions feeling physical sensations and behaviours with end-users and their parents (gaming scenarios and biomarkers)
18	serious game	psychologist/ school counsellor school psychologist/educationalist	adapt scenarios according to new events (pandemic, extreme weather conditions) or new stressors (migration, war.) (for business version)
19	Mobile awareness app	therapist/parents	have a video to understand specific terms I.e. distorted thinking or feelings or emotion (instructions) in age appropriateness way (part of gaming scenario)
20	serious game	end users	build my own world

21	Serious Game	End-users	talk with people in that world
22	Serious Game	End-users	be able to customize my world
23	Serious Game	End-users	roam around in my world
24	Serious Game	End-users' <i>experts</i> /parents	have an attractive storyline (gender and age, culture appropriateness for avatar selection)
25	Mobile awareness app	End-users	Be able to reflect on my thoughts, feelings and behaviours and record these thoughts
26	serious game	End-users	to collect rewards or gain point during the game without waiting the end of scenario
27	Serious Game	End-users	do certain actions in the world to gain points or rewards
28	Serious game	parents	limit time-screen
29	serious game	mental health care professionals	to be able to analyse feelings and emotions timely avoiding recall bias or other external influence when they assessed people face to face, integrating sensor data (gaming scenarios)
30	Serious game	End-users	Customise characters from blank space basically so that they can select skin colour from a palate and body shape, gender identity from a palate selection so that they fully design character.
31	serious game	End-users	Change colour of the environment in the game linked to rewards or actions
32	Serious game	end users	Able to change the music of the environment maybe selecting by Spotify
33	Serious game	end users	Select music to complement their environment (relaxing etc or from singer of the moment, top hits or also cartoon soundtrack)
34	Serious game	End-users	Be able to instantly transport to another room or environment without finish the current scenario (enable cheating)
35	Serious game	End-users	Transport round game like in vehicle
36	Serious game	End-users	Tap screen or drag to another scenario
37	Serious game	End-users	Ability to gift elements to other characters or players

38	Serious game	End-users	Have characters in the environment that a story can be told about to have a chance to apply cognitive restructuring about through selecting an answer (speech bubbles, text bubbles, multiple choices....)
39	Serious game	End-users	Have a character be able to generate thoughts that will be analysed through NLP to generate triggers in the game
40	Serious game	healthcare professionals/psychologist	avoid anthropomorphism (i.e. bottle don't speak for young adults,)
41	Serious game	parents	(parental control configuration, timeframes and active game timing)
42	Serious game	researchers/experts	compute facial expressions analyses and affective digital phenotyping to infer emotions (digital biomarkers)
43	Serious game	experts/game industry	to embed 10-heuristic rules to guide tool design and a optimise usability of serious game
44	serious game	experts/industry	pass a quality benchmark score (for business version compared with other similar tools)
45	serious game	researchers/experts	Behavioural markers ( age-development and gender appropriate), Time on task, Choices and preferences, Content preference, Visual search, Cognitive performance, Remembering instructions, Deciding which route or course of action to take under a limited time without pressure, Recognising patterns in a puzzle (some of which will require mental shifting)., Inhibition, Set shifting, Motor performance, kinematics in mouse behaviours( or patch tablet or pen), keystroke dynamics, Verbal responses to key tasks and questions (if we will develop a vocal /sound recognition system)
46	serious game/other SMILE tools	Safeguarding Psychologist(s) during project	Monitoring of indicators of danger e.g. mentions of suicidality so that we can employ a timely response during the study period. (
47	Serious Game	Teenager	

48	serious game	end. Users	able to do a screenshot a share and print the rewards gained in social media
49	serious game	parents/end users, experts	have a tutorial for the first-time user and about how to fix easy technical problems
50	Mobile awareness app	parents/teachers, young people, young adults	have a tutorial for the first-time users and about how to fix easy technical problems
51	Mobile awareness app	End-users	to access easy
52	Mobile awareness app	parents/end-users	be able to have privacy and anonymity
53	mobile awareness app	parents	limit time-screen
54	Mobile awareness app	End-users	Be able to learn how use it easily
55	Mobile awareness app	End-users	have an app with a visually appealing interface (age appropriateness)
56	Mobile awareness app	End-users	to be able to notice about your mood progress /improvement (have an alarm or messages)
57	Mobile awareness app	end-users	Have messages from chatbot judgement free ("how do you feel today? What are planning to do to improve your situation?")
58	Mobile awareness app		be able to edit or enter an entry if some things were forgotten to do the day before (i.e. tap the date on the mood page and change retroactively)
59	Mobile awareness app	end users	to be able to write negative thoughts down and confront them in the app with easy-to-understand definitions of the types of distorting thinking (have a space to write down and record and visualize this information in a graph
60			
61	mobile awareness app/serious game	end users	able to understand how I can improve my mood (tips, suggestions)
62	Mobile awareness app	teenager and young adults	Be able to track mental state – mood/anxiety etc to understand the relationship they have with specific events, thoughts, feelings or behaviours (tracking them with visual path or graph)



63	Mobile awareness app	Young people/experts	have an app where I can ask for support, recommendation and evidence-based information
64	Mobile awareness app	healthcare professionals	avoid the risk to boost the attitude of technological solutionism (i.e. reminder to recommend talking with peers or parents or ask to doctor) and give specific information to fight stigma, and to improve patients' doctors' communication, tips to talk freely with peers
65	Mobile awareness app	teachers/educational staff	allow the use of an unobtrusive tool without interfering with school tasks (you have to register your location if you set the app when you at school you and chatbot could recommend staying focused on STEM...)
66	Mobile awareness app	End-users	a more engaging and supernatural chatbot (end-users can select what kind of voice they like)
67	Mobile awareness app	End-users	to interact in my own native language (pilot languages and to have a dictionary to translate directly the Chatbot text)
68	Mobile awareness app/Knowledge platform	End-users/experts	include mindfulness, or relaxations exercises and nutritional guide according to mood of the day (i.e. drink herbal tea or eat a limited number of chocolates or some kind of fruits with Magnesium....)
69	Mobile awareness app	experts/	include academic best practices (I.e. periodic quizzes in a gamified way to consolidate information)
70	Mobile awareness app	end users/game expert	have a program's signature "easy peasy" (avoiding long information to create the account)
71	Mobile awareness app	end users	to be able to opt to log my mood or to work with a virtual coach that can do this for me (to be discussed with developer)
72	Mobile awareness app	adolescents	to be able to understand how emotions could affect diet nutrition and physical development (with a videos or short news, psychoeducational tips, use for example emoji that tell you about diet and emotions)
74	Mobile awareness app	policymakers,	Have an app ensuring legal clarity and ethical correctness, and avoid insecurities in users with regard to the safeguarding of human rights, privacy, and data security

75	serious game	experts/educationalist	to have daily mini-lessons on crucial topic (i.e. physiological sources of stress, mind-body connection, the emotional wheel.....) without being boring and remind adolescent of school environment)
76	Mobile awareness app	end users/ experts	have a personal timeline to predict the program's impact on achieve improvement in mood and well-being at the first entry. (based on general answers) (for the business version)
77	Mobile awareness app	Young people	have an app with multimedia contents and customization
78	Decision support system	expert	have a data science approach where developers record decisions in the constructions of data transformation and knowledge
79	Decision support system	school counsellor, psychologist	According with PHQ-9 assessment, recognizing vulnerable situations and make an alarm
80	Decision support system	experts/clinicians	incorporate algorithms and AI tested and trained on data sets to support professional decision about suicide ideation or eating behaviour at risk
81	Decision support system	experts/clinicians	incorporate supervised machine learning model to mental health data to predict outcome or triaging
82	Decision support system	healthcare professionals	to be informed about the risk profile and what are the burden of mental distress in a community, real word of adolescents
83	Decision support system	healthcare professionals and organization	Integrate the new system with care practice with adaptation to local real word (pilot study)
84	Decision support system	healthcare professionals	optimise current mental health services allowing a better and more fluid user experience
85	Decision support system	healthcare professionals	to receive a training before and during implementation of new technology
86	Decision support system	policymakers	future proofing for the new generations of citizens who are more acquainted with digitally enhanced services
87	Knowledge management platform	teachers	capitalize knowledge supporting young person and adolescent development needs, including mental wellbeing in classroom
88	Knowledge management platform	policymakers	reduce the burden of mental health by addressing barriers with evidence-based policies

89	Knowledge management platform	healthcare professionals/policymakers, educational staff/parents	Identify the negative impacts of technology on young person's physical, nutritional and mental health and the particular vulnerabilities of at-risk patients in a digital world
90	Knowledge management platform	healthcare professionals	acquire new skill set, including keeping abreast of technological developments;
91	Knowledge management platform	healthcare professionals	create a personalized digital ecosystem of knowledge
92	Knowledge management platform	healthcare professionals	that could impact on young's wellbeing and mental health
93	Knowledge management platform	healthcare professionals/educational staff	be able to guide parents and young people to be supported by e-mental health solutions
94	Knowledge management platform	researchers/experts	understand how people naturally engage with digital solution to have data about their impact on health and develop more useful measures and scores
95	Knowledge management platform	policymakers/healthcare professional	enhance digital health literacy and skills in adolescents by providing the state of the art in each pilot country and foster digital solution dissemination
96	Middleware	Game dev	use a swagger with API documentation
97	SMILE Data API		
98	Self-Assessment and monitoring framework	healthcare professionals	monitor the effectiveness of digital solutions
99	Self-Assessment and monitoring framework	healthcare professionals	integrate ideas from many different disciplines as well as the framework for blended care using I.e. 'channel switching' in at risk situations
100	Self-Assessment and monitoring framework	mental health care professionals	reduce the waiting list
101	Self-Assessment and monitoring framework	healthcare professionals	provide subject monitoring outside of healthcare setting and therapy sessions, (for business version)

102	Self-Assessment and monitoring framework/mobile awareness app	End-users/experts	be able to monitor sleep duration, exercise levels, tone of voice, nutritional habits, to have a comprehensive data collection
103	Self-Assessment and monitoring framework	experts/clinicians	allow users to submit repeated measures at different times of the day and on different days from their own environment.
104	Self-Assessment and monitoring framework/mobile awareness app	End-users	have a virtual companion to talk to sometimes and guided self-assessment
105	Self-Assessment and monitoring framework	researchers/experts	Stress markers using chatbot and scale questions. Provide a repeatable, verifiable, meaningful and relatable output that can be matched with data from other subsystems like gameplay data.
106	Rewarding system	Young people/experts	Reward the engagement of young people in the gamification, or reward experts for their support
107	data visualization	clinicians/researchers	"Collect high-resolution real-world individual data "
108	Data visualization	Clinicians /researchers	see the raw data of the studies
109	Data visualization	Clinician/policymakers	to request of permission (if data don't belong to my organization) to see data
110	data visualization	healthcare professionals/researchers/policymakers	correlate the technology use on young person' physical, nutritional and mental health
111	Data visualizations	clinicians, researchers	visualize overview, zoom and filter for details on demand,
112	data visualization	End-users. Teachers, parents,	be able to view a simplified version of data (that I have access to)
113	data visualization	clinicians, researchers	to personalize data visual layout
114	data visualization	clinicians, researchers	have different colour to represent data

115	Knowledge management platform	clinicians/researchers	have a physical representation of data on a human body model (i.e. data sculpture to learn about the holistic approach i.e. mental and physical health )
116	data visualization	clinicians/researchers	able to export data on excel, csv spreadsheet
117	data visualization	clinicians/researchers	see the interpretations of data from my own organization
118	open knowledge platform		have an accessible and intuitive interface without having hard e-skills
119	data visualization	End-users	see my own progress of the game (e.g. how did I manage module 2 and how was my well-being then?) – this has to be seen from an individual perspective without any comparison with others
120	Self-Assessment and monitoring framework	clinician/researcher	be sure that every end-user answers to the 5 validated instruments once a week (PHQ-9, GAD7, CCAS, WHO). If they refuse to answer to any of those, they will not be allowed to continue
121	Self-Assessment and monitoring framework	clinician/researcher	be sure that every end-user gets the correct version due to the age (the age that they had when they started the study) of the users
122	Self-Assessment and monitoring framework	clinician	be sure that end-users with a high score in depression or anxiety gets immediately a nation-specific support site. What happens afterwards, we show him the message for support and the link, and we block the app??? (question for team)
123	Self-Assessment and monitoring framework	clinician/researcher	be able to add scales, (, limits for notifications and warnings and things like this, or any other scale) if necessary. A scale should be applied to a certain age -group.
124	serious game	End-users	For the weekly scales, there will be multiple questions asked by our platform. Don't be bothered too much by the questions. The questions should be delivered in a gamified way (asked by a NPC, e.g. a Sigmund Freud Avatar or a Stephen Hawking-like scientist with glasses etc.) The avatar has to be age specific.

125	serious game	End-users	For rewards. I want to have a feeling of achievement, not only by getting abstract rewards (stars, hearts) but by being able to effectively influence the game (e.g. buildings can get coloured after a task completion, music to be listen after task completion)
126	AI	researchers/experts	understand, what the AI is doing and what parameters flow into it. Explainable AI has provided a report for the data that was processed and resulted
127	serious game	End-users	not feel observed. For biomarkers, we only want 1 consent in the beginning for everything. We do not want to have to accept conditions every 2 minutes
129	Data visualization	researchers/experts	get individualized profiles of game progress based on a) demographics b) scores of scales c) biomarkers (e.g. how do 11-year-old girls in Germany with high climate anxiety behave in module 3; is depression in 20 year old boys correlated to a bi-omarkers in module 4... etc. (This is according to the data access rights and policy)
130	serious game	End-users	be able to stop a task and get back later, while my results are saved automatically. We could use some checkpoints.
131	serious game	End-users	be able to walk around the streets of the world and to enter some buildings
132	serious game	End-users	not have to read too much text. I want short texts and pragmatic with some options that the app would read the text for me. ( have an automatic reading option)
133	Knowledge management platform	parents/teachers/clinicians	have access a selection of reliable sources on adolescents' mental health
134	Website	parents/teachers/clinicians	be sure that the SMILE app developers of are qualified to safeguard their adolescents
135	Website	parents/teachers/clinicians	be informed about study results related to the project
136	serious game	End-users	be able to create my own world by selecting buildings, colours, weather, people from a list and/able to add something new

137	serious game	End-users	be able to choose people in my world and excluding people that I don't want to let in (math teacher, bad neighbour...) – the environment has to be social for me, for my own understanding of social
138	serious game	End-users	be asked to reflect my choices (based on my own progress, not a generic one) in an age-appropriate way
139	serious game	End-users	be able to select answers in multiple choice fields (e.g. assessing of thoughts from 1-5, see file on canvas), then get answers related to my scoring, then get an explanation (all of this provided by a psychologist-like NPC)
140	serious game	End-users	be able to do this (select answers from a list or write a custom answer)
141	Mobile awareness app	End-users, school counsellors	able to receive update information on sensitization campaign against stigma, or mental health promotion, and local /national contact point
142	Mobile awareness app	end. Users	be able to monitoring my own improvement in resilience and coping strategies (i.e. charts, trends)
143	Mobile awareness app	End-users	able to receive endorsement when the improvement is acquired (individually)
144	Mobile awareness app		to find dilemmas to provide users with opportunities to determine what they would do in complex situations
145	Mobile awareness app	end users	find dynamic features with immediate feedback to the questionnaires
146	Authorization Server	Deploying Party	The Server must follow security by design/default best practices as laid out by CISA
147	Authorization Server	Deploying Party	Supply Machine readable SBOM
148	Authorization Server	End-users	Implement policies ensuring that users can only access their own data
149	Authorization Server	Clinicians	Implement policies complying with GDPR for data dashboards, i.e., pseudonymisation ensuring non identifiability.
150	Authorization Server	Clinicians	Implement policies complying with GDPR for data exported to public data repositories

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151	General Data Management	End-users	Capability of exporting user-specific datasets for data requests. And ability to delete data on request.
152	Authorization Server	Deploying Party	Ensure secure development practices and software supply-chain by following Open-Source Security Foundations best-practices. Automatic self-suiting using OpenSSF Scorecard.
153	Authorization Server	Developers	Documented stable APIs. REST, SSE, Rsocket. Encrypted transport. Support of JWT, Oauth, custom Tokens, Basic Authentication.



## 5. Technical Specifications

### 5.1 Game specifications

#### Description

The SMILE Serious game is a smartphone RPG game where the user is put in an imaginary world and has to go through various scenarios during the gameplay. The game is developed to be played over a 12-week period and is based on the principles of Cognitive behaviour therapy. The gameplay targets younger audiences dealing with mental health issues such as anxiety, depression, bullying, and social anxiety. The methodology of developing “SMILE serious game” focuses on the involvement of clinicians in the design process and the incorporation of user feedback into visual and thematic elements of the game. Development will be conducted using Unity3D.

#### Minimum Requirements

The game is made using unity3D and requires access to the front camera of the smartphone to capture bio marker data. Therefore, the minimum requirement involves a smartphone with a front camera and a compatible Operating system. The minimum requirements include the following:

Compatible Operating systems:

iPhone and iPad: IOS 12.0

Smartphone: Android 12.0

#### Logical design

The game’s core, built inside the game client for iOS and Android devices, includes various game scenarios that the player interacts with. As the player engages with the game, the front camera of the device captures video snippets, which, along with other player data and information, are sent to a middleware from WIZ. This middleware serves as a bridge, facilitating the transfer of video snippets, usage information, player checkpoints, progress information, and other game data between the game application and the FHIR server where all the data is saved for analysis.

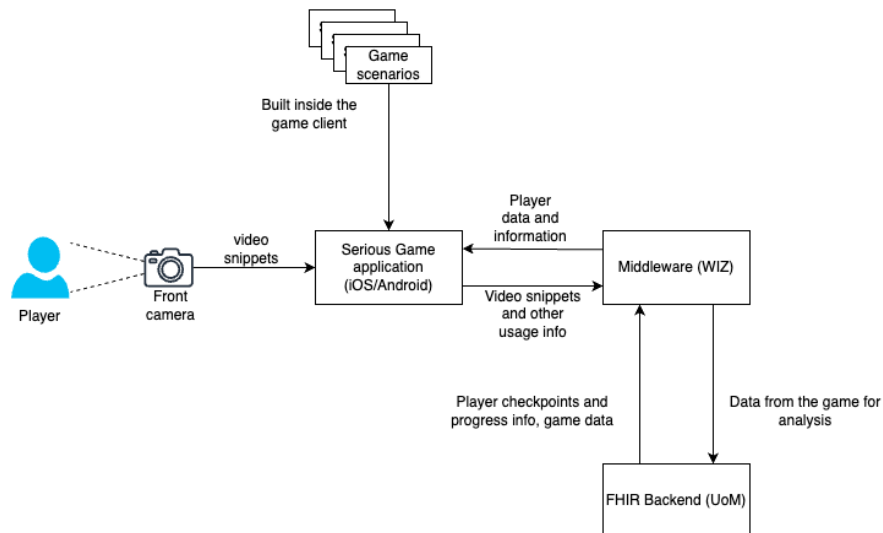


Figure 2 Logical Design - Serious game

## Functionalities

Table 6 Functionalities - Serious Game

Functionality	Description	Data Objects
Scenario loading	The component loads the various scenarios inside the game for the player to play	Unity Scene and unity game object
Data collection	The game can collect various metadata about the usage of the game by the player.	JSON
Bio markers data collection	The game can collect specific data for analysis of the bio markers such as video snippets at specific times as defined by the clinicians and other partners	JSON/mp4 files
User authentication	The game connects to the key cloak server of the project for user authentication.	JWT Token
Game	The main functionality includes the gaming features incorporated to maximise engagement and storytelling based on the scenarios	N/A
Avatar Editor	The user can create an avatar for themselves that they can also use in the awareness app	Avatar (.obj/.fbx files)

Game storyline	The game will include functionalities needed to address the storyline being developed in WP4 of the project and initially documented in D4.1.	-
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User stories addressed.

*Table 7 User stories - Serious game*

User stories ID	Functionality
1,4,6,8,9,10,11,12,13,14,17,20,22,23,24,26,27,28,34,40,43,44,49,75,125,130,131,132,136,138,140,	Game
30	Avatar Editor
42,45	Bio markers data collection

## 5.2 Awareness App specifications

### Description

The awareness app is where users fill in questionnaires through chatbot or quiz form, record weekly diary, join a community where they will be allowed to chat and talk in groups. The app is also used to visualize and display feedback to the users, i.e. progress, “achievements” and status. The app will also integrate ESM features for daily diary during piloting. It will be a complementary app to the game to provide seamless usage of the smile solution for end-user. It also collects data for other smile tools. The tool will be developed by RDIUP.

### Minimum Requirements

User devices:

iPhone and iPad: IOS 5.0

Smartphone: Android 5.0 Lollipop (API 21)

Deployment requirements:

Operating System: Linux, Windows, MacOS

CPU: x86/Aarch64/ARM64

RAM: 4 GB

Disk Space: 10-20 GB

Others: Python 12

## Logical design of the tool

The tool will have a mobile application and a backend API system. The logical design of the tool is the following:

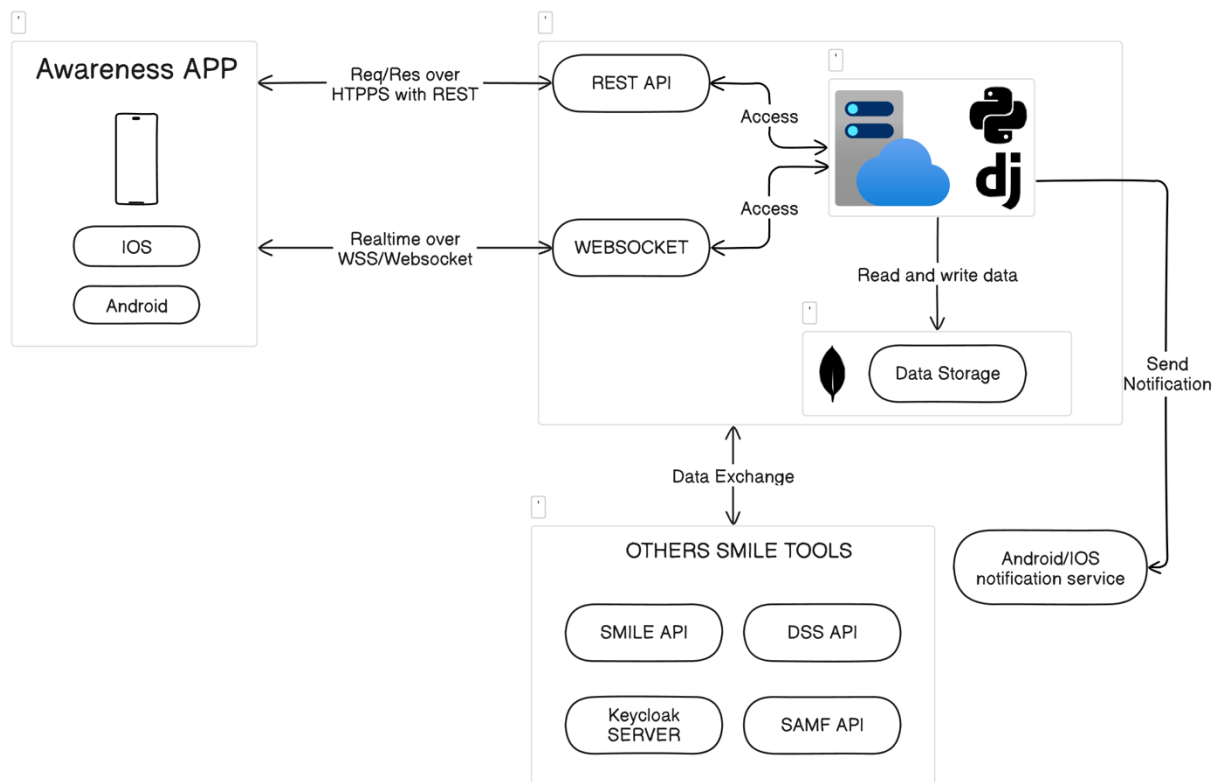


Figure 3 Logical Design - Awareness app

Figure 1 Logical design – Awareness app.

## Functionalities supported.

Table 8 Functionalities - Awareness app

Functionality	Description	Data Objects
Chatbot	Chat based questionnaire to collect data from user for others smile tools such as DSS, SAMF etc. (GAD-7, PHQ-9, ESM etc.)	JSON data
Dashboard	Provide feedback to user and help to monitor his progress.	JSON data
Room Discussion	Group chat room and group voice call for adolescent for	JSON data

	peer review and support.	
Nutritional and Lifestyles education	Teach adolescent nutritional and lifestyle best practice to increase their awareness.	JSON data
Rewarding System	A token-based rewarding system or decentralized achievement certificate to reward adolescent to increase their retention and engagement.	JSON data
ESM/Questionnaires	The app will also include the questionnaires which will be finalised and documented in D7.1.	JSON

#### User stories addressed.

The following table shows the User stories addressed in the document from the table in section 4.2.

*Table 9 User stories - Awareness app*

User stories ID	Functionality
25, 57, 59	Chatbot
56, 59, 61, 62	Dashboard
63	Room Discussion
63	Nutritional and Lifestyles education
37	Rewarding system

## 5.3 Self-assessment and monitoring framework specifications

### Description

The SMILE Self-Assessment and Monitoring Framework (SAMF) developed by University of Maribor module is designed to provide an efficient collection of high-quality information processing capability to significantly decreased complexity and burden of reporting.

The intent is to simulate a gamified Self Reporting conversation, i.e. to informally discuss about their mental health experiences and impressions over the week, right after the completion of each week's activities to collect digital biomarkers.

### Minimum requirements

The tool runs as a backend component with the following deployment environment:

Operating System: Linux

CPU: x86/Aarch64/ARM64

RAM: 16GB

GPU: GeForce RTX 3090 24GB

Disk Space: 64GB to 128GB.

Others: Python 3.8

### Logical design

*Table 10 Components - SAMF*

Component name	Data input	Data output	Function(s) performed
Linguistic Features Extractor	Transcription of the diary recording	Linguistic features	NLP
Speech Features Extractor	Audio of the diary recording	Speech features	Speech processing
Visual Features Extractor	Diary recording video	Visual features	Video processing
Mapping into Observable Cues	Low-level descriptors (linguistic, speech, visual features)	Digital observable Cues, FHIR resource	Calculation of observable cues, Storing the outputs as FHIR resources

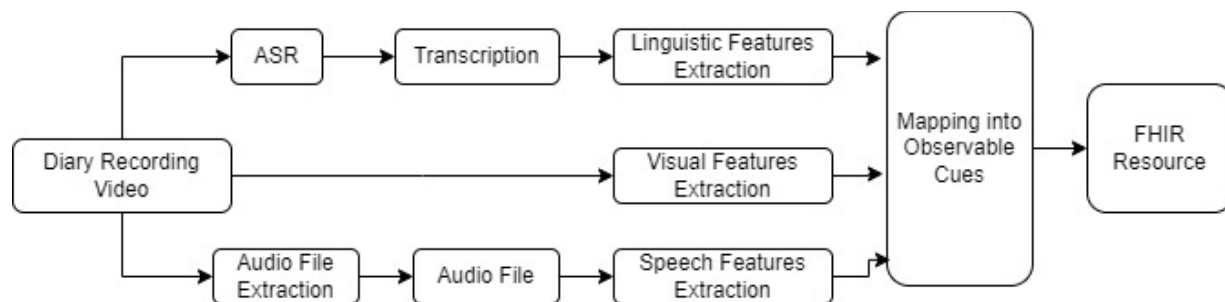


Figure 4 Logical Design - SAMF

## Functionalities

Table 11 Functionalities - SAMF

Functionality	Description	Data Objects
ASR	Automatic speech recognition for extracting the transcription of the diary recordings video	Transcription
Audio Extraction	Extracting the audio file from the diary recordings video	Audio file
Feature Extraction	Extracting the linguistic, speech and visual features	linguistic, speech and visual features
Mapping into observable cues	Mapping all features into digital observable cues for the classification module	Observable cues
Storing	Storing the observable cues as FHIR resource	FHIR resource

## User stories addressed.

Table 12 User stories - SAMF

User stories ID	Functionality
102	be able to monitor sleep duration, exercise levels, tone of voice, nutritional habits, to have a comprehensive data collection
103	allow users to submit repeated measures at different times of the day and on different days from their own environment.

105	Stress markers using chatbot and scale questions. Provide a repeatable, verifiable, meaningful and relatable output that can be matched with data from other subsystems like gameplay data.
120	be sure that every end-user answers to the 5 validated instruments once a week (PHQ-9, GAD7, CCAS, WHO BREF). If they refuse to answer to any of those, they will not be allowed to continue

## 5.4 Decision Support System

### Description

DSS (Decision support system), developed by NVISION, is a computing element that will integrate inputs and will automatically give out outputs with the data collected in the project. There will be three DSS's:

- DSS1: Collects inputs from the game and gives out outputs onto the game. Explainability of the outputs will be shown through a UI.
- DSS2: Collects inputs from the awareness app, game and other potential data sources and gives out an output regarding the status of mental health of the young user/player. Explainability of the outputs will be shown through a UI.
- DSS3: Collects evidence-based knowledge and provide support doctors (TBD). Explainability of the outputs will be shown through a UI.

### Minimum Requirements

Since it is a backend component no requirements for user device is needed. The requirement for deployment includes Azure cloud auto-scaling. The development language used will be c#.

### Logical design

*Table 13 Components - DSS*

Component name	Data input	Data output	Function(s) performed
DSS1	Game interactions and scores.	Will move the player to a new scenario.	Allows player to move among scenarios in the game.
DSS2	Game scenarios' scores & awareness app data.	Player stratification regarding their risk level of anxiety or depression.	Serves as a diagnosis tool for professionals.



DSS3	Evidence Knowledge (TBD)	Expert support (TBD)	Serves as Supporting Tool for professionals
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## Functionalities

*Table 14 Functionalities - DSS*

Functionality	Description	Data Objects
Scenario Redirection	Player will be sent to a different scenario depending on their behaviour in the previous scenario and the score got during the previous scenario-	JSON data
Risk of Diagnosis Tag	Player will be given a tentative diagnosis of their individual risk of anxiety or depression.	JSON data

## User stories addressed.

*Table 15 User stories - DSS*

User stories ID	Functionality
78, 83	Scenario Redirection
78, 79, 82	Risk of Diagnosis Tag

## 5.5 SMILE Middleware API

### Description

The SMILE middleware API, developed by WIZ, is set of integration tools that will serve as a middle ground for communication between all digital tools. It also includes features for user management, API playground, and authentication.

### Minimum Requirements

Since it is a backend component, no user device requirement is needed. The requirement for deployment includes the following:

Operating System: Ubuntu 20.04 LTS

CPU: 6-8 core Intel CPU

RAM: 32GB, scale up as needed

Disk Space: Minimum 5GB.

## Logical design

*Table 16 Components - Middleware API*

Component name	Data input	Data output	Function(s) performed
API Web Server	HTTP Requests	Different data responses depending on the request	Web Server
Keycloak	Authentication Requests	JWT Token	Authentication
Smile User Account	User Profile Data	User Object	User Management
Smile API Playground	API Request	API Response	API Playground

## Functionalities

*Table 17 Functionalities - Middleware API*

Functionality	Description	Data Objects
API Web Server	Web server hosting APIs, facilitating communication between client applications and backend services	JSON Objects Configurations, Files (Videos, Images or any other)
Keycloak	Identity and access management platform for securing applications and services.	Client Credentials, JWT
Smile User Account	This is a web page where users can create / manage their accounts.	Client Credentials, User Data

Smile API Playground	Smile API Playground is a tool that allows users to browse, explore, and try out the SMILE API	JSON Request/Response Schemas
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#### User stories addressed.

The tool doesn't fulfil any specific requirement but supports in the fulfilment of the requirements of other tools.

## 5.6 Automatic Speech Recognition

### Description

University of Maribor provides ASR engine as the service which plays significant role in the diary pipeline. ASR provides the textual transcription from the diary audio. Results of that transcription are then sent further to the symptom extraction engine. The component is delivered as a SERVICE. All infrastructure requirements are handled internally on UM's infrastructure.

### Minimum Requirements

The service is deployed as a cloud Service on UM's Infrastructure

Operating System: Linux

CPU: x86/Aarch64/ARM64

RAM: 32GB

GPU: GeForce RTX 3090 24GB

Disk Space: 128GB to 512GB.

Others: Python, venv

### Logical design

As the part of the diary pipeline, the audio (speech) is extracted from the diary video and used as an input to the ASR inference for specific language model. Raw results are sent to the spellchecker and written as a textual transcription result in a JSON.

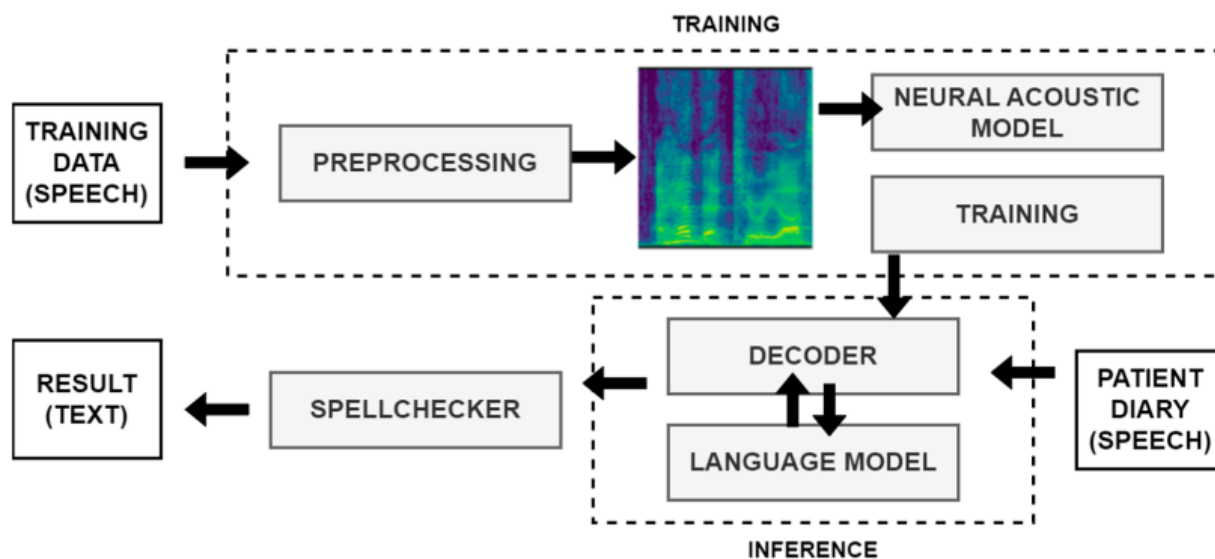


Figure 5 Logical Design - ASR

## Functionalities

Table 18 Functionalities - ASR

Functionality	Description	Data Objects
ASR Language Model	Text transcription of the speech	JSON based payload
ASR Spellchecker	Spellchecking of the transcription	JSON based payload

User stories addressed.

Table 19 User stories - ASR

User stories ID	Functionality
122	Will provide the endpoints to feed the results for depression

## 5.7 FHIR Server

### Description

The FHIR Server, developed by University of Maribor, is a resource storage which runs HL7 FHIR v4 standard will save the UM Chatbot PHQ9 and GAD7 user responses as Questionnaire and Questionnaire Response resources in its database. FHIR Server will also store the Compositions of the extracted features and

classification of the SAMF Pipeline and link the diary videos with video storage. Those resources can later be accessed by the whitelisted users. FHIR offers access to the resources over its REST API interface.

### Minimum Requirements

The component is deployed as a cloud service and has no specific requirements as the service used is completely platform agnostic and does not require additional space and installations.

### Logical design

*Table 20 Components - FHIR Server*

Component name	Data input	Data output	Function(s) performed
FHIR REST API	Handling the CRUD for the FHIR resources. JSON based. Using Swagger for development and documentation.  <a href="https://hapi.fhir.org/baseR4/swagger-ui/">https://hapi.fhir.org/baseR4/swagger-ui/</a>	JSON based. Using Swagger for development and documentation.	CRUD for FHIR resources.
FHIR Server Dashboard and Storage	Using SQL or NoSQL database for FHIR resources storage. HAPI FHIR Dashboard for tracking the updates of the resources.  <a href="https://hapi.fhir.org/">https://hapi.fhir.org/</a>	/	Using SQL or NoSQL database for FHIR resources storage. HAPI FHIR Dashboard for tracking the updates of the resources.

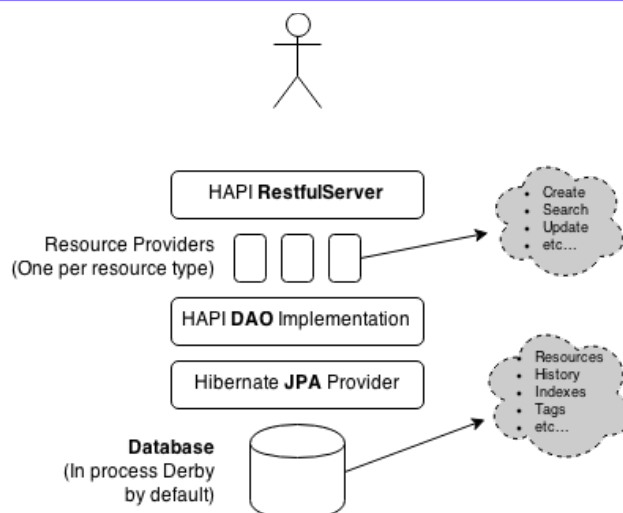


Figure 6 Logical Design - FHIR Server

## Functionalities

Table 21 Functionalities - FHIR Server

Functionality	Description	Data Objects
FHIR resource administration	Management of the FHIR resources	FHIR resources in JSON form
FHIR resource database	Storing the FHIR resources	FHIR resources in JSON form

## User stories addressed.

Table 22 User stories - FHIR Server

User stories ID	Functionality
120	Will provide endpoints for to store questionnaires answers as resources
122	Will provide the endpoints to store the results of depression
153	Authentication with JWT
119	Providing structured resources collected from the end-user

129	Providing structured resources collected from the end-user, linked to the end-user via Patient Resource which includes all the demographic information
143	Providing structured resources collected from the end-user, linked to the end-user. Awareness app can exploit them to present the data,

## 5.8 Knowledge Management Ecosystem Portal

### Description

The Knowledge Management Ecosystem Portal (KM-EP), developed by FTK, is designed to provide a framework and common platform for managing knowledge and scientific as well as educational content.

Its architecture consists of five main subsystems: Information Retrieval (IRS), Learning Management (LMS), Content and Knowledge Management (CMS), User Management (UMS), and Storage Management (SMS).

The KM-EP is based on LAMP and the Symfony framework for PHP on a technical level.

### Minimum Requirements

The component is deployed as a cloud service using docker and the deployment requirements are:

Operating System: Linux

CPU: x86/Aarch64/ARM64

RAM: at least 16 GB

Disk Space: 500 GB

### Logical design

*Table 23 Components - KMEP*

Component name	Data input	Data output	Function(s) performed
Ecosystem Portal	User input	Hypertext, graphics	Information retrieval
Storage Management Subsystem	Assets	Data Storage (File System, Database)	Storage

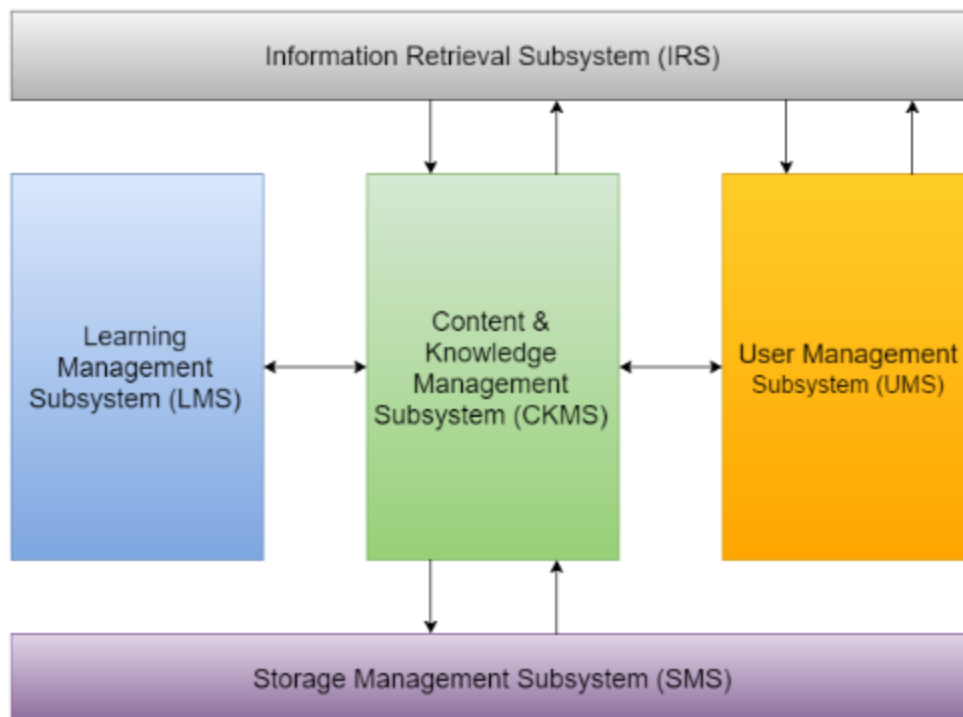


Figure 7 Logical Design - KMEP

## Functionalities

Table 24 Functionalities - KMEP

Functionality	Description	Data Objects
Information Retrieval (IRS)	let's users search and access assets in the proper file formats	information researchers for
Learning Management (LMS)	manages learners, learning materials, and supports the learning process	n/a (may be adapted)
Content and Knowledge Management (CMS)	manages content. Objects, their metadata, and other forms of knowledge representations	SMILE assets



User Management (UMS)	manages users, groups of users, authentication, accounting, and access control information for all subsystems	User credentials
Storage Management (SMS)	preserves the integrity of the digital file and its metadata for the lifetime of an asset so that it can be controlled, versioned, repurposed, and archived according to the administrative direction	Information on data storage

User stories addressed.

*Table 25 User stories - KMEP*

User stories ID	Functionality
133	have access a selection of reliable sources on adolescents' mental health
118	have an accessible and intuitive interface without having hard e-skills
115	have a physical representation of data on a human body model (i.e. data sculpture to learn about the holistic approach i.e. mental and physical health )
95	enhance digital health literacy and skills in adolescents by providing the state of the art in each pilot country and foster digital solution dissemination
94	understand how people naturally engage with digital solution to have data about their impact on health and develop more useful measures and scores. To have an adequate search tool to explore the available content
93	be able to guide parents and young people to be supported by e-mental health solutions
92	that could impact on young's wellbeing and mental health
91	create a personalized digital ecosystem of knowledge
90	acquire new skill set, including keeping abreast of technological developments;

89	Identify the negative impacts of technology on young person' physical, nutritional and mental health and the particular vulnerabilities of at-risk patients in a digital world
88	reduce the burden of mental health by addressing barriers with evidence-based policies
87	capitalize knowledge supporting young person and adolescent development needs, including mental wellbeing in classroom

## 5.9 SAPL Server

### Description

The SAPL Server, developed by FTK, is an authorization service, i.e., a policy decision point (PDP), used in Attribute-(Stream)-based Access Control.

It manages access control rules in the SAPL language and is capable of making decisions answering authorization questions based on these rules.

Administrators can manage policies using the servers UI and services in the OKP can delegate access control decision to the SAPL server.

### Minimum Requirements

There are no specific requirements the service use is completely platform agnostic and does not require additional space and installations. Use of integration libraries is optional and then the related technology stack limitations apply. The deployment requirements are as follows:

Operating System: Linux, Windows, MacOS

CPU: x86/Aarch64/ARM64 (Given that JDK 17+ is available for the given OS/Platform)

RAM: 4GB

Disk Space: 300MB to 2GB depending on what is counted (include docker images, DB installs, etc.)

Program itself: about 300MB. Data: 10MB. Add JDK, MariaDB, OS Runtime

Others: JDK 17+ installed or Container Runtime

### Logical design

*Table 26 Components - SAPL*

Component name	Data input	Data output	Function(s) performed
Policy Decision Point (PDP)	Rules, Policies, Authorization Subscriptions, Authorization	Authorization Decisions, Logs and decision	Authorization

	Requests, Client Credentials  <a href="https://sapl.io/docs/3.0.0-SNAPSHOT/3_1_PublishSubscribeProtocol/">https://sapl.io/docs/3.0.0-SNAPSHOT/3_1_PublishSubscribeProtocol/</a>  External Attributes from Policy Information Points for decision making	traces	
Policy Administration Point (PAP)	Rules, Policies, User Credentials	UI for administration. Code editors,  Rules Versioning, Currently active set of rules to be used by the PDP,  Client Credentials	Administration of access control rules and client credentials.

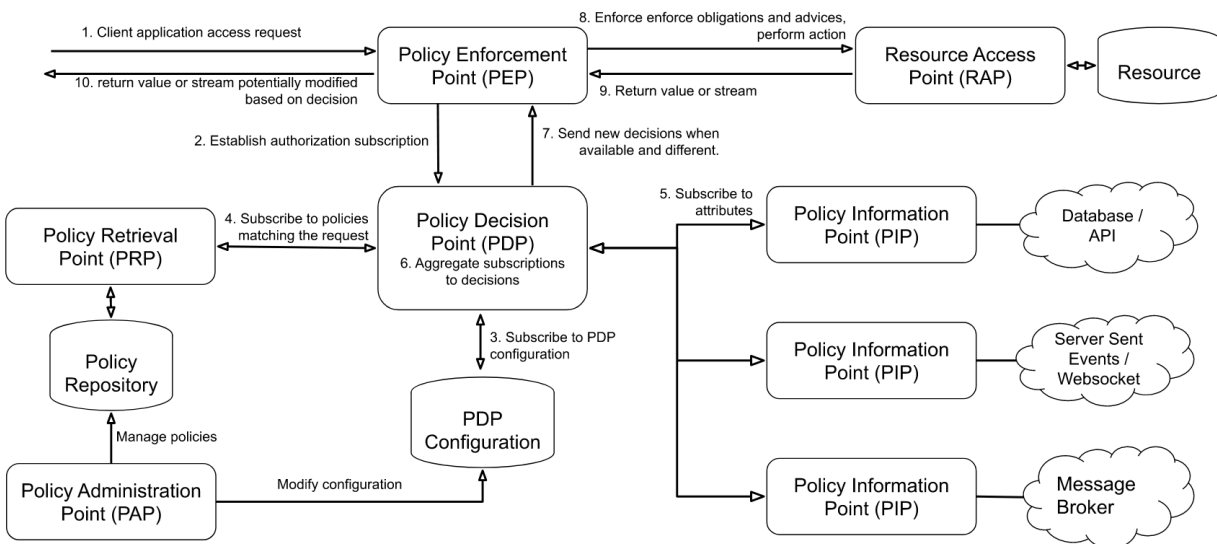


Figure 8 Logical Design - SAPL

More information can be found on the sapl website<sup>1</sup>

<sup>1</sup> <https://sapl.io/>

## Functionalities

Table 27 Functionalities - SAPL

Functionality	Description	Data Objects
Policy Administration Point	Management of Access Control Policies	Client PDP SAPL Documents Credentials Configuration
Policy Decision Point	Authorization Service	Client PDP SAPL Documents Credentials Configuration

### User stories addressed.

The component acts as a general component used for the secure implementation and access of the other components of the system and therefore does not have any specific requirements.

## 5.10 UM REST API

### Description

UM REST API will provide secure endpoints for the UM Framework with Chabot to exchange questions and answers for user and the diary recording pipeline to extract observable cues and store them in FHIR. UM REST API will provide the HTTP endpoints for all the services hosted by UM. The component is delivered as a SERVICE. All infrastructure requirements are handled internally on UM's infrastructure.

### Minimum Requirements

There are no specific requirements the service use is completely platform agnostic and does not require additional space and installations. The deployment environment requires the following:

Operating System: Linux

CPU: x86/Aarch64/ARM64

RAM: 4GB

Disk Space: 32GB to 64GB.

Others: JDK 11+ installed or Container Runtime

## Logical design

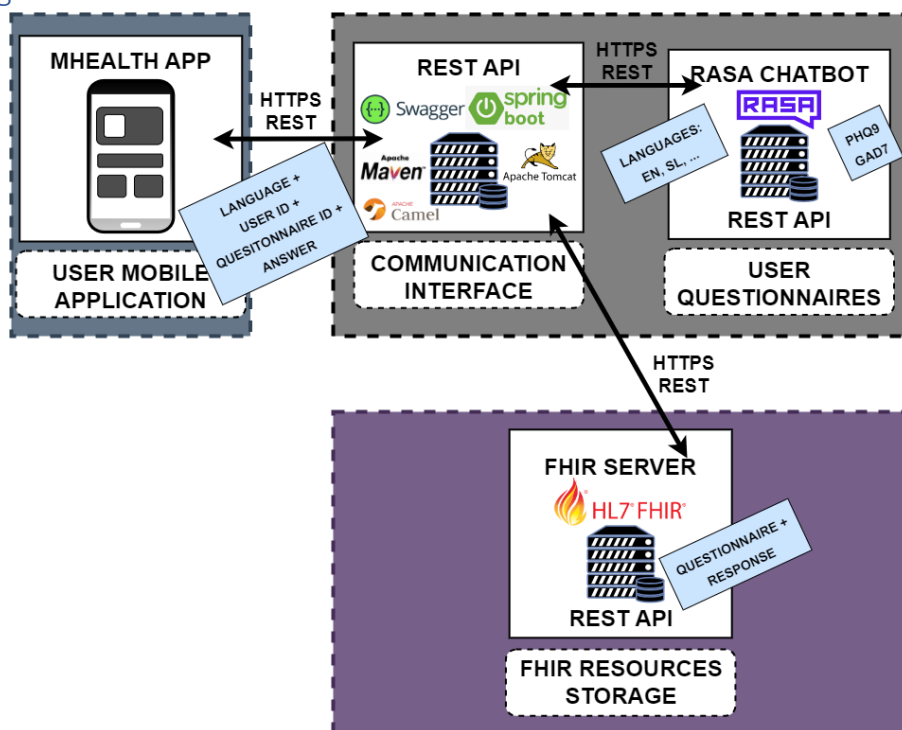


Figure 9 Logical Design - UM REST API

## Functionalities

Table 28 Functionalities - UM REST API

Functionality	Description	Data Objects
Access to the Chatbot	Management of the Chatbot and integration with the mHealth App	JSON based payload
Access to the Diary Pipeline	Integration with the Diary Pipeline and mHealth App	JSON based payload

## User stories addressed.

Table 29 User stories - UM REST API

User stories ID	Functionality
120	Will provide endpoints for access to questionnaires

122	Will provide the endpoints for the results for depression
153	Authentication with JWT, Authorization via SAPL

## 5.11 Chatbot

### Description

Chatbot, by University of Maribor, is developed to provide a convenient and nonintrusive way of collecting, integrating, and representing patient-collected real-world data and outcomes in the form of structured questionnaires (Patient Reported Outcomes – PROs).

The content of the conversation is based on the symptom which is extracted during the conversation via AI tools and constructed as symptom centric discourse.

The component is delivered as a SERVICE. All infrastructure requirements are handled internally on UM's infrastructure.

### Minimum Requirements

The component runs as a service on UoM's infrastructure, the deployment environment requires:

Operating System: Linux

CPU: x86/Aarch64/ARM64

RAM: 16GB

GPU: GeForce RTX 3090 24GB

Disk Space: 64GB to 128GB.

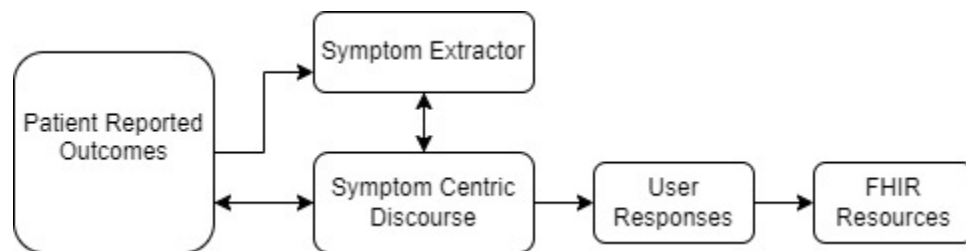
Others: Python

### Logical design

*Table 30 Components - Chatbot*

Component name	Data input	Data output	Function(s) performed
Patient Reported Outcomes	User responses to questions	FHIR resource	Digital survey collecting data psychometrically validated questionnaires stored as FHIR
Symptom Tracker	Discourse text	FHIR resource	Symptom extraction via AI, stored as FHIR
Symptom Centric	User responses to	FHIR resource	Creation of conversation based on

Discourse	questions		extracted symptoms, stored as FHIR
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## Functionalities

Table 31 Functionalities - Chatbot

Functionality	Description	Data Objects
Symptom Extraction	Searching and extracting the word related with symptoms	Symptoms
Symptom Centric Discourse	Being able to do conversation based on extracted symptoms	Discourse
Collecting User Responses	Collecting the answers of the users from PROs	User Responses
Storing into FHIR	Storing all responses to FHIR server	FHIR resource

## User stories addressed.

Table 32 User stories - Chatbot

User stories ID	Functionality
53	to access easy
59	Write down, express thoughts
66	Engaging chatbot, but not supernatural, natural language interface is not foreseen.

---

67	Interact in native language
103	allow users to submit repeated measures at different times of the day and on different days from their own environment
105	Stress markers using chatbot and scale questions. Validated instruments will be implemented
120	A CDS hooks concept will be delivered using FHIR. Tasks will be predefined, and that Game App can verify if everything was completed
121	Tasks will be predefined by experts and lined with the Patient-Resource, which will include age.
123	Any instrument, that can be executed as a digital survey can be added and linked with the end-user via CDS Hook



## 6. Use cases

### 6.1. Personas

As presented in the DoA and explored under Task 1.1 and 1.2 of the SMILE project, six main profiles were identified as key external stakeholders within this project: younger groups that are sub-divided in three – youngers from 10 to 14 years-old, from 15 to 18 years-old and 19 to 24 years-old; healthcare professionals (that include doctors, psychologists, nurses and other healthcare relevant agents); teaches; and parents/educators.

Setting this ground, the literature review and the first contact with representatives of these external stakeholders' groups across the seven countries involved in the pilot study application, allowed the creation of a first version of six "personas cases". The "Persona" tool consists of the creation of a fictitious profile based on the study of groups of people who use a product or service. We present initial versions of these people that are **not validated by the participants**. This technique defines a basis for development work, it is a way to summarize the characteristics of a group in a representation so that participants can empathize with the case presented and speak not only from their perspective but also from a more global perspective of the group they represent.

Later phases of interaction with the external stakeholders will enable the SMILE consortium to refine these personas, deepening the information and acquiring its validation.

Follow the images of the first version of the six personas created.



Figure 10 Persona – 1st version – Mary (10 to 14 years-old)

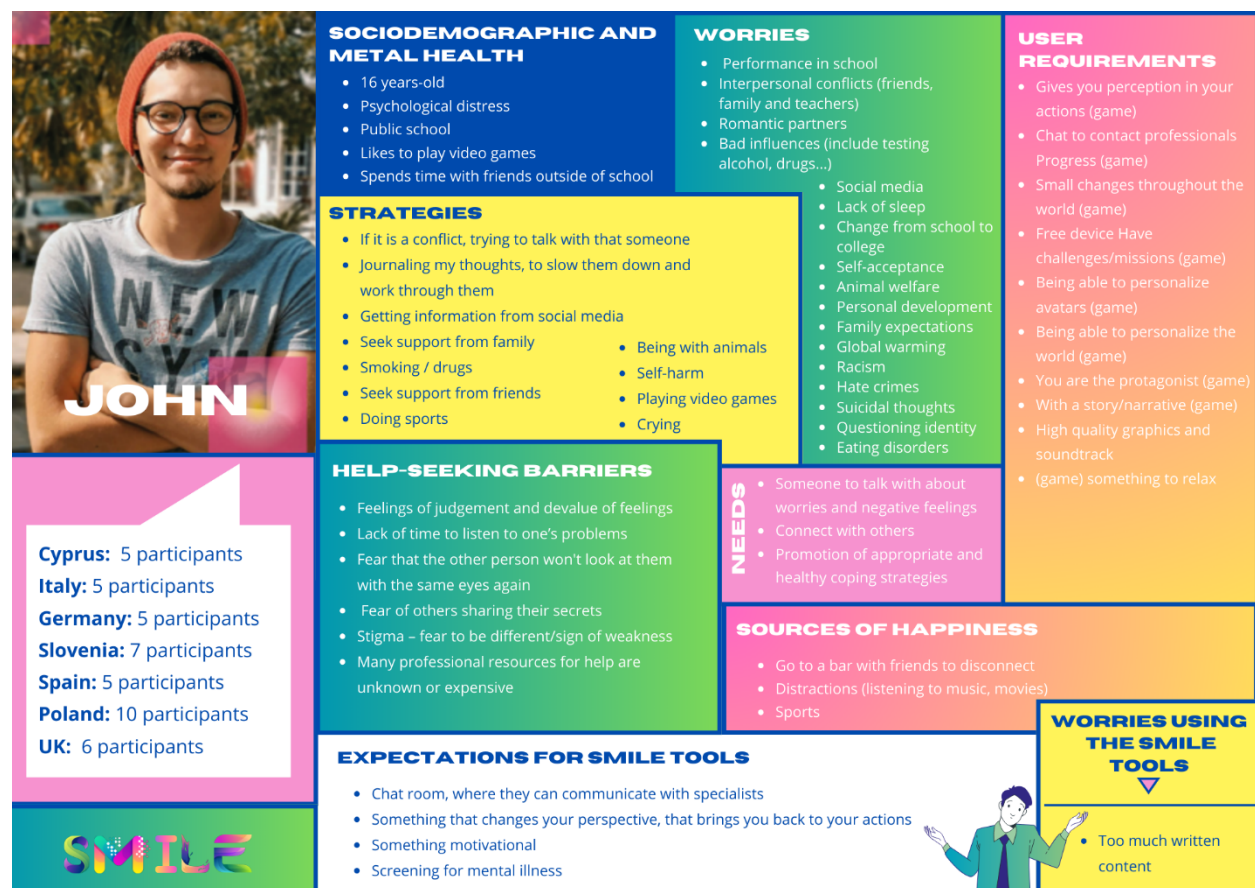


Figure 11 Persona – 1st version – John (15 to 18 years-old)



Figure 12 Persona – 1st version – Alicia (19 to 24 years-old)



Figure 13 Persona – 1st version – Sara (healthcare professional)



Figure 14 Persona – 1st version – Fran (teacher)





Figure 15 Persona – 1st version – Ana (parent)

## 6.2. First version of the use case

A first version of the use case where the main technologies that are being develop and its potential use and interaction with the end-users of the project are herein presented.

In this deliverable, the discussions between WP2, WP4, WP6 and WP7 enabled the creation of a representative diagram flow of the youngers and healthcare professionals' profiles within the Project study. The major information that can be found in this diagram is the SMILE tools that are interacting with these two profiles, the technologies that support these tools, the general description of the study to the younger end-users, the inclusion criteria and the pre- and post-study tests marks.

In later phases of the SMILE project, further decisions will be made. These developments will allow for the deepen and specification of this and more use cases.

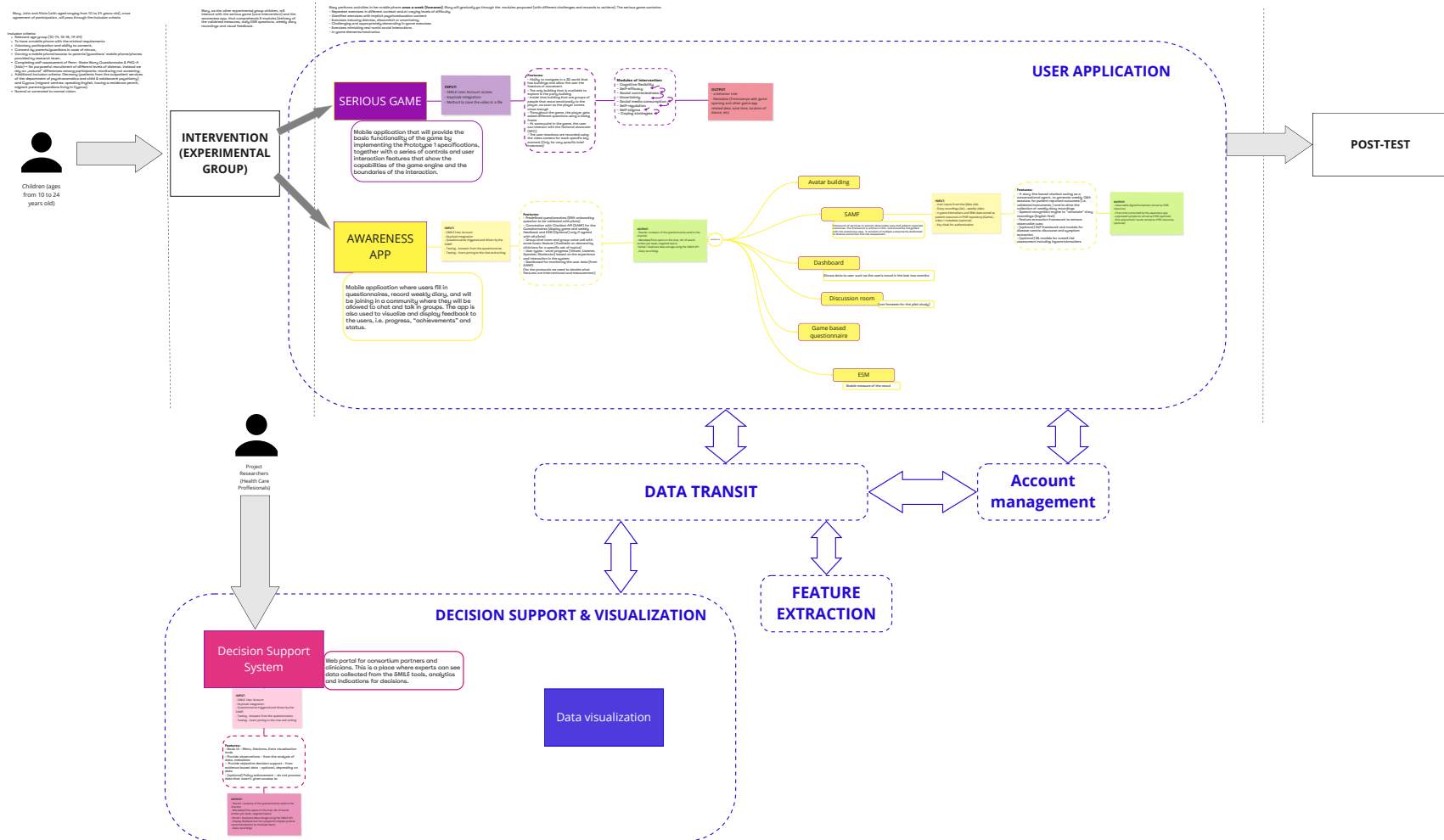


Figure 16 1st Use case



## 7. Conclusions

The deliverable documents the work done till now in gathering the user requirements and forming the user stories for the development of the SMILE platform as a whole. The deliverable focuses on the steps followed in the methodology to gather the requirements and the use cases, as well as the personas intended to be targeted by the project use cases. The deliverable also documents in detail the various specification for the technical components of the project and how they intend to work in addressing the stories and the requirements by the users. Most of the technical components are addressing multiple user stories with some components acting as a bridge or a supplementary component to build the entire pipeline to conduct the studies. More detailed descriptions of the technical components will be provided in specific deliverables in the various works packages in the next months. The use cases will also be updated in the further versions of the deliverables of work packages 2.

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## 9. Annexes

### Annex A: Main script – Workshop – Young (10-24 years) – April/May 24

#### Objectives

- Persona's validation and refinement
- Get feedback on the game scenarios and storyline.
- Development of data capture mechanisms
- Visualization of results (SAMF)
- Development of risk assessment models
- Development of medical device assessment framework
- Get feedback on the app initial features.
- Improve the initial UX/UI design.

#### Expected outcomes.

- UI preferences for the visualization of the results
- Validation of the questions
- Refined version of the personas
- Improved set of features to be implemented.
- Improved co-created UX/UI design.

#### Considerations

- Age – form the same age groups as stated in the DoA.
- Gender – in recruitment, an attempt to maintain a balance.

### Session with youngers from 10 to 24 years old

**Time of the workshop: 1h50m**

**Colour code for this document:** Blue: questions to participants; Green: Facilitators information; Red: material used.

#### Presentation

[SMILE\\_SmileTools\\_Workshop\\_Presentation v1.0\\_EN.](#)

Part 1 – Introduction and personas

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
#1	Obligations	<ul style="list-style-type: none"> <li>• Introduce the Project/workshop goal. To develop a video game through which young people will work on their well-being, resilience,</li> </ul>	5 min.

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
		<p>mental health and so on. European project. 14 entities from 9 European countries. Involved Psychologists, researchers, game developers, software developers, ...</p> <ul style="list-style-type: none"> <li>• <b>Consent forms</b> and <b>informative sheets</b> documents and <b>survey</b></li> </ul>	
#2	Introduction	<p>Explain session objectives.</p> <p>Explain session rules.</p>	2 min.
#3	Personas	<p>Present the Persona that represents the same age group.</p> <p>Questions:</p> <ol style="list-style-type: none"> <li>1 Do you think this person represents people from your age group?</li> <li>2 Is there something you want to consider it should be modified?</li> </ol>	10 min.

## Part 2 – Awareness app

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
#1	Introduction	<p>Presentation of the app.</p> <p>A mobile application where users can fill out questionnaires, record weekly diaries (video/audio), join a community where they can chat, engage in group discussions, and support each other, earn rewards for activities, view their progress and achievements, and receive feedback.</p> <p>The app also utilizes video content to educate and empower users to make informed decisions regarding their nutrition and lifestyle choices, thereby promoting resilient physical and mental health.</p>	2 min.
#2	Features Improvement suggestion	<p>Initial mock-ups are shown.</p> <ul style="list-style-type: none"> <li>• Features <b>questionnaires</b>: (Facilitators: Explanation and details in ANNEX)</li> </ul> <p>Participants reflect on. 1 minute</p>	18 min.

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
		<p>Participants suggest features. 4 minutes</p> <p>Participant are invited to vote on: M (must), S (should), C (could), N (Will Not Have) 1 minute.</p> <ol style="list-style-type: none"> <li>1 View assigned questionnaires list and search through.</li> <li>2 Answer questionnaire with ability to track progress and the possibility to pause and resume later.</li> <li>3 Reward user on questionnaire completion.</li> <li>4 View questionnaire details after completion</li> <li>5 Questionnaire may contain single and multiple-choice question, audio and video recording question, text answer question.</li> <li>6 Receive notification on questionnaire assignment.</li> <li>7 Collecting some device metadata (sleep pattern, etc.) during questionnaire if user agree.</li> </ol> <ul style="list-style-type: none"> <li>• Features Chat Room: (Facilitators: Explanation and details in ANNEX)</li> </ul> <p>Participants reflect on. 1 minute</p> <p>Participants suggest features. 4 minutes</p> <p>Participant are invited to vote on: M (must), S (should), C (could), N (Will Not Have) 1 minute.</p> <ol style="list-style-type: none"> <li>8 View discussion rooms I'm in and search through based on room name.</li> <li>9 View room chat history (up 30 days) with possibility to send/reply to messages.</li> <li>10 Participating to voice call discussion by starting or joining a call.</li> <li>11 Create or join chat room.</li> <li>12 Voice call participant can request speaker seat, gift other or leave before the end.</li> </ol> <p>Features <b>NUTRITIONAL CONTENT</b> (Facilitators: Explanation and details in ANNEX)</p> <p>Participants reflect on. 1 minute</p> <p>Participants suggest features. 4 minutes</p> <p>Participant are invited to vote on: M (must), S (should), C (could), N (Will Not Have) 1 minute.</p> <ol style="list-style-type: none"> <li>13 View nutritional and lifestyle education video lesson tailored to specific age group.</li> </ol>	

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
		14 Test knowledge and earn rewards with a fun nutritional and lifestyle quiz!	
#3	UX/UI co-creation	<p>Initial mock-up is shown.</p> <ul style="list-style-type: none"> <li>• <b>Mock-up questionnaires</b></li> <li>• <b>Mock-up Chat Room</b></li> <li>• <b>NUTRITIONAL CONTENT mock-up video</b></li> </ul> <p>Reflect on the UX/UI 2 minutes.</p> <p>Participants provide feedback for improvement. 8 minutes</p>	10 min.

## Part 3 – SAMF

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
#1	Introduction	<p>Researchers from our project team are interested in psychology, mental health and technology.</p> <p>Research question: Is it possible to deduct, from a recording of a person, how this person feels?</p> <p>This will be done with an AI model.</p> <p>The model will observe speech speed, voice pitch, pronoun usage, ...</p>	1 min.
#2	Diary recordings	<p><b>Presentation of diary recordings (4 min)</b></p> <ul style="list-style-type: none"> <li>▪ <i>Presentation of diary recordings: why do we need them, what would the participants' role be in this, how would the recordings and data be used in the project.</i></li> <li>▪ <i>Mock-up presentation of how recording such video would look like</i></li> </ul> <p><b>Show Video Diary Recording.mp4 (OPTIONAL)</b></p> <p>Read <b>SMILE Diary Recording Translation</b> to English in the ANNEXES (OPTIONAL)</p> <p>We will achieve the goals from the previous slide only if we receive a BIG NUMBER of recordings from young people. On these, AI model will train.</p> <p>Here it's your or your peers' turn. The task will be to record a video diary and meanwhile speak into the camera.</p> <p><b>**We show the recording example** 30 seconds</b></p> <p>Today, we won't be making videos, we are still DESIGNING the process of how to CONVINCING young person to film themselves, how to GIVE THEM INSTRUCTIONS and how to carry this out in general.</p> <p><b>**Here, we emphasize the part where we ask them for their opinions. This way, they will feel important so they will give is more insights. **</b></p>	4 min

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
		In this part, we will ask you a couple of questions and you will help us to carry out the project well and get as many recordings as possible.	
#3		<p><b>Discussion on content questions for diary recordings (10 min)</b></p> <ul style="list-style-type: none"> <li>Present all the questions for baseline measurement (on PPT) and gather feedback (questions are presented on ANNEX)</li> </ul> <p>Instructions for moderators: the participants are presented that these are the questions young people will be answering to WHILE filming the video. We give them time to read them quietly to themselves. Then, we ask them the first question in blue, and after receiving answers, we show the second question.</p> <p>Instruction for participants: These are the questions that young people will be answering to while filming the videos. Read them carefully and imagine yourself answering these questions and filming yourself while doing it.</p> <ul style="list-style-type: none"> <li>1 min – quiet reading of the questions</li> <li>Show the first question: 4 min for discussion.</li> </ul> <p>1 Would you feel comfortable answering such questions?</p> <ul style="list-style-type: none"> <li>We show the second question: 4 min for discussion.</li> </ul> <p>2 Is there a question that you would not like to answer to? Why?</p>	10 min
#4		<p><b>Discussion on (execution of) diary recordings (10 min)</b></p> <ul style="list-style-type: none"> <li>Present the questions for HOW to carry out the recording of the videos? (on PPT) and gather feedback.</li> </ul> <p>Instructions for moderators:</p> <p>The questions should be shown one by one. There is not much time, thus no room for extra questions is foreseen.</p>	10 min

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
		<p>For a better image about the time constraints we have, a time that should be devoted for each question is suggested.</p> <ol style="list-style-type: none"> <li>1 Would you agree with yourself filming such videos? Would your parents agree? (&lt;18y) In case somebody says ,no ' , we need to ask WHY NOT? 1,5min</li> <li>2 Would you agree that information from the videos is shared with doctors? For what kind of information would you agree (transcript, whole video, only the indicators)? 1 min</li> <li>3 Under which conditions would you film such videos? In what area/room, alone or with parents, 1 min</li> <li>4 Is there anything that would discourage you to film such videos? What? Young person only list ideas. 1,5min</li> <li>5 In case you would not want to film these videos, would you be willing to answer the same questions via chat? Young person answer with yes/no. 30s.</li> <li>6 How much time would you be willing to spend to record such videos? Young person state the number. 30s</li> </ol>	

## Part 4 – Game features

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
#1	Introduction	<p>Presentation of the activity.</p> <p>A game is designed to allow you to roam around a city and do tasks that challenge them but at the same time also teach them how to handle situations better. Please see in detail the next styles explaining the various themes and see which ones are most exciting to you". Ever wanted to design your own game character?</p> <p>Now you can! Choose your hero's looks, outfits, and even select a trusty companion to join you on your journeys. Whether it's a fiery dragon, a wise robot, or</p>	2 min.



Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
		something entirely unique, your adventure will be truly yours	
#2	Shows themes	<p>Then, 10 game scenarios setting/themes are presented Screen ppt presentation.</p> <p>Suggestion: printed also if possible (but only picture, hero and environment).</p> <ul style="list-style-type: none"> <li>• Fantasy Setting (Medieval Theme)</li> <li>• Realistic Setting (Present Day Theme)</li> <li>• Science-Fiction (Future Theme)</li> <li>• Underwater World theme</li> <li>• Post-Apocalyptic theme</li> <li>• Wild West theme</li> <li>• Steam Punk theme.</li> <li>• Cyberpunk setting</li> <li>• Mystical Forest setting</li> <li>• Film Noir/Crime Mystery</li> </ul>	10 min.
#3	Shows Types of camera perspectives	Then shows types of camera perspectives: 1 <sup>st</sup> person view and 3 <sup>rd</sup> person view, Isometric and Top Down	1 min.
#4	Questions	<p>Ask each participant next questions by round about what they had seen before and take note of the answers.</p> <ol style="list-style-type: none"> <li>1 Which top 3 game themes do you find most exciting? List your top 3 themes.</li> <li>2 What kind of setting makes you want to explore more? List your top 3 themes.</li> <li>3 If you could choose, what magical companion would you love to have on your adventures? List top 3 companions</li> <li>4 What kind of hero would you be? Answer can be anything here.</li> <li>5 What type of missions do you think are the most fun? Solving puzzles, exploring new locations or helping friends</li> <li>6 How do you like to learn new things in games? Through stories, challenges or creating and building.</li> <li>7 How important is it for you to customize your character and world? Not important, somewhat important, very important</li> </ol>	16 min

Code	Phase	Activity to carry out (description and questions to pose)	Time for activity
		<p>8 What would you like to customize? (colour, skin colour, hair, clothes, ...)</p> <p>9 What's one thing you would love to see in a game that you haven't seen before? Can be anything.</p> <p>10 Which camera perspective did you like the most?</p> <p><b>(OPTIONAL QUESTIONS)</b></p> <p>11 What's the coolest game you've ever played, and what made it so special?</p> <p>12 How do you feel when a game teaches you something new in a fun way? Can you give an example?</p> <p>13 How many games do you play on your phones, and which one do you play the most?</p> <p>14 Where do you usually play smartphone games? Living room, bedroom etc.?</p>	

Part 3 – SAMF \* **Questions for diary recordings to be presented to participants** *Note. These questions are baseline questions that would be repeated also in the final evaluation. We do not present questions related to each of the modules since they will probably still change as the game development progresses.* Questions: 1. a. Can you tell me about yourself, so I can get an idea of who you are? 1. b. How would you describe yourself to someone who is just getting to know you, including your emotions, interests, and relationships? 2. Can you describe what goes through your mind on a regular day, including any persistent negative thoughts or worries? 3. How would you describe your overall feelings and energy levels recently? Any noticeable changes affecting your daily life, work, family, or friends? 4. Can you describe your typical reactions in challenging situations, especially in relationships with others? 5. Do you engage in some activities or hobbies when you are not feeling well? Do they help you to feel better? 6. Is there anything specific that you find really fascinating or intriguing lately? And how did that make you feel? **Diary Recording**

### Transcription

0:00

Dear John, welcome to our weekly session.

0:03

Before we delve into our questions, I want to remind you that we value detailed responses.

0:09

Feel free to provide thorough explanations.

0:12

Lengthy answers are encouraged.

0:14

After answering each question fully, please indicate next to proceed to the following one.

0:21

Now let's proceed with the questions.

0:24

First question, Tell me about yourself so I can get a picture of who you are.

0:31

So my name is John.

0:33

I'm 31 years old, born and bred in Mighty Board, Slovenia.

0:38

I'm a medical doctor, a child and adolescent psychiatry residents to be precise.

0:44

In my free time, I enjoy cycling.

0:48

In fact, I'm currently in the process of purchasing a new road bike.

0:52

During the winter I used an older bike on an indoor trainer, but now it's time to hit the road, so I need a new one.

1:00

Naturally, me and my girlfriend of seven years recently moved in a house where I built my own greenhouse cabinet.

1:11

Well, I bought a glass cabinet from IKEA and filled it with plants, but technically I still had to assemble it, so let's say I built it.

1:20

Thus, you could say that plants and plant propagation is one of my interests.

1:26

I wouldn't go as far as to say I have a green thumb, but I do find enjoyment in it nonetheless.

1:33

So my interests include cycling plants and yeah, my cat, Nada Santra.

1:41

We adopted her when she was a few months old and we had her for three years.

1:48

Now she's extremely demanding, brimming with energy and constantly 6 playtime.

1:55

Generally I complain about the amount of time she demands, but on her quieter days or when her energy is low, which is rare to be frank, I do find myself worrying about her.

2:08

I would say that I am more of an introvert with occasional need for extroversion.

2:15

I'm empathetic, caring, meticulous person.

2:20

I guess you could say that I'm quite emotional.

2:23

It doesn't take much for me to cry during a sad movie or a happy movie, but it also doesn't take much to make me laugh.

2:31

So I always try to look on the bright side of life, keyword being try.

2:38

Sometimes I succeed, sometimes I don't.

2:43

Yeah.

2:44

Next question.

2:46

Second question, can you share what's on your mind daily, including any persistent negative thoughts or worries?

2:54

As I said, my cat no.

2:57

During work days, patients go through my mind and I try to go through their minds, but when I

come home, yeah, the cat.

3:06

Also, my girlfriend is a psychiatry resident.

3:09

So when we get home, we tend to talk about the cases we had during the day.

3:15

But we do try to limit the time we spent on that subject.

3:20

Besides work, general stuff.

3:23

You know what needs to be done around the house?

3:26

When will we go shopping?

3:28

Where will we go shopping?

3:31

What movie or TV show are we going to watch in the evening?

3:35

The answer is almost always Master Chef Australia.

3:39

OK, I wouldn't say that there are any persistent negative thoughts in my head, as in being present 24/7, but of course I do worry.

3:50

I'm quite anxious by nature.

3:52

In fact, I worry about things that needs to be done.

3:56

I'm doing them, are they're going to be done well enough, are they done well enough?

4:03

Things like that.

4:03

You know, minor things that are nothing in comparison with things that are going on in the world around us at the moment.

4:12

I do read and listen about those things.

4:14

Catastrophes, I should say, but my mind is quite good at forgetting about those during the day.

4:23

Yeah.

4:24

Next question.

4:26

Third question.

4:27

How would you describe your overall feelings and energy levels recently?

4:31

Any noticeable changes affecting your daily, daily life, work, family or friends?

4:39

I'd say I feel quite good.

4:41

7 1/2 out of 10, then being the best and one being the worst.

4:47

It's spring, so to be a bit tired, it's normal, I guess.

4:54

Nothing out of the ordinary, No.

4:57

Next question.

4:59

Thank you for your cooperation.

5:01

We value your participation and contributions.

5:04