Digital literacy enables up-to-date sleep medicine in inclusive healthcare

eSleep_dHealth

Document: Social Innovation Toolkit for digital literacy and inclusive digital interventions in sleep medicine

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1 Introduction

The **Social Innovation Toolkit for digital literacy and inclusive digital interventions in sleep medicine** is an integral part of the **Digital literacy enables up-to-date sleep medicine in inclusive healthcare project**, crafted to enable higher education institutions to design and implement a Social Innovation Incubator focused on advancing digital sleep medicine. Developed as part of **Work Package 3 Design of Social Innovation Toolkit for Digital Sleep Medicine**, the Toolkit is complemented by a carefully designed Curriculum and Open Educational Resources. These materials will be used in the implementation of the course and in preparing students for participation in the incubator, ensuring they are equipped with the necessary knowledge and skills for success. The Toolkit's keys include providing step-by-step guidance for establishing incubators, integrating innovative teaching practices, and promoting EU-aligned service-learning models that combine academic work with real-world social engagement.

This Toolkit stands out by its unique approach of fostering collaboration across multiple universities. Unlike traditional incubators confined to individual institutions, this model leverages the collective strengths of diverse universities and their student bodies, offering a rare example of interdisciplinary and inter-university cooperation. By advancing digital literacy and fostering entrepreneurial thinking, the Toolkit equips students to tackle health challenges, enhance education, and develop solutions aligned with labor market needs. This Toolkit is grounded in interdisciplinary principles that combine digital health, sleep medicine, and entrepreneurship, addressing pressing healthcare needs while fostering essential skills in digital literacy, technological innovation, and social responsibility.

While the Toolkit provides specific examples in digital sleep medicine, its framework is designed to be versatile, supporting universities in implementing incubators on diverse themes of social innovation. This approach ensures that universities can adapt the incubator model to their unique needs, fostering cross-disciplinary collaboration and cultivating a broader pool of innovative solutions. It is important to note that this document presents a comprehensive catalog of tools, offering universities a flexible selection to tailor to their unique challenges. The specific tools utilized in an incubator will vary depending on the focus and objectives of the chosen theme or challenge. Future iterations of the program may feature different tools, ensuring adaptability to emerging trends and needs.

The purpose of the Toolkit is to bridge academic learning with real-world health applications by equipping students and educators with structured methods, tools, and resources for addressing digital health challenges in a socially impactful way. With the rapid growth of digital technologies and the increasing need for specialized healthcare, higher education institutions require resources that integrate open pedagogy and collaborative learning. This Toolkit meets that need by fostering innovation-driven approaches to health issues, emphasizing both preventive health measures and interdisciplinary collaboration. Designed with flexibility, it provides a foundation that universities can adapt to various topics, making it relevant for a wide range of health innovation and digital literacy initiatives.

The structure of this Toolkit is designed to guide users through the core concepts and stages of incubator creation, offering an adaptable resource for broader health education goals. Beginning with

an introduction to its purpose, context, and scope, the Toolkit lays a foundation for understanding the value of social innovation in healthcare education, including case studies of successful models. It then explores the resources and methods needed to build relevant skills, enhance digital literacy, and foster user-centered healthcare innovations.

A practical roadmap follows, detailing steps for launching and managing incubator activities to ensure a collaborative, impactful experience for both students and mentors. Finally, the Toolkit concludes with strategies for sustaining the incubator's impact over the long term, expanding partnerships, and adapting the framework to other areas of health innovation.

In essence, this Toolkit is structured to guide users through the stages of incubator creation, including activity planning, educational resources, and implementation steps. By following these guidelines, institutions can develop incubators that contribute to a sustainable impact in various domains of social innovation.

2 Understanding Social Innovation Incubators

2.1 Definition and Importance

Social innovation involves the design and implementation of new solutions that introduce conceptual, process, service, product, or organizational changes. These innovations are crafted to improve the well-being of individuals and communities and promote systemic change. Unlike conventional innovation, which often focuses primarily on market-driven solutions, social innovation prioritizes positive societal impact, targeting systemic issues such as healthcare accessibility, poverty, education inequality, and environmental sustainability. This approach tackles complex societal challenges by bridging gaps in services, resources, and infrastructure to meet the unique needs of diverse communities, often by leveraging technology and community engagement.

In practice, social innovation may take the form of new technologies, policies, or community-based programmes that fundamentally change how services are delivered, or resources allocated. Also, social innovation often involves partnerships across sectors, drawing on the expertise of public institutions, private companies, and non-profits to develop comprehensive, scalable solutions that improve the quality of life and strengthen community resilience.

Encouraging the development of social innovation in the education system, particularly in higher education, is essential, as students play a key role as agents of change in society. Integrating social innovation into higher education creates dynamic learning environments where students actively engage with current societal challenges. This approach highlights experiential learning, allowing students to apply theoretical knowledge to real-world contexts, deepening their understandings beyond the classroom and fostering a sense of purpose. Social innovation applies skills such as critical thinking, problem-solving, creativity, interdisciplinary collaboration, adaptability, and enhances an entrepreneurial mindset with an understanding of inclusivity, cultural competence, and social responsibility. It also encourages students to develop practical, impactful solutions to pressing social issues, making educational programmes more relevant to current societal needs. As a result, students not only become more competitive in the job market but also emerge as empathetic and socially conscious professionals, well-equipped to drive meaningful change and adapt to evolving career demands.

Social innovation empowers universities to play a transformative role in addressing societal challenges, driving impact at both local and global levels. At the local level, universities connect with community stakeholders to identify and address the specific needs of their communities. By collaborating with local organizations, governments, and businesses, they can co-create initiatives that improve access to essential services, promote social equity, or foster economic development. Globally, universities leverage their interdisciplinary expertise, research capacities, and diverse partnerships to develop innovative solutions to complex global issues. For example, they can contribute to scalable solutions that address widespread challenges such as public health, education, or environmental sustainability. By adopting social innovation, universities can become catalysts for positive societal change and build

effective partnerships with stakeholders, such as government agencies, non-profit organizations, and businesses, amplifying their role as agents of social progress.

Social innovation is of great significance in healthcare and sleep medicine, particularly in addressing the many unmet health needs that require innovative solutions. Despite advancements in healthcare, gaps remain in areas such as access, affordability, and personalization of care, especially for vulnerable and underserved communities. In sleep medicine, these challenges are evident in the limited availability of diagnostic tools, insufficient access to treatments, and a lack of tailored solutions for diverse populations. Social innovation, with its emphasis on inclusivity and user-centric design, plays a crucial role in bridging these gaps and contributing to the development of innovative, impactful solutions. The rapid growth of digital technologies, such as remote patient monitoring, AI-driven diagnostics, and mobile health apps, offers new opportunities to overcome these challenges in sleep medicine. These innovations improve accessibility, equity, and personalization of care. By supporting the development of these technologies, social innovation incubators can ensure that sleep care is scalable and adaptable to meet the diverse needs of communities, ultimately making treatments more accessible, affordable, and individualized.

Although this toolkit emphasizes digital health and sleep medicine, its principles are designed to be adaptable across various fields and sectors. The toolkit was created as a guide for designing and implementing a specific incubator that reflects the unique needs of the digital health and sleep medicine domain. However, its broader intent is to provide guidelines that other universities and institutions can use to establish similar initiatives tailored to their unique challenges and goals. In doing so, this toolkit aims to foster the growth of social innovation across diverse settings, empowering institutions to address societal challenges through collaborative, impactful, and scalable solutions.

2.2 Social Innovation Incubators in Sleep Medicine and Digital Health

Social innovation incubators are structured programmes or organisational units designed to support the development, testing, and implementation of innovative solutions that address societal challenges in a participatory and inclusive way. Their primary objective is not merely to generate new technologies, but to create social value, such as improving health outcomes, accessibility, and equity through collaborative innovation processes.

Unlike traditional incubators that focus on market potential and commercialisation, social innovation incubators place strong emphasis on user needs, community engagement, and real-world problem-solving. They bring together a diverse range of stakeholders – including students, researchers, healthcare professionals, patients, community representatives, businesses, and policymakers – to co-create solutions tailored to specific social contexts.

In higher education settings, social innovation incubators function as bridges between education, research, and societal needs. They are often embedded within existing institutional structures, such as innovation offices, interdisciplinary centres, or academic programmes, enabling students and staff to apply their knowledge to real challenges. Through a structured process involving ideation, design,

prototyping, testing, and evaluation, incubators help transform ideas into tangible solutions that can be integrated into healthcare systems, particularly in underserved areas.

Key features of social innovation incubators include:

- **Collaborative learning environments**, where interdisciplinary teams work together on problem-solving.
- **Co-creation with end-users**, ensuring solutions are relevant, accessible, and inclusive.
- **Focus on societal impact**, with clear mechanisms for measuring health, social, and policy outcomes.
- **Integration into institutional frameworks**, allowing innovations to be sustained beyond the initial project phase.
- **Use of technology as an enabler**, supporting innovation in areas such as telemedicine, artificial intelligence, and mobile health, without making technology the central driver.

Within the field of sleep medicine and digital health , social innovation incubators provide a structured and collaborative environment for developing solutions that address unmet health needs, particularly among vulnerable and underserved populations. Sleep disorders are increasingly recognized as a major public health challenge, affecting quality of life, productivity, and overall well-being, yet access to specialised diagnostics and treatments remains uneven across regions and social groups.

Social innovation incubators in this domain leverage digital technologies as enablers – such as telemedicine platforms, mobile health applications, wearable devices, artificial intelligence, and remote monitoring tools – to extend the reach of sleep health services, support early detection of disorders, and facilitate continuous care. However, their primary focus is not technological development itself, but co-designing inclusive, user-centred solutions that fit the needs and capacities of end users.

These incubators operate through structured innovation cycles that typically include:

- **Needs assessment** of different population groups to identify barriers to accessing sleep health services (e.g., lack of specialists, digital literacy gaps, socio-economic constraints).
- **Co-creation workshops and interdisciplinary collaboration** involving students, healthcare professionals, ICT experts, patients, and community representatives to design solutions that respond to these needs.
- **Development and piloting** of digital tools, educational interventions, or service delivery models tailored to local contexts (e.g., mobile screening units, patient education apps, or virtual group therapy).
- **Evaluation and integration** of successful interventions into existing healthcare systems and institutional frameworks, ensuring long-term sustainability.

By focusing on social impact, inclusivity, and practical implementation, social innovation incubators in sleep medicine and digital health support the transformation of healthcare systems. They help bridge the gap between technological innovation and real-world adoption, ensuring that digital solutions are accessible, user-friendly, and effective in improving sleep health for all population groups.

2.3 Social Innovation Incubators vs. Traditional Innovation Models

While both social innovation incubators and traditional innovation models aim to generate new solutions and drive change, they differ significantly in their underlying goals, processes, and approaches to technology and stakeholder engagement.

Traditional innovation models typically focus on technological advancement, commercialisation, and market competitiveness. Innovation is often driven by research and development activities and industry interests, with success measured through economic outcomes such as product development, intellectual property, and market growth. Stakeholder engagement is usually limited to consumers or end-users at later stages of development, and education and research institutions often play a supportive or external role.

In contrast, social innovation incubators prioritise societal impact, inclusivity, and community engagement. Rather than treating technology as the central driver, they use it as an enabler to design solutions that respond to real-world needs. Innovation emerges through collaborative, participatory processes that involve diverse stakeholders from the outset, including communities, patients, healthcare professionals, students, researchers, policymakers, and businesses.

These incubators are frequently embedded within higher education institutions, connecting research, education, and practice. Their aim is to foster interdisciplinary learning environments that enable students and researchers to co-create solutions for pressing societal challenges – such as improving access to sleep health services through digital tools – while simultaneously building skills in entrepreneurship, user-centric design, and social responsibility.

The table below outlines key differences between the two approaches.

Table 1 Social Innovation Incubators vs. Traditional Innovation Models

Dimension	Social Innovation Incubators	Traditional Innovation Models
Primary Goal	Address societal challenges and improve health equity, inclusivity, and community well-being	Develop new products, services, or technologies for commercialisation and market growth
Innovation Driver	User and community needs, co-creation processes	Technological advancement, research and development outcomes
Role of Technology	Technology is an enabler to support user-centric solutions and social change	Technology is often the main driver and focus of innovation
Stakeholder Involvement	Multi-stakeholder engagement including communities, patients, NGOs, policymakers, students, and healthcare professionals	Primarily industry, research and development teams, and sometimes end-users as consumers
Educational Integration	Embedded within higher education curricula and research, focusing on student capacity building and societal engagement	Typically external to curricula, often linked to commercialization pipelines
Outcome Focus	Sustainable social impact, inclusivity, improved health access (e.g., sleep health for vulnerable groups)	Economic growth, patents, products, and technological competitiveness
Evaluation Metrics	Social impact indicators, community engagement, improved access and inclusion	Market performance, IP portfolio, return on investment

Source: https://www.sciencedirect.com/science/article/abs/pii/S0040162521006235

2.4 Case Studies

Despite the numerous benefits that social innovation brings to higher education, there is still a noticeable lack of initiatives within academic institutions aimed specifically at fostering social innovation. Research highlights that the integration of social innovation into higher education remains underdeveloped, underscoring the need for structured efforts to address this gap. *(Source: Social Innovation in Higher Education, 2020)* To overcome this challenge, it is crucial to develop various programmes, such as social innovation incubators, which provide students and faculty with the tools, resources, and frameworks to collaboratively tackle societal challenges.

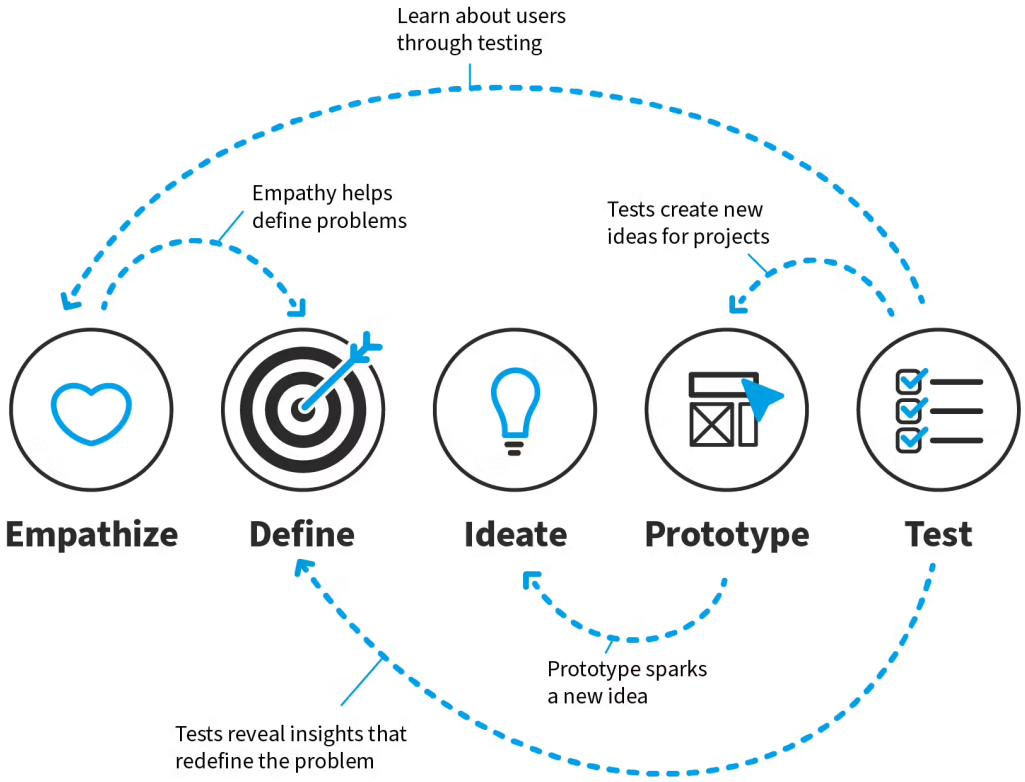
The following examples of successful social innovation incubators in digital health demonstrate how social innovation incubators and similar programmes can successfully address unmet societal needs, while also empowering academic institutions to take on a more active role in creating positive change:

- **UniStart - University of Split**[1]

UniStart, a programme jointly developed by NetHub and the University of Split, aims to encourage the development of interdisciplinary skills, entrepreneurial thinking, and innovative solutions among students. The programme focuses on addressing real-world healthcare challenges through collaborative, student-led innovation. By forming interdisciplinary teams, participants work together to develop and refine solutions to pressing healthcare issues using the Design Thinking method. The challenges addressed during the programme's two editions include facilitating the daily living needs of

[1] https://nethub.hr/

older adults and addressing the issue of company at emergency hospital admissions. The programme is designed to guide teams of students through the entire process of developing and testing entrepreneurial ideas aimed at improving a specific need within healthcare. Students receive mentorship and valuable advice from industry experts. The figure below presents an overview of the methodology applied throughout the programme.



Source: https://www.interaction-design.org/literature/topics/design-thinking?srsltid=AfmBOorSFHTW2yMgy0SkBzj31f-EpW9Ey2_68ifs5UBGpAk1oDSxyVVm

Figure 1 Design Thinking method

To further strengthen their entrepreneurial skills, students participate in workshops on key business topics, such as market research, business modeling, and pitching strategies, preparing them for the programme's culminating event – Demo Day. On Demo Day, teams present their ideas and prototypes to a panel of experts, demonstrating the impact and viability of their innovation. Through this immersive experience, UniStart not only equips students with practical skills in digital health innovation but also fosters an entrepreneurial mindset critical to projects aimed at social impact. Example of solution developed through the second edition of UniStart is Wait-Mate, interactive screens for emergency room waiting areas. These screens display the number of patients and estimated waiting times by triage category, aiming to reduce waiting frustration and increase patient awareness. One of the members of the winning team of the first generation of students who attended the programe statetd that participating in the programme was a valuable experience that broadened their perspective, especially as a medical student working with peers from technology and economics fields. One of the jury

members highlighted the value of the programme in fostering multidisciplinary collaboration among students from different fields. He emphasized the importance of such initiatives, especially in the context of advancing technologies like artificial intelligence, and expressed hope that student-led innovation will inspire broader cooperation for the benefit of the hospital and the local community.

- **SPARK Finland - Health Tech and Life Sciences**[2]

SPARK Finland, a programme across twelve Finnish universities, focuses on translating academic discoveries into practical, value-driven health technologies. Its primary aim is to advance clinical solutions by providing structured guidance at every stage, from preclinical research to real-world healthcare applications. The program uses a structured innovation pathway aligned with technology readiness levels. Teams apply during biannual calls and are selected through a competitive process. After acceptance, they receive long-term mentoring (up to three years) to advance their concepts toward clinical validation and commercialization.

The calls are open to a broad range of topics within the health tech and life sciences sectors, covering areas such as pharmaceuticals, diagnostics, bioinformatics, and health IT solutions.

Proposed projects should:

- Tackle an unmet need within the fields of life sciences, medicine, or healthcare.
- Apply an innovative approach, potentially creating opportunities for intellectual property.
- Demonstrate the potential to progress toward clinical application, clinical trials, or commercialization within a 2–3 year timeframe.

Example of the solution that participated in the project is HumanCardio. This is a specialized solution developed to perform toxicity testing on human heart cells. The system enables precise and reliable assessment of potential cardiotoxic effects of new drug candidates. It has been implemented at FHAIVE, a reference toxicity laboratory recognized by EURL ECVAM, ensuring that the platform contributes to high-standard preclinical testing and regulatory compliance.

By emphasizing a mentorship-driven approach, offering tailored support through workshops, industry partnerships, and educational resources, SPARK Finland equips students and researchers with critical entrepreneurial skills bridging the gap between academic research and impactful health innovations. This model fosters an ecosystem where innovations respond to real-world needs while promoting collaboration between academia and industry.

[2] https://sparkfinland.fi/

3 Designing the Social Innovation Incubator

3.1 Tools and resources

Entrepreneurship and innovation design skills are essential competencies that enable individuals to identify opportunities, develop impactful solutions, and navigate complex social challenges. These skills encompass a blend of creative, analytical, and interpersonal abilities that foster an entrepreneurial mindset, empower individuals to think innovatively, work collaboratively, and adapt to rapidly changing environments. Recognizing their importance, the European Council has identified entrepreneurship as one of the key competencies for lifelong learning in its 2018 Recommendation on Key Competences for Lifelong Learning. These competencies serve as the foundation for designing meaningful, inclusive solutions in digital health and beyond, empowering individuals to drive positive change in their communities and industries.

The general educational tools and resources necessary for fostering social innovation within higher education focus on both theoretical and practical skill development. Students need access to specific tools to understand social innovation principles and to apply them effectively. These include problem-solving methods, design thinking frameworks, and tools for needs assessment and stakeholder analysis. Practical resources, such as case studies, mentorship, and project opportunities, help students connect theoretical knowledge to real-world challenges. With these tools, students can identify societal needs, develop ideas, and create sustainable solutions. The right combination of educational resources and practical tools raise students' capabilities to address important societal challenges and create innovative solutions, but also empower them to become active contributors of social progress.

This chapter will outline the key entrepreneurial skills essential for fostering social innovation, followed by an introduction to various educational tools designed to support digital literacy and inclusive digital healthcare. These tools are specifically tailored for use within the **Digital literacy enables up-to-date sleep medicine in inclusive healthcare (eSleep_dHealth)** course and are aligned with the project's focus on integrating sleep medicine, digital technologies, and entrepreneurship, with special attention to addressing the needs of elders and their varying levels of digital skills.

The tools presented in this chapter are categorized into several key groups — needs assessment tools, design thinking tools, technology tools, evaluation and monitoring tools, and advocacy and policy resources. Each tool description covers the skills and dimensions the tool addresses, their appropriate level of development, learning outcomes, teaching-learning strategies, necessary educational materials, support resources, and evaluation tools.

The chapter also emphasizes the importance of designing solutions that are adaptable and inclusive, ensuring that innovations address the diverse needs of stakeholders, particularly older adults, while fostering ethical and effective use of digital tools in healthcare.

3.1.1 Skills

To succeed in entrepreneurship and innovation design, individuals need a core set of skills that enable them to identify opportunities, address complex challenges, and bring new ideas to life. These skills foster an entrepreneurial mindset that combines curiosity, critical analysis, strategic planning, and adaptability, qualities essential for navigating dynamic and competitive environments, and are particularly valuable for innovators aiming to create solutions that address social challenges.

To improve clarity and usability for students, the skills are organised into two categories:

- **Essential Skills** – Fundamental competencies required for all participants to engage effectively in innovation processes.
- **Desirable Skills** – Additional competencies that strengthen entrepreneurial capacity and are particularly useful for students pursuing advanced innovation roles or leadership positions.

Essential Skills

1. **Curious and Critical Mindset**: A foundation for innovation, this skill involves maintaining a curious approach to understanding the root causes of challenges and exploring novel solutions. This includes awareness of diverse situations, such as economic, environmental or social contexts, and the ability to recognize opportunities to transform ideas into innovative products or services. In digital health, a critical mindset allows innovators to question existing methods, identify gaps in patient care, and consider the potential impact of emerging technologies on global health challenges, such as sleep disorders.
2. **Strategic Thinking and Business Planning**: To contribute to solving key challenges, innovators must develop strategic thinking skills, which include creating well-defined plans for new initiatives. This involves setting goals, outlining actionable steps, and identifying necessary resources and partnerships. In sleep medicine, strategic planning also includes considering how digital health solutions can scale to meet broader market demands, from improving individual sleep monitoring to addressing population-level sleep disorders.
3. **Communication and Negotiation Skills**: Effective communication is essential for gaining buy-in from stakeholders, including potential investors, customers, team members, regulatory bodies and partners. Entrepreneurs must articulate the value of their ideas clearly, showcasing benefits and potential impacts. Strong negotiation skills are equally vital when securing funding for digital heath innovations, establishing partnerships, and advocating for policy changes that facilitate the adoption of digital health or sleep care solutions.
4. **Market Analysis and Identification of Target Needs**: Understanding the market and identifying the specific needs of target users is a critical part of innovation. This ensures that solutions address real-world problems and have a meaningful impact for the identified stakeholder. This involves analyzing demographics, assessing pain points, and understanding user preferences. Conducting thorough market research helps innovators tailor their solutions, ensuring that

digital health tools, such as sleep tracking apps, remote consultations, or therapeutic devices, are relevant, valuable, and aligned with the need and preferences of target groups.

5. **Digital Literacy**: Digital literacy is essential for innovators in sleep medicine and digital health, enabling them to use digital tools and data effectively to design, implement, and evaluate solutions. Innovators need to understand basic data analysis and interpretation involves working with analytical tools (e.g., Excel, dashboards) to clean, organise, and interpret quantitative and qualitative data. Also, they need to navigate digital health platforms (such as, telemedicine systems, patient portals, and mHealth applications) to understand core functionalities, evaluate usability and interoperability, and prototype solutions within realistic digital health settings. Finally, they need to understand how to use remote collaboration and co-creation technologies cover the use of digital platforms or teamwork, co-design, and innovation across distributed settings to engage stakeholders online, run virtual design processes, and manage shared documentation effectively.
6. **Leadership Skills**: Leadership skills are essential for guiding teams, coordinating projects, and ensuring the successful development of innovative solutions. They enable participants to manage interdisciplinary teams, engage multiple stakeholders, and foster a collaborative and creative environment. Key competencies include: **team coordination in virtual and interdisciplinary settings** (organising tasks, delegating responsibilities, and monitoring progress across distributed teams, ensuring accountability and efficiency), **stakeholder communication** (engaging patients, healthcare professionals, academic supervisors, policymakers, and industry partners through clear, empathetic, and goal-oriented communication), **conflict resolution and negotiation** (identifying sources of conflict, mediating disagreements, and maintaining positive team dynamics internally and with external partners), **decision-making under uncertainty** (making informed and timely choices even with incomplete information, balancing risk and innovation), **fostering creativity and innovation** (encouraging idea generation, experimentation, and iterative learning within teams, supporting user-centred and socially impactful solutions).

Desirable Skills

1. **Understanding of Relevant Technologies and Platforms**: Given the increasing reliance on digital tools, entrepreneurs benefit from a foundational knowledge of technologies relevant to their field. This may include software platforms, data analytics, automation tools, or digital marketing technologies, depending on the project's focus. This skill ensures that innovators can not only implement these technologies effectively but also keep up with advancements in digital health tools that may further enhance sleep health interventions.
2. **Regulatory and Ethical Awareness**: Innovators need to understand the regulatory requirements and ethical implications associated with their solutions. This includes compliance with industry standards, data privacy laws, and ethical best practices. Ethical awareness also involves

prioritizing the well-being of patients by designing solutions that respect their autonomy and address potential biases or unintended consequences in digital health technology.

3. **Empirical Testing and Validation Through Prototyping and User Feedback**: Testing and validating ideas through empirical methods ensures that solutions are effective and reliable. This skill includes building prototypes, gathering feedback from users, and refining products based on real-world insights. Common empirical methods include usability testing, A/B testing, surveys, focus groups, and pilot studies, all of which help innovators assess functionality, user experience, and clinical impact. Iterative validation also helps identify necessary adjustments, enhancing the usability, accuracy, and clinical relevance of digital health products before they are widely launched.
4. **Advanced Market Strategy and Scale-up Skills**: Advanced market strategy and scale-up skills enable innovators to transform early-stage digital health concepts into sustainable, market-ready solutions. In sleep medicine, these competencies ensure that innovations – such as telehealth services, apps, or monitoring tools – are strategically positioned and scalable within complex healthcare systems. Key components include: **strategic positioning and value proposition** (defining clear, differentiated benefits aligned with clinical needs, user experience, and health system priorities), **market segmentation and stakeholder mapping** (identifying high-impact target groups and understanding decision-making structures to tailor engagement strategies), **business models and market entry** (exploring sustainable financing (e.g., subscriptions, partnerships) and pilot pathways through clinics, hospitals, or insurers), **regulatory and policy alignment** (navigating EU/national regulations, reimbursement frameworks, and policy priorities to support adoption), **scaling pathways** (designing roadmaps for expansion, including phased rollouts, cross-border adaptation, and strategic partnerships), **impact and sustainability** (establishing KPIs for clinical, economic, and social outcomes, and developing long-term maintenance and financing plans).

By developing these core skills, individuals are well-prepared to navigate the complex landscape of entrepreneurship and innovation. These competencies help entrepreneurs to build impactful solutions, foster sustainable business practices, and ultimately, drive progress in the fields of sleep medicine and digital health.

3.1.2 Overview of tools

The tools presented in this chapter are designed to equip students with the skills, methodologies, and structured approaches necessary to address complex challenges in healthcare and innovation. Categorized into several key groups mentioned at the begining of this chapter, they provide a comprehensive framework for developing practical and impactful solutions. Each category is tailored to a specific aspect of the innovation process, ensuring that students can approach problem-solving systematically and effectively.

In addition to these horizontal categories, the tools are also classified based on their alignment with specific vertical themes that reflect the project's focus areas:

- **Tools for addressing digital literacy through user-centric design**: Tools that aim to enhance digital literacy and promote user-centered innovation, empowering diverse populations to engage with digital solutions effectively.
- **Tools for inclusive digital healthcare with a focus on sleep medicine disorders**: These tools address healthcare gaps and challenges specific to sleep medicine, fostering the development of solutions that are inclusive, accessible, and tailored to real-world needs.
- **Horizontal tools**: These tools provide versatile methodologies and frameworks applicable across a broad spectrum of disciplines and contexts. They focus on foundational approaches to innovation and problem-solving, enabling their use in various fields beyond healthcare or digital literacy, making them universally relevant.

This vertical categorization ensures that each tool is applied purposefully, addressing both the broader goals of digital literacy and inclusivity as well as the specific objectives of this project. Particular emphasis is placed on tools that align with the needs of the elderly population and sleep medicine, ensuring their relevance to the project's core mission.

In the context of this project, particular attention is given to **elderly population** as a vulnerable group often excluded from the benefits of digital health tools due to **limited digital skills**. This digital divide restricts their ability to access optimized healthcare services, making it crucial to address their specific needs when designing digital solutions. By focusing on their challenges, students are encouraged to create innovations that are inclusive and tailored to real-world user requirements.

To achieve this, it is essential to develop skills during education that empower future innovators to identify and address these needs effectively. This part of the Toolkit introduces tools that guide students through the innovation process, from understanding user needs to creating and refining solutions. These tools support both digital literacy and inclusivity, enabling them to design solutions that are accessible, practical, and aligned with the actual requirements of diverse user groups, including elderly population.

3.1.2.1 Needs Assessment Tools

These tools help identify and understand the digital skills, challenges, and needs of various user groups, particularly those with limited digital literacy. They serve as the foundation for understanding user requirements and ensuring the design of solutions that address real-world needs effectively. By engaging directly with target populations, students can gain a deeper understanding of specific challenges, such as digital literacy levels, which provides a foundation for designing more inclusive and accessible solutions that meet real-world requirements. The table below provides a detailed overview of the needs assessment tools used within the course.

Table 2 Needs assessment tools

Needs Assessment Tools	
Tool	**In-Depth Interviews**
Description	**In-Depth Interviews** are qualitative research methods used to gather detailed insights from participants about their experiences, needs, and challenges. Within the course, students use this tool to explore perspectives on digital literacy, health technology usage, and sleep medicine challenges. These interviews serve as a foundation for understanding user requirements and identifying areas for innovation in healthcare.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge** • Understanding of entrepreneurial mindset and its relevance in health tech. • Methods for recognizing business opportunities in healthcare. • Basic principles of entrepreneurship within the context of health technology. • Methods for opportunity recognition and validation in the health sector. **Research skills** • Market analysis and identification of target customer needs. **Life skills** • Strategic thinking and planning for new business initiatives. • Communication and negotiation skills in entrepreneurial settings. **Mindset and attitudes** • Encouraging creativity and innovative thinking in identifying business opportunities. • Resilience and adaptability in the face of entrepreneurial challenges.
Development Level	• **Introductory level**: This tool is focused on introducing students to qualitative research methods and stakeholder engagement.
Learning Outcomes	The In-Depth Interviews in Sleep Medicine support the **learning outcomes defined in Part 1 of the Entrepreneurship module**, including: • Identify and evaluate opportunities for innovation in sleep medicine. • Understand the entrepreneurial mindset necessary to drive health tech advancements.
Teaching-Learning Strategies	• **Stakeholder Engagement Training**: Equip students with the skills to conduct professional interviews and discussions with healthcare professionals and end-users. • **Field Engagement**: Facilitate structured interviews with healthcare professionals, end-users, or other stakeholders to gather detailed insights about their experiences, challenges, and needs.
Educational Materials	• Reading materials and OERs that support Part 1 of the Entrepreneurship module. • Examples of interview scripts and stakeholder engagement guides.
Support Materials	• Tools for organizing qualitative data collected from interviews. • Resources on effective communication, including active listening and follow-up question techniques.
Evaluation Tools	• **Team Report Assessment**: Evaluate the clarity and comprehensiveness of the interview data, including identified needs and proposed solutions. • **Self-Reflection**: Each student submits a brief reflection on their learning experience and their role in conducting interviews.
Tool	**Focus Groups**

Needs Assessment Tools	
Description	**Focus Groups** are facilitated discussions involving multiple participants, used to gather diverse perspectives on a specific topic. Students use this tool to explore group dynamics and gain insights into user needs, particularly in the context of healthcare and sleep medicine.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge**: • Understanding of entrepreneurial mindset and its relevance in health tech. • Methods for recognizing business opportunities in healthcare. **Research Skills**: • Market analysis and identification of target customer needs. **Life Skills**: • Strategic thinking and planning for new business initiatives. • Communication and negotiation skills in entrepreneurial settings. **Mindset and Attitudes**: • Encouraging creativity and innovative thinking in identifying business opportunities.
Development Level	• **Introductory level**: Focuses on introducing students to stakeholder engagement and collaborative problem-solving in healthcare.
Learning Outcomes	The Focus Groups in Sleep Medicine support the **learning outcomes defined in Part 1 of the Entrepreneurship Module**, including: • Identify and evaluate opportunities for innovation in sleep medicine. • Understand the entrepreneurial mindset necessary to drive advancements in health technology.
Teaching-Learning Strategies	• **Stakeholder Engagement Training**: Train students in moderating focus group discussions and engaging participants effectively. • **Field Engagement**: Facilitate focus group discussions with patients, healthcare providers, or other stakeholders to explore diverse perspectives on their experiences, challenges, and needs.
Educational Materials	• Reading materials and OERs that support Part 1 of the Entrepreneurship Module.
Support Materials	• Tools for organizing qualitative data collected from focus groups. • Resources on effective facilitation techniques, including managing group dynamics and fostering participation.
Evaluation Tools	• **Focus Group Report Assessment:** Evaluate the clarity, comprehensiveness, and innovation potential of insights gathered. • **Self-Reflection:** Students submit reflections on their experience in moderating or analyzing focus group discussions.
Tool	**Opportunity Analysis**
Description	**Opportunity Analysis** enables students to examine the current landscape of solutions addressing unmet medical needs in sleep medicine. Through market analysis, they identify existing solutions, highlight gaps, and explore opportunities for innovation. The activity results in a comprehensive report proposing actionable insights and areas where new or improved solutions can address these gaps effectively. This tool fosters a strategic approach to innovation in healthcare.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge** • Understanding of entrepreneurial mindset and its relevance in health tech.

Needs Assessment Tools	
	• Methods for recognizing business opportunities in healthcare. • Basic principles of entrepreneurship within the context of health technology. • Methods for opportunity recognition and validation in the health sector. **Research skills** • Market analysis and identification of target customer needs. **Life skills** • Strategic thinking and planning for new business initiatives. • Communication and negotiation skills in entrepreneurial settings. **Mindset and attitudes** • Encouraging creativity and innovative thinking in identifying business opportunities. • Resilience and adaptability in the face of entrepreneurial challenges.
Development Level	• **Introductory level**: This tool is focused on introducing students to the fundamentals of market analysis and opportunity identification, providing structured guidance to help them assess existing solutions and identify gaps in healthcare innovation.
Learning Outcomes	The Opportunity Analysis supports the **learning outcomes defined in Part 1 of the Entrepreneurship module**, including: • Identify and evaluate opportunities for innovation in sleep medicine. • Understand the entrepreneurial mindset necessary to drive health tech advancements.
Teaching-Learning Strategies	**Group assignment:** Teams gather and analyze data on existing solutions related to their selected unmet medical need.
Educational Materials	• Market data and research articles • Reading materials and OERs that support Part 1 of the Entrepreneurship module
Support Materials	• Examples of market gap analyses
Evaluation Tools	• **Peer Feedback**: Groups present their maps to peers for constructive feedback. • **Self-Reflection**: Each student submits a brief reflection on their role, group dynamics, and learning outcomes.
Tool	**Electronic Sleep Diary**
Description	The **Electronic Sleep Diary** is a digital tool used for tracking individual sleep patterns over a week, allowing students to document their habits, quality, and disturbances. In the project, students compare diary entries with other assessment tools, like standardized questionnaires and consumer sleep technology, to develop a comprehensive understanding of sleep behavior.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Standard sleep diagnostic procedures • Sleep history and examinations • Measuring/monitoring sleep and wakefulness • Sleep stages **Life skills** • Analytical skills to evaluate the strengths and limitations of different sleep measurements. • Identifying and addressing challenges in the application of digital health and sleep medicine and research. **Mindset and attitudes**

Needs Assessment Tools	
	• Fostering an attitude that emphasizes the importance of patients' well-being and needs, and actively seeking their perspectives and experiences in shaping healthcare solutions. • Encouraging patients to actively engage in their healthcare by fostering a mindset that emphasizes the use of digital health tools for empowerment.
Development Level	• **Introductory level**: Introduces students to the basics of data logging and its application in sleep medicine.
Learning Outcomes	The Electronic Sleep Diary supports the **learning outcomes defined in Part 2 of the Sleep Medicine module**, including: • Describe and explain diagnostic procedures such as questionnaires, sleep diaries, polysomnography, polygraphy (home sleep apnea testing), multiple sleep latency tests, maintenance of wakefulness tests, and actigraphy in assessment of different sleep disorders. • Comprehend the strengths and limitations of automatic and manual sleep scoring.
Teaching-Learning Strategies	• **Individual assignment:** Students use an Electronic Sleep Diary to document their daily sleep patterns over a one-week period. This activity involves recording bedtime, wake-up time, total sleep duration, perceived sleep quality, and any disturbances during the night. The purpose is to familiarize students with sleep-tracking methodologies and provide a foundation for analyzing personal sleep behaviors.
Educational Materials	• Access to an electronic sleep diary tool (e.g., Sleep Revolution App). • Reading materials and OERs that support Part 2 of the Sleep Medicine module
Support Materials	• Guides for comparing diary data with other tools.
Evaluation Tools	• **Report**: Short report on sleep trends, including comparisons with objective tools and questionnaires.
Tool	**Sleep Questionnaires**
Description	**Sleep Questionnaires** are standardized tools, such as the Insomnia Severity Index (ISI), designed to assess various aspects of sleep health. Within the project, students administer, score, and analyze these questionnaires to identify and assess sleep disorders in hypothetical or real-world samples.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Standard sleep diagnostic procedures • Sleep history and examinations • Measuring/monitoring sleep and wakefulness • Sleep stages • Sleep breathing disorders • OSA and OSAS • Screening tools for SBDs • Diagnostics and treatment of OSA(S) • OSA(S) and comorbidities • Interdisciplinary approach to OSA • OSA phenotypes • Impact of OSA on life quality, health outcomes • OSA and sleepiness behind a wheel **Research skills** • Engage in collaborative efforts to conduct interdisciplinary aproach to OSA. • Develop the ability to effectively communicate with collaborators of diverse cultural backgrounds.

Needs Assessment Tools	
	• Analysis of biomedical signals. • Engage in the interpretation of qualitative and quantitative data to uncover significant insights. • Combine both quantitative and qualitative methods to gain a thorough understanding of relevant clinical and research questions. • Recognize research and academic articles with standard guidelines for sleep medicine approach to OSA. **Life skills** • Analytical skills to evaluate the strengths and limitations of different sleep measurements. • Identifying and addressing challenges in the application of digital health and sleep medicine and research. • Cultivate the ability to independently research and stay updated on the ever- changing trends sleep medicine and research with emphasis on new developments in digital health aimed to recognize, diagnose and treat OSA. **Mindset and attitudes** • Fostering an attitude that emphasizes the importance of patients' well-being and needs, and actively seeking their perspectives and experiences in shaping healthcare solutions. • Encouraging patients to actively engage in their healthcare by fostering a mindset that emphasizes the use of digital health tools for empowerment. • Emphasize the significance of efficient teamwork and collaboration in accomplishing common goals, recognizing the collective power of interdisciplinary teams. • Encourage a mindset that supports patient empowerment by utilizing digital health tools, motivating them to actively participate in their own healthcare.
Development Level	• **Introductory level**: Introduces students to the basics of diagnostic tools in sleep medicine.
Learning Outcomes	The Sleep Questionnaires support the **learning outcomes defined in Part 2 of the Sleep Medicine module**, including: • Describe and explain diagnostic procedures such as questionnaires, sleep diaries, polysomnography, polygraphy (home sleep apnea testing), multiple sleep latency tests, maintenance of wakefulness tests, and actigraphy in assessment of different sleep disorders. • Comprehend the strengths and limitations of automatic and manual sleep scoring. • Develop research questions and hypotheses relevant to sleep research and describe use of various data collection methods, such as questionnaires, interviews, and objective measurements. The Sleep Questionnaires support the **learning outcomes defined in Part 4 of the Sleep Medicine module**, including: • Classify and define OSA and other sleep-related breathing disorders. • Understand the phenotypes of OSA. • Define and discuss health and social implications and comorbidities of OSA. • Understand the various treatment options available for obstructive sleep apnea. • Understand and discuss the OSA-related health risks of elderly patients with suspected OSA. • Apply the screening tools for OSA in general population. • Explain the sleepiness behind a wheel in OSA and name the legal regulations for drivers with suspected or diagnosed OSA.

Needs Assessment Tools	
Teaching-Learning Strategies	• **Individual assignment:** Students use Sleep Questionnaires to document their daily sleep patterns over a one-week period. This activity involves recording bedtime, wake-up time, total sleep duration, perceived sleep quality, and any disturbances during the night. The purpose is to familiarize students with sleep-tracking methodologies and provide a foundation for analyzing personal sleep behaviors. • **Case-Based Learning**: Students apply Epworth sleepiness scale, STOP and STOP-Bang questionnaires and home sleep apnea testing questionnaires to realistic patient scenario. Analyze data and propose next steps in the diagnostic pathway.
Educational Materials	• Scoring instructions and case examples for training. • Reading materials and OERs that support Part 2 and Part 4 of the Sleep Medicine module
Support Materials	• Detailed guidelines for interpreting results.
Evaluation Tools	• **Report**: Short report on sleep trends, including comparisons with objective tools and questionnaires.
Tool	**Sleep Analysis with Sleep Technology Devices**
Description	**Sleep analysis using sleep technology devices** involves collecting and interpreting physiological data such as sleep stages, heart rate, and movement patterns. These devices provide real-time, objective insights into sleep quality, helping students evaluate and understand sleep disorders.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Standard sleep diagnostic procedures • Sleep history and examinations • Measuring/monitoring sleep and wakefulness • Sleep stages **Life skills** • Analytical skills to evaluate the strengths and limitations of different sleep measurements. • Identifying and addressing challenges in the application of digital health and sleep medicine and research. **Mindset and attitudes** • Fostering an attitude that emphasizes the importance of patients' well-being and needs, and actively seeking their perspectives and experiences in shaping healthcare solutions. • Encouraging patients to actively engage in their healthcare by fostering a mindset that emphasizes the use of digital health tools for empowerment.
Development Level	• **Introductory level**: Introduces students to wearable technologies and basic data analysis.
Learning Outcomes	The Sleep Analysis with Sleep Technology Devices supports the **learning outcomes defined in Part 2 of the Sleep Medicine module**, including: • Describe and explain diagnostic procedures such as questionnaires, sleep diaries, polysomnography, polygraphy (home sleep apnea testing), multiple sleep latency tests, maintenance of wakefulness tests, and actigraphy in assessment of different sleep disorders. • Analyze the strengths and limitations of consumer sleep technology such as smartwatches. • Comprehend the strengths and limitations of automatic and manual sleep scoring. • Develop research questions and hypotheses relevant to sleep research and describe use of various data collection methods, such as questionnaires, interviews, and objective measurements.

Needs Assessment Tools	
Teaching-Learning Strategies	• **Individual assignment:** Students use Sleep Technology Devices to document their daily sleep patterns over a one-week period. This activity involves recording bedtime, wake-up time, total sleep duration, perceived sleep quality, and any disturbances during the night. The purpose is to familiarize students with sleep-tracking methodologies and provide a foundation for analyzing personal sleep behaviors.
Educational Materials	• Device-specific user manuals and troubleshooting guides. • Reading materials and OERs that support Part 2 of the Sleep Medicine module
Support Materials	• Reference Charts
Evaluation Tools	• **Report:** Short report on sleep trends, including comparisons with objective tools and questionnaires.
Tool	**Polysomnography**
Description	**Polysomnography** (PSG) is a comprehensive diagnostic tool used to monitor and evaluate multiple physiological parameters during sleep. It records brain activity (EEG), eye movements (EOG), muscle activity (EMG), heart rate (ECG), breathing patterns, and oxygen levels. PSG is considered the gold standard for diagnosing sleep disorders such as sleep apnea, insomnia, and parasomnias. In the project, students will analyze PSG outputs to understand its applications and limitations in clinical sleep assessments.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Standard sleep diagnostic procedures • Sleep history and examinations • Measuring/monitoring sleep and wakefulness • Sleep stages **Life skills** • Analytical skills to evaluate the strengths and limitations of different sleep measurements. • Identifying and addressing challenges in the application of digital health and sleep medicine and research. **Mindset and attitudes** • Fostering an attitude that emphasizes the importance of patients' well-being and needs, and actively seeking their perspectives and experiences in shaping healthcare solutions. • Encouraging patients to actively engage in their healthcare by fostering a mindset that emphasizes the use of digital health tools for empowerment.
Development Level	• **Intermediate level**: Suitable for students with basic knowledge of sleep physiology and assessment tools. Introduces advanced diagnostic methods.
Learning Outcomes	The Polysomnography supports the **learning outcomes defined in Part 2 of the Sleep Medicine module**, including: • Identify sleep disorders belonging to different categories such as insomnia, sleep-related breathing disorders, central disorders of hypersomnolence, circadian rhythm sleep-wake disorders, parasomnias, sleep-related movement disorders, and other sleep disorders. • Describe and explain diagnostic procedures such as questionnaires, sleep diaries, polysomnography, polygraphy (home sleep apnea testing), multiple sleep latency tests, maintenance of wakefulness tests, and actigraphy in assessment of different sleep disorders. • Apply the knowledge and demonstrate basic skills in human polysomnography scoring and interpretation. • Comprehend the strengths and limitations of automatic and manual sleep scoring.

Needs Assessment Tools	
	• Apply the knowledge and demonstrate basic skills in human polysomnography scoring and interpretation.
Teaching-Learning Strategies	• **Case-Based Learning**: Students use anonymized patient PSG recordings for analysis.
Educational Materials	• Anonymized PSG recordings or simulated data. • Reading materials and OERs that support Part 2 of the Sleep Medicine module
Support Materials	• Step-by-step instructions for manually scoring sleep stages and respiratory events.
Evaluation Tools	• **Group Presentations Assessment**: Students collaboratively present findings and proposed interventions based on PSG data.
Tool	**Digital Literacy Assessment Scales**
Description	**Digital literacy assessment scales** measure participants' abilities to navigate digital health platforms, use remote collaboration tools, and interpret health-related data. These scales help innovators understand the baseline digital skills of patients, healthcare providers, and other stakeholders, informing the design of user-centred interventions.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge** • Core concepts of digital health and the role of emerging technologies in healthcare. • Overview of design principles for digital health applications. **Research skills** • Ability to assess the viability and effectiveness of digital health technologies through user-centred design and feedback. **Life skills** • Enhancing digital literacy and technical skills relevant to healthcare. **Mindset and attitudes** • Embrace innovation and continuous improvement in healthcare technologies.
Development Level	• **Introductory to intermediate**: Scales can be adapted for different stakeholder groups.
Learning Outcomes	The In-Depth Interviews in Sleep Medicine support the **learning outcomes defined in Part 1 of the Digital Health module**, including: • Demonstrate skills in carving out a digital health application from a complex case on an individual basis. • Summarize conclusions according to their importance after peer-to-peer discussions of how digital health applications can be designed for healthcare purposes. • Demonstrate the ability to communicate ideas and information clearly and respectfully across disciplinary boundaries.
Teaching-Learning Strategies	• **Classroom Activities:** Introduce students to the scales and have them complete sample assessments • **Case Studies:** Apply the scales to hypothetical or real patient groups to interpret digital literacy levels • **Group Discussions:** Compare results and identify strategies to address gaps
Educational Materials	• Reading materials and OERs that support Part 1 of the Digital Health module. • Access to standardized digital literacy scales
Support Materials	• Guidelines for administering scales. • Digital platforms or spreadsheets for data collection and analysis.

Needs Assessment Tools	
Evaluation Tools	• **Individual Project Assessment**: Students use the assessment data to inform their initial design of a digital health mobile application. Evaluation focuses on how effectively they integrate insights from digital literacy scales into user-centred design decisions.
Tool	**Health Technology Adoption Readiness Surveys**
Description	**Health Technology Adoption Readiness Surveys** evaluate stakeholders' willingness, motivation, and perceived barriers to adopting digital health tools, such as sleep monitoring apps or telemedicine platforms. Data collected provides insights into potential adoption challenges and informs solution design and implementation strategies.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge** • Understanding of entrepreneurial mindset and its relevance in health tech. • Methods for recognizing business opportunities in healthcare. • Basic principles of entrepreneurship within the context of health technology. • Methods for opportunity recognition and validation in the health sector. **Research skills** • Market analysis and identification of target customer needs. **Life skills** • Strategic thinking and planning for new business initiatives. • Communication and negotiation skills in entrepreneurial settings. **Mindset and attitudes** • Encouraging creativity and innovative thinking in identifying business opportunities. • Resilience and adaptability in the face of entrepreneurial challenges.
Development Level	• **Introductory level**: Suitable for classroom simulations or real-world pilot studies.
Learning Outcomes	The In-Depth Interviews in Sleep Medicine support the **learning outcomes defined in Part 1 of the Entrepreneurship module**, including: • Identify and evaluate opportunities for innovation in sleep medicine. • Understand the entrepreneurial mindset necessary to drive health tech advancements.
Teaching-Learning Strategies	• **Field Engagement**: Conduct surveys with simulated or real stakeholder groups. • **Data Analysis Workshops:** Students analyze responses to identify adoption barriers.
Educational Materials	• Reading materials and OERs that support Part 1 of the Entrepreneurship module. • Survey templates and examples.
Support Materials	• Tools for compiling and visualizing survey data. • Guides for interpreting adoption readiness scores.
Evaluation Tools	• **Team Report Assessment**: Students Opportunity Analysis Report is evaluated based on the quality of research, identification of gaps, and clarity of proposed innovation opportunities.

Source: eSleep_dHealth Curriculum

While the tools listed above provide specific methods for collecting and analysing data, effective needs assessment in sleep medicine and digital health requires structured stakeholder engagement and participatory processes. To support this, two complementary elements are introduced:

1. **Stakeholder Mapping Template with Engagement Strategies**

A structured template is provided to help students and educators systematically identify, categorise, and prioritise key stakeholders (e.g., patients, healthcare professionals, policymakers, technology providers). Stakeholder mapping is a strategic tool used to identify all relevant actors involved in or affected by innovation initiatives. It helps clarify their roles, interests, and influence, and defines engagement strategies to ensure meaningful participation throughout the innovation process. In the context of sleep medicien and digital health, structured stakeholder engagement ensures that solutions are co-created with patients, professionals, policymakers, and other key actors, leading to more relevant, accepted, and sustainable innovations.

How to use this tool:

1. **Identify stakeholder groups** relevant to the initiative (e.g., patients, healthcare professionals, academic staff, policymakers, technology providers, community organisations).
2. **Map individual stakeholders or organisations** within each group.
3. **Assess their roles, influence, and interest** in relation to the innovation process.
4. **Select engagement strategies** appropriate to each stakeholder group (e.g., inform, consult, collaborate, co-design).
5. **Plan engagement activities** such as workshops, focus groups, interviews, or advisory sessions.
6. **Document expected contributions and outcomes**, and update the map throughout the project lifecycle.

This tool helps ensure that diverse perspectives are integrated early in the innovation process and that engagement activities are aligned with project goals.

An example of the template is provided below.

Table 3 Stakeholder Mapping Template

Stakeholder Group	Stakeholder / Organization	Role / Function	Interest	Influence	Engagement Strategy	Planned Engagement Activities	Expected Contribution

2. Participatory Assessment Framework – Step-by-Step Implementation Guide

The Participatory Assessment Framework is a structured, step-by-step guide for involving stakeholders in the needs assessment and innovation process. It complements the Stakeholder Mapping Template by translating stakeholder insights into actionable knowledge and co-designed solutions. The framework ensures that all relevant perspectives – patients, healthcare professionals, policymakers, technology providers, and community representatives – are actively engaged in identifying needs, prioritizing challenges, and shaping interventions.

By following this framework, students and innovators can systematically integrate stakeholder input, promoting inclusivity, collaboration, and real-world relevance in sleep medicine and digital health. It encourages iterative learning, feedback loops, and shared ownership of outcomes, which are critical for socially impactful innovation.

Key Steps in the Framework:

1. **Stakeholder Identification and Mapping:** Use the Stakeholder Mapping Template to list and categorize stakeholders based on interest, influence, and relevance.
2. **Selection of Engagement Tools:** Decide which methods (interviews, focus groups, surveys, co-design workshops) are most appropriate for each stakeholder group.
3. **Data Collection and Feedback Loops:** Collect qualitative and quantitative data while ensuring continuous feedback from stakeholders to refine insights.
4. **Joint Analysis and Validation:** Collaboratively interpret results with stakeholders to ensure findings are accurate, relevant, and actionable.
5. **Integration into Opportunity Analysis Report**: Develop a report summarizing the state-of-the-art, market analysis, and identified opportunities. Highlight unmet needs, gaps in current solutions, and potential areas for innovation.

By using the Participatory Assessment Framework, students and innovators systematically gather, analyze, and synthesize stakeholder insights, ensuring that their understanding of needs, challenges, and opportunities is comprehensive and evidence-based. This structured approach not only strengthens stakeholder engagement but also provides a solid foundation for the development of Design Thinking projects. By completing this participatory assessment, students are fully prepared to enter the ideation and prototyping phases of Design Thinking, ensuring that solutions are user-centered, socially relevant, and technically feasible.

3.1.2.2 Design Thinking Tools

Design thinking offers a structured, iterative approach to problem-solving that is central to the innovation process. These tools guide students through empathy mapping, ideation, prototyping, and testing, allowing them to develop user-centered solutions that address the real-world needs of diverse stakeholders. By applying design thinking techniques, students can create innovative, practical, and

effective health solutions that are responsive to the needs of various populations. The table below provides a detailed overview of the design thinking tools used within the course.

Table 4 Design thinking tools

Design Thinking Tools	
Tool	**Lightning Talks**
Description	**Lightning Talks** are short presentations that provide key insights on specific topics, typically lasting 5–10 minutes. In the **Empathize phase** of the Design Thinking process, they introduce participants to diverse perspectives and challenges in the problem space, fostering a shared understanding. In this activity, students listen to expert-led discussions on topics such as digital health trends, sleep medicine challenges, or user-centric innovation design. These talks equip students with foundational knowledge and inspire them to identify unmet needs and opportunities for innovation in healthcare.
Applicability	Horizontal
Skills and Dimensions Covered	**Knowledge** • In-depth understanding of design thinking and sprint methodologies. • Application of these methodologies to create viable health tech solutions. **Life skills** • Collaborative skills in multidisciplinary teams. **Mindset and attitudes** • A proactive approach to problem-solving. • Commitment to user-centered design and continuous refinement.
Development Level	• **Introductory level**: Introduces students to foundational knowledge in digital health and innovation through expert-led discussions.
Learning Outcomes	The Lightning Talks support the **learning outcomes defined in Part 2 of the Entrepreneurship module**, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Expert-Led Discussions:** Experts present current trends and challenges in digital healthcare and sleep medicine, providing students with foundational insights. • **Group Assignment:** Students work in teams to analyze the key takeaways from the talks and brainstorm potential problem areas.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Recordings or summaries of lightning talks.
Support Materials	• Examples of successful healthcare innovations highlighted in lightning talks. • Templates for capturing key insights during presentations.
Evaluation Tools	• **Peer Feedback:** Teams present their summarized insights to peers for constructive feedback. • **Self-Reflection:** Each student submits a brief reflection on how the talks influenced their understanding of the problem space. • **Team Report Assessment:** Evaluate the clarity and relevance of the insights captured from the talks.
Tool	**User Interviews**

Design Thinking Tools	
Description	**User Interviews** are structured conversations with end-users to gather insights about their needs, behaviors, and pain points. In the **Empathize phase** of the Design Thinking process, this tool helps teams understand the user perspective and uncover opportunities for innovation. In this activity, students conduct interviews with potential users to explore their experiences with existing solutions or challenges in sleep medicine and digital health. Insights from these interviews guide the framing of problem statements for subsequent phases.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • In-depth understanding of design thinking and sprint methodologies. • Application of these methodologies to uncover unmet needs in healthcare. **Life skills** • Collaborative skills in multidisciplinary teams. **Mindset and attitudes** • Commitment to user-centered design and continuous refinement.
Development Level	• **Introductory level**: Introduces students to the fundamentals of user engagement, focusing on active listening and translating qualitative insights into actionable problem statements.
Learning Outcomes	The User Interviews support the **learning outcomes defined in Part 2 of the Entrepreneurship module**, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Group Assignment:** Students work in teams to prepare interview questions, conduct interviews, and summarize findings, promoting collaboration and critical thinking. • **Problem-Based Learning:** Students address real-world challenges by analyzing insights from user interviews and identifying key problem areas.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Examples of effective interview guides and techniques.
Support Materials	• Examples of successful user interviews in healthcare. • Templates for interview question development and note-taking.
Evaluation Tools	• **Peer Feedback:** Teams present their findings to peers for constructive feedback. • **Team Report Assessment:** Evaluate the clarity and comprehensiveness of interview summaries and their alignment with identified needs. • **Self-Reflection:** Each student submits a brief reflection on their learning experience and contribution to the activity.
Tool	**Empathy Map**
Description	**Empathy Map** is a visual tool used to capture what users say, think, feel, and do, helping teams develop a deeper understanding of their perspective. In the **Empathize phase** of the Design Thinking process, it organizes qualitative insights from interviews or observations into actionable patterns. In this activity, students create empathy maps based on user research, highlighting key emotions, behaviors, and pain points. This helps guide the team's focus on user-centered solutions.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge**

Design Thinking Tools	
	• In-depth understanding of design thinking and sprint methodologies. • Application of these methodologies to create viable health tech solutions. **Research skills** • Empirical testing and validation of product ideas through prototyping and user feedback. **Life skills** • Collaborative skills in multidisciplinary teams. **Mindset and attitudes** • A proactive approach to problem-solving.
Development Level	• **Introductory level:** Introduces students to visualizing user insights for developing user-focused solutions.
Learning Outcomes	The Empathy Map supports the **learning outcomes defined in Part 2 of the Entrepreneurship module**, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Group Assignment**: Teams create empathy maps using insights from interviews or observations, fostering collaboration and critical thinking. • **Problem-Based Learning**: Students analyze user behaviors and emotions to identify key challenges.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Templates and examples of empathy maps.
Support Materials	• Examples of empathy maps created in healthcare projects. • Templates for mapping user insights.
Evaluation Tools	• **Peer Feedback**: Groups present their maps to peers for constructive feedback. • **Team Report Assessment**: Evaluate the clarity and accuracy of the empathy maps. • **Self-Reflection**: Students submit reflections on their role and the insights gained during the activity.
Tool	**Persona Development**
Description	**Persona Development** is the process of creating fictional characters that represent specific user groups, encapsulating their goals, behaviors, and pain points. In the **Empathize phase** of the Design Thinking process, it helps teams focus their design efforts on the needs of their target users. In this activity, students use research findings to develop detailed personas, such as a patient managing sleep disorders or a caregiver using digital health tools. These personas guide the team's design decisions by ensuring solutions align with real user needs.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • In-depth understanding of design thinking and sprint methodologies. • Application of these methodologies to create viable health tech solutions. **Research skills** • Empirical testing and validation of product ideas through prototyping and user feedback. **Life skills** • Collaborative skills in multidisciplinary teams. **Mindset and attitudes**

Design Thinking Tools	
	• Commitment to user-centered design and continuous refinement.
Development Level	• **Introductory level:** Introduces students to creating structured user profiles to guide design decisions.
Learning Outcomes	The Persona Development supports the **learning outcomes defined in Part 2 of the Entrepreneurship module**, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Group Assignment**: Teams create personas by analyzing user data and synthesizing findings into actionable user profiles. • **Problem-Based Learning**: Students align personas with identified challenges to develop tailored solutions.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Persona templates and examples.
Support Materials	• Case studies demonstrating persona development. • Templates tailored for healthcare user personas.
Evaluation Tools	• **Peer Feedback**: Teams present their personas to peers for feedback. • **Team Report Assessment**: Evaluate the depth and relevance of personas to identified user needs. • **Self-Reflection**: Each student submits a brief reflection on their role in creating personas and the insights gained.
Tool	**HMW Questions (How Might We Questions)**
Description	**HMW Questions** are a tool used to transform challenges and insights into opportunities for innovation. In the **Define phase** of the Design Thinking process, this activity helps teams reframe problems into actionable design questions. In this activity, students craft HMW questions based on insights from research, interviews, or empathy maps. For instance, a question like "How might we make digital tools for sleep disorder management easier to use for patients with low digital literacy?" enables teams to focus their ideation efforts on addressing specific user needs.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge**: • In-depth understanding of design thinking and sprint methodologies. • Application of these methodologies to create viable health tech solutions. **Life skills**: • Collaborative skills in multidisciplinary teams. **Mindset and attitudes**: • A proactive approach to problem-solving.
Development Level	**Introductory level:** Introduces students to reframing challenges into actionable opportunities through HMW questions.
Learning Outcomes	The HMW Questions support the **learning outcomes defined in Part 2 of the Entrepreneurship module**, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Group Assignment**: Teams collaborate to create HMW questions from user insights, fostering critical thinking and structured problem-solving.

Design Thinking Tools	
	• **Problem-Based Learning**: Students reframe real-world challenges into opportunities for innovation through carefully crafted HMW questions.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Examples of effective HMW questions from healthcare projects.
Support Materials	• Templates for developing HMW questions. • Case studies showing how HMW questions lead to innovative solutions in healthcare.
Evaluation Tools	• **Peer Feedback**: Groups share their HMW questions with peers for critique and improvement. • **Team Report Assessment**: Evaluate the relevance and clarity of HMW questions in addressing user challenges. • **Self-Reflection**: Students submit reflections on how their questions align with user needs and guide the ideation process.
Tool	**Brainstorming**
Description	**Brainstorming** is a collaborative technique used to generate a wide range of ideas in a short amount of time. In the **Ideate phase** of the Design Thinking process, it helps teams explore potential solutions without judgment, fostering creativity and innovation. In this activity, students work in teams to brainstorm ideas addressing the challenges framed in their HMW questions. The focus is on quantity over quality, encouraging students to think outside the box and explore unconventional approaches to healthcare innovation.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge**: • In-depth understanding of design thinking and sprint methodologies. **Life skills**: • Collaborative skills in multidisciplinary teams. • Project management and execution of design sprints. **Mindset and attitudes**: • A proactive approach to problem-solving. • Commitment to user-centered design and continuous refinement.
Development Level	• **Introductory level:** Introduces students to structured techniques for generating creative solutions to healthcare challenges.
Learning Outcomes	The Brainstorming supports the **learning outcomes defined in Part 2 of the Entrepreneurship module**, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Group Assignment**: Teams work collaboratively to generate as many ideas as possible in a limited time frame, focusing on diverse approaches to solving framed challenges. • **Facilitated Workshops**: Instructors guide brainstorming sessions to ensure a free flow of ideas and adherence to best practices.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Examples of successful brainstorming sessions in healthcare innovation.

Design Thinking Tools	
Support Materials	• Templates for organizing and capturing brainstormed ideas. • Guidelines for effective brainstorming, including rules for fostering inclusivity and creativity.
Evaluation Tools	• **Idea Categorization**: Assess how effectively teams categorize and prioritize ideas generated during brainstorming. • **Peer Feedback**: Peers provide input on the creativity and feasibility of brainstormed ideas. • **Team Report Assessment**: Evaluate the diversity and relevance of ideas in addressing the defined HMW questions.
Tool	**Crazy 8s**
Description	**Crazy 8s** is a rapid ideation exercise where participants sketch eight distinct ideas in eight minutes to encourage creativity and quick thinking. In the **Ideate phase** of the Design Thinking process, it pushes participants to explore a wide range of solutions without overthinking or self-censoring. In this activity, students work individually to sketch quick concepts for solutions addressing the challenges defined by their HMW questions. The focus is on variety and speed, enabling teams to explore diverse possibilities before moving forward with the most promising ideas.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge**: • In-depth understanding of design thinking and sprint methodologies. **Life Skills**: • Collaborative skills in multidisciplinary teams. • Project management and execution of design sprints. **Mindset and Attitudes**: • A proactive approach to problem-solving. • Commitment to user-centered design and continuous refinement.
Development Level	• **Introductory level**: Introduces students to rapid ideation techniques for generating diverse solution concepts.
Learning Outcomes	The Crazy 8s supports the **learning outcomes defined in Part 2 of the Entrepreneurship module**, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Individual Assignment**: Students independently sketch eight ideas in eight minutes based on HMW questions, promoting rapid ideation and creativity. • **Group Review**: Teams review individual sketches collectively, identifying the most promising concepts to pursue further.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Examples of Crazy 8s sketches in healthcare innovation.
Support Materials	• Templates for Crazy 8s exercises. • Guidelines for rapid sketching and idea generation.
Evaluation Tools	• **Peer Feedback**: Teams evaluate the variety and creativity of ideas generated by their peers. • **Idea Selection Assessment**: Review the rationale behind selecting specific ideas for further development. • **Self-Reflection**: Students submit reflections on their experience with rapid ideation and how it influenced their approach to problem-solving.
Tool	**Storyboarding**

Design Thinking Tools	
Description	**Storyboarding** is a visual tool that maps out the user's journey step by step, illustrating how a solution interacts with their needs and challenges. In the **Ideate phase** of the Design Thinking process, it helps teams visualize how their ideas address user problems and ensure that every step of the journey aligns with the user's goals. In this activity, students create storyboards to depict how their proposed solutions, such as a digital tool for managing sleep disorders, would function in real-world scenarios. These storyboards help identify gaps, refine ideas, and validate whether the solution is practical and user-centered.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge**: • In-depth understanding of design thinking and sprint methodologies. • Application of these methodologies to create viable health tech solutions. **Life Skills**: • Collaborative skills in multidisciplinary teams. **Mindset and Attitudes**: • Commitment to user-centered design and continuous refinement.
Development Level	• **Introductory level:** Introduces students to visualizing user journeys for evaluating and refining solution concepts.
Learning Outcomes	The Storyboarding supports the learning outcomes defined in Part 2 of the Entrepreneurship module, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Group Assignment**: Teams collaboratively create storyboards to illustrate how their solution addresses user needs, promoting teamwork and critical thinking. • **Scenario-Based Learning**: Students develop storyboards around specific user scenarios to ensure alignment with real-world challenges.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Templates and examples of storyboards tailored to healthcare innovation.
Support Materials	• Case studies demonstrating effective storyboarding in healthcare projects. • Templates for structuring user journey storyboards.
Evaluation Tools	• **Storyboard Review**: Assess the clarity, logic, and alignment of the storyboard with user needs and goals. • **Peer Feedback**: Teams present their storyboards to peers for critique and improvement. • **Self-Reflection**: Students reflect on how storyboarding helped refine their ideas and address user challenges.
Tool	**Pitch Presentation**
Description	**Pitch Presentation** is a concise, persuasive tool designed to communicate a proposed solution or idea persuasively to an audience, such as stakeholders, investors, or collaborators. In the **Ideate phase** of the Design Thinking process, this tool helps students develop their ideas into a structured narrative, highlighting the solution's value and potential impact. By addressing key challenges and opportunities, students demonstrate how their proposed solutions align with user needs and project goals. This activity involves developing and delivering a compelling pitch that integrates user insights, market

Design Thinking Tools	
	analysis, and innovative strategies, providing an opportunity for feedback and further refinement.
Applicability	Horizonal
Skills and Dimensions Covered	**Knowledge**: • In-depth understanding of design thinking and sprint methodologies. • Application of these methodologies to create viable health tech solutions. **Life skills**: • Collaborative skills in multidisciplinary teams. • Project management and execution of design sprints. **Mindset and attitudes**: • A proactive approach to problem-solving. • Commitment to user-centered design and continuous refinement.
Development Level	• **Intermediate level**: Designed for students with some foundational understanding of solution development, focusing on professional presentation techniques.
Learning Outcomes	The Pitch Presentation supports the learning outcomes defined in Part 2 of the Entrepreneurship module, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Guided Pitch Development**: Students receive step-by-step instruction on how to construct a persuasive pitch, including defining the problem, presenting the solution, and addressing potential challenges. • **Practice and Feedback Sessions**: Students rehearse their presentations and receive constructive feedback from peers and instructors to refine their delivery.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Templates for creating professional pitch slides.
Support Materials	• **Checklist for Pitch Preparation:** A step-by-step guide for ensuring the presentation covers all critical components, such as audience engagement, timing, and clarity. • **Guides for Effective Communication:** Resources on creating impactful narratives, including storytelling techniques and visual design principles.
Evaluation Tools	• **Presentation Assessment**: Evaluate clarity, structure, and persuasiveness of the pitch. • **Peer Feedback**: Peers provide constructive critiques on content, delivery, and overall impact. • **Self-Reflection**: Students reflect on their performance and identify areas for improvement in future presentations.
Tool	**Role-playing**
Description	**Role-playing** is an interactive tool where participants simulate user interactions with a proposed solution to gain insights into its functionality, usability, and effectiveness. In the **Prototype phase** of the Design Thinking process, it allows teams to test user scenarios, identify potential issues, and refine their solutions. In this activity, students take on roles such as users, healthcare providers, or other stakeholders to simulate real-world interactions with their prototype. By acting out scenarios, they can uncover usability challenges and ensure their solution aligns with user needs.

Design Thinking Tools	
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge**: • In-depth understanding of design thinking and sprint methodologies. **Life Skills**: • Collaborative skills in multidisciplinary teams. • Project management and execution of design sprints. **Mindset and Attitudes**: • A proactive approach to problem-solving. • Commitment to user-centered design and continuous refinement.
Development Level	• **Introductory level:** Introduces students to user-centered testing methods by simulating real-world scenarios with prototypes.
Learning Outcomes	The Role-playing supports the **learning outcomes defined in Part 2 of the Entrepreneurship module**, including: • Apply design thinking methods to develop innovative solutions to complex health challenges. • Utilize design sprint techniques to rapidly prototype and test new ideas in the context of sleep medicine.
Teaching-Learning Strategies	• **Scenario-Based Learning**: Students create user scenarios and act them out to simulate interactions with their prototypes. • **Group Assignment**: Teams collaboratively identify and address usability challenges through role-playing.
Educational Materials	• Reading materials and OERs that support Part 2 of the Entrepreneurship module. • Scenario templates to guide role-playing activities.
Support Materials	• Examples of role-playing activities in healthcare design projects. • Guidelines for creating realistic user scenarios.
Evaluation Tools	• **Scenario Feedback**: Assess how effectively students simulate user interactions and identify usability issues. • **Usability Report**: Teams document the findings from role-playing sessions and propose improvements. • **Self-Reflection**: Students reflect on the role-playing experience and how it influenced their design decisions.
Tool	**Prototyping**
Description	**Prototyping** involves creating tangible or digital models of a proposed solution to test its functionality, usability, and alignment with user needs. In the **Prototype phase** of the Design Thinking process, this tool allows teams to bring their ideas to life and refine them based on user feedback. In this activity, students develop prototypes that represent key features of their solution, such as a digital health app interface or a physical mockup for a healthcare device. These prototypes serve as a foundation for iterative testing and improvement.
Applicability	Horizontal
Skills and Dimensions Covered	**Knowledge**: • Insight into the process of taking a product from prototype to market. • Understanding of intellectual property and funding strategies for startups. **Research Skills**: • Financial forecasting and business model testing. **Life Skills**:

Design Thinking Tools	
	• Leadership and management skills necessary for startup success. • Effective pitching and presentation skills for securing investment. **Mindset and Attitudes**: • Entrepreneurial spirit with a focus on innovation and market disruption. • Ethical considerations in business practices, particularly in the health tech field.
Development Level	• **Intermediate level:** Focuses on preparing students to develop market-ready prototypes and address business considerations.
Learning Outcomes	The Prototyping supports the **learning outcomes defined in Part 3 of the Entrepreneurship Module**, including: • Navigate the funding landscape for health tech innovations. • Prepare and deliver an effective pitch to potential investors.
Teaching-Learning Strategies	• **Project-Based Learning:** Teams develop high-fidelity prototypes and integrate feedback to align their solutions with market requirements. • **Workshop-Driven Learning:** Students participate in workshops to learn prototyping tools and techniques for creating market-ready solutions.
Educational Materials	• Reading materials and OERs that support Part 3 of the Entrepreneurship module. • Tutorials on advanced prototyping tools (e.g., Figma, Adobe XD, physical mockup creation).
Support Materials	• Case studies showcasing successful prototyping and commercialization of health tech solutions. • Examples of investor-ready prototypes and presentation materials.
Evaluation Tools	• **Prototype Assessment:** Evaluate the functionality, usability, and market readiness of prototypes. • **Investor Pitch Simulation:** Students present their prototypes in a simulated investor pitch, focusing on business viability. • **Self-Reflection:** Students reflect on how prototyping prepared them for commercialization.
Tool	**User Testing**
Description	**User Testing** evaluates a prototype's readiness for market entry by observing real users interacting with the solution and gathering feedback. In the **Test phase** of the Design Thinking process, this tool validates the business potential and usability of the solution, helping teams refine their offering before commercialization. In this activity, students conduct structured testing sessions to gather insights on user satisfaction, potential barriers, and the overall market fit of their solution.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge**: • Insight into the process of taking a product from prototype to market. **Research Skills**: • Financial forecasting and business model testing. **Life Skills**: • Leadership and management skills necessary for startup success. • Effective pitching and presentation skills for securing investment. **Mindset and Attitudes**:

Design Thinking Tools	
	• Entrepreneurial spirit with a focus on innovation and market disruption.
Development Level	• **Intermediate level:** Focuses on evaluating market readiness and refining solutions based on user feedback.
Learning Outcomes	The User Testing supports the **learning outcomes defined in Part 3 of the Entrepreneurship Module**, including: • Navigate the funding landscape for health tech innovations. • Prepare and deliver an effective pitch to potential investors.
Teaching-Learning Strategies	• **Scenario-Based Testing**: Students design realistic market scenarios for testing prototypes with end-users. • **Iterative Testing and Refinement**: Students conduct multiple rounds of testing to improve usability and validate business viability.
Educational Materials	• Reading materials and OERs that support Part 3 of the Entrepreneurship Module. • Templates for documenting user feedback and usability data.
Support Materials	• Examples of market testing reports in health tech. • Guidelines for structuring user feedback into business strategies.
Evaluation Tools	• **User Testing Report**: Evaluate the comprehensiveness and relevance of testing findings for market readiness. • **Investor Pitch Preparation**: Assess how testing insights are integrated into a compelling investor pitch. • **Self-Reflection**: Students reflect on how user testing shaped their understanding of market needs and solution viability.

Source: eSleep_dHealth Curriculum

3.1.2.3 Technology Tools

Technology tools provide students with hands-on experience in using advanced digital health technologies, such as wearable devices, diagnostic systems, and digital platforms. These tools bridge the gap between theory and practice, enabling students to design, test, and refine innovative solutions that improve patient outcomes and address diverse healthcare challenges. The table below provides a detailed overview of the technology tools used within the course.

Table 5 Technology tools

Technology Tools	
Tool	**Figma**[3]
Description	**Figma** is a cloud-based technology platform used for creating, prototyping, and testing digital solutions. It provides a collaborative environment for teams to design user interfaces and simulate user interactions, enabling iterative development of digital health tools. As a key technology tool, Figma allows students to integrate stakeholder feedback directly into the design process, ensuring that solutions are both functional and user-friendly. Within this project, students utilize Figma to develop intuitive interfaces for digital health applications tailored to sleep medicine and the needs of diverse user groups, including those with limited digital literacy.
Applicability	Addressing Digital Literacy through User-Centric Design
Skills and Dimensions Covered	**Knowledge** • Fundamentals of machine learning and its applications in sleep data analysis.

[3] https://www.figma.com

Technology Tools	
	• Techniques for managing and analyzing large datasets. **Research skills** • Use of statistical tools and software for data analysis in healthcare research. **Life skills** • Analytical thinking and problem-solving using quantitative data. • Adaptability to new tools and methodologies in data science. **Mindset and attitudes** • Advocating for data-driven decision making in healthcare. • Openness to learning and applying new analytical techniques.
Development Level	• **Introductory level**: The activity provides a hands-on introduction to advanced data analysis techniques in an accessible and guided manner.
Learning Outcomes	The Figma supports the **learning outcomes defined in Part 3 of the Digital Health module**, including: • Understand ways in which machine learning and advanced data analysis techniques can prove impactful in healthcare. • Discuss ways in which data analysis can be carried out when data is collected through novel emerging technologies. • Evaluate the effectiveness and appropriateness of machine learning and advanced data analysis techniques compared to simpler traditional techniques. • Demonstrate skills in data analysis of medical data, both objective data and subjective data.
Teaching-Learning Strategies	• **Group Assignment**: Students collaboratively design and prototype an interface for a digital health tool, focusing on usability and user engagement. • **Project-Based Learning**: Hands-on sessions guide students through Figma's features, emphasizing prototyping and real-time collaboration.
Educational Materials	• Figma tutorials and guides for interface design and prototyping. • Reading materials and OERs that support Part 3 of the Digital Health module
Support Materials	• Real-world examples of effective user-centered digital health interfaces. • Case studies highlighting the role of interface design in healthcare outcomes. • Guides on integrating user feedback into iterative design processes.
Evaluation Tools	• **Team Interface Design Report Assessment:** Each team submits a report detailing their design process, including iterations, stakeholder feedback integration, and final interface evaluation. • **Prototype Usability Assessment:** Evaluate the functionality, accessibility, and user experience of the final prototype. • **Self-Reflection:** Students provide a reflective report on their experience with Figma, focusing on collaboration, design challenges, and lessons learned.
Tool	**Stormboard**[4]
Description	**Stormboard** is a collaborative technology platform that enables teams to organize, prioritize, and act on innovative ideas using shared digital workspaces. It offers features such as real-time collaboration, data visualization, project roadmapping, and task tracking, making it ideal for managing complex workflows in digital health innovation. Within this project, Stormboard is used by students to map out healthcare solutions, analyze data, and strategize for inclusive digital health tools in sleep medicine. Its robust integrations, including data import/export and

[4] https://uwp.stormboard.com/app/login

Technology Tools	
	visualization tools, support efficient collaboration and decision-making across multidisciplinary teams.
Applicability	Addressing Digital Literacy through User-Centric Design
Skills and Dimensions Covered	**Knowledge** • Fundamentals of machine learning and its applications in sleep data analysis. • Techniques for managing and analyzing large datasets. **Research skills** • Use of statistical tools and software for data analysis in healthcare research. **Life skills** • Analytical thinking and problem-solving using quantitative data. • Adaptability to new tools and methodologies in data science. **Mindset and attitudes** • Advocating for data-driven decision making in healthcare. • Openness to learning and applying new analytical techniques.
Development Level	• **Introductory level:** Focuses on introducing students to collaborative tools for organizing and managing healthcare innovation projects.
Learning Outcomes	The Stormboard supports the **learning outcomes defined in Part 3 of the Digital Health module**, including: • Understand ways in which machine learning and advanced data analysis techniques can prove impactful in healthcare. • Discuss ways in which data analysis can be carried out when data is collected through novel emerging technologies. • Evaluate the effectiveness and appropriateness of machine learning and advanced data analysis techniques compared to simpler traditional techniques. • Demonstrate skills in data analysis of medical data, both objective data and subjective data.
Teaching-Learning Strategies	• **Group Assignment:** Students use Stormboard to collaboratively map workflows and identify key milestones for a digital health solution. • **Workshop-Based Learning:** Hands-on sessions guide students through Stormboard's features, emphasizing data organization and visualization.
Educational Materials	• Reading materials and OERs that support Part 3 of the Digital Health Module. • Tutorials on using Stormboard for collaborative workflow management.
Support Materials	• Examples of project workflows and visualized data management. • Guides on leveraging collaborative tools for healthcare innovation.
Evaluation Tools	• **Workflow Report Assessment:** Assess the clarity, feasibility, and alignment of mapped workflows with project goals. • **Self-Reflection:** Students reflect on their experience with Stormboard and its impact on their ability to organize and analyze workflows.
Tool	**FigJam**[5]
Description	**FigJam** is a virtual whiteboard platform designed for collaborative brainstorming, workflow visualization, and project planning. Its intuitive tools, such as templates, comments, and shapes, allow teams to map out

[5] https://www.figma.com/figjam/

Technology Tools	
	solutions, refine ideas, and organize workflows effectively. Within this project, FigJam serves as a collaborative tool for visualizing patient journeys, understanding sleep medicine workflows, and designing inclusive solutions that cater to the needs of diverse user groups, including those with sleep disorders.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Standard sleep diagnostic procedures • Sleep history and examinations • Sleep stages **Life skills** • Analytical skills to evaluate the strengths and limitations of different sleep measurements. • Identifying and addressing challenges in the application of digital health and sleep medicine and research. **Mindset and attitudes** • Fostering an attitude that emphasizes the importance of patients' well-being and needs, and actively seeking their perspectives and experiences in shaping healthcare solutions. • Encouraging patients to actively engage in their healthcare by fostering a mindset that emphasizes the use of digital health tools for empowerment.
Development Level	• **Introductory level:** Provides students with tools to organize, visualize, and improve workflows in sleep medicine and healthcare innovation.
Learning Outcomes	The FigJam supports the **learning outcomes defined in Part 2 of the Sleep Medicine module**, including: • Identify sleep disorders belonging to different categories such as insomnia, sleep-related breathing disorders, central disorders of hypersomnolence, circadian rhythm sleep-wake disorders, parasomnias, sleep-related movement disorders, and other sleep disorders. • Describe and explain diagnostic procedures such as questionnaires, sleep diaries, polysomnography, polygraphy (home sleep apnea testing), multiple sleep latency tests, maintenance of wakefulness tests, and actigraphy in assessment of different sleep disorders. • Analyze the strengths and limitations of consumer sleep technology such as smartwatches. • Apply the knowledge and demonstrate basic skills in human polysomnography scoring and interpretation. • Describe and differentiate the stages of sleep. • Develop research questions and hypotheses relevant to sleep research and describe use of various data collection methods, such as questionnaires, interviews, and objective measurements.
Teaching-Learning Strategies	• **Group Assignment:** Students collaboratively use FigJam to map out diagnostic and treatment pathways for sleep medicine disorders. This includes visualizing processes such as patient intake and follow-up care. • **Scenario-Based Learning:** Students work on simulated cases of sleep medicine challenges (e.g., diagnosing obstructive sleep apnea or insomnia) and use FigJam to develop structured approaches to managing and addressing these challenges collaboratively.
Educational Materials	• Reading materials and OERs that support Part 2 of the Sleep Medicine Module. • Tutorials on using FigJam for workflow visualization and process mapping.
Support Materials	• Pre-built templates for diagnostic and treatment workflows in sleep medicine.

Technology Tools	
	• Case studies demonstrating the use of collaborative tools to improve healthcare delivery.
Evaluation Tools	• **Workflow Assessment:** Evaluate the clarity, feasibility, and effectiveness of workflows created using FigJam. • **Peer Feedback:** Students provide constructive feedback on workflow designs and their applicability to real-world healthcare challenges. • **Self-Reflection:** Students reflect on their experience with FigJam and its relevance to improving healthcare workflows in sleep medicine.

Source: eSleep_dHealth Curriculum

3.1.2.4 Advocacy and Policy Resources

Advocacy and policy tools provide a framework for addressing ethical, social, and regulatory considerations in digital innovation. These tools help ensure that solutions are equitable, inclusive, and aligned with societal needs and legal standards. By addressing broader challenges such as accessibility, sustainability, and patient rights, students are empowered to influence policies and promote healthcare solutions that improve outcomes in sleep medicine and beyond.

Navigating policy frameworks and integrating new initiatives within institutional structures are critical aspects of establishing and sustaining Social Innovation Incubators in sleep medicine and digital health. However, due to the diversity of administrative procedures, governance models, and regulatory environments across different higher education institutions and countries, the Toolkit cannot provide step-by-step guidance for every unique context. Instead, it offers strategic directions, external resources, and practical tools to support institutional engagement and policy navigation. Institutions are encouraged to adapt the guidance provided here to their internal processes and consult with relevant legal, administrative, and policy departments.

For those who wish to gain a deeper understanding of policy landscapes relevant to digital health, higher education, and innovation, the Toolkit provides links to external resources, including EU policy frameworks and guidance documents on digital health integration. These resources can help institutions tailor their policy engagement strategies to their specific administrative and legal contexts. The main resoruces that provide guidance on regulatory standards, funding opportunities, ethical considerations, and strategic priorities include:

- **European Commission**: The European Commission plays a central role in shaping EU digital health policies. It provides regulatory frameworks, strategic priorities, and funding opportunities to support the digital transformation of health and care systems across Member States. Its Digital Europe Programme is a key EU funding instrument designed to accelerate digital transformation across Europe. In the context of health, it supports the deployment of digital infrastructures, artificial intelligence, advanced data analytics, and cybersecurity solutions to strengthen health systems. The programme provides financial and strategic support to Member States and institutions to build capacity, integrate digital technologies, and scale innovative solutions.[6]

[6] https://health.ec.europa.eu/ehealth-digital-health-and-care/digital-health-and-care_en?utm_source

- **World Health Organization**: World Health Organization provides global and regional guidance on the implementation of digital health solutions. It focuses on establishing ethical frameworks, governance mechanisms, and capacity-building strategies for digital health adoption. The WHO resources include policy recommendations, toolkits for digital health readiness, and frameworks to support in achieving equitable access to digital health technologies.[7]

The table below provides a detailed overview of the advocacy and policy tools used within the course.

Table 6 Advocacy and policy resources

Advocacy and Policy Resources	
Tool	**Ethical Analysis of AI and Data-Driven Technologies in Healthcare**
Description	**Ethical Analysis of AI and Data-Driven Technologies in Healthcare** is a collaborative activity where students evaluate the ethical implications of using advanced digital health technologies, including artificial intelligence and data-driven systems. Teams will explore critical topics such as privacy, bias, transparency, accountability, and patient rights. The activity culminates in a research report that integrates theoretical reflections on ethics with practical considerations, examining the potential benefits and drawbacks of these technologies in healthcare settings.
Applicability	Digital Literacy through User-Centric Innovation Design
Skills and Dimensions Covered	**Knowledge** • Understanding ethical implications and the potential impacts of AI in healthcare. • Awareness of data privacy laws and regulations relevant to digital health. **Research skills** • Critical evaluation of AI technologies for biases and ethical concerns. **Life skills** • Navigating ethical dilemmas in the use of artificial intelligence. • Decision-making skills in complex, technologically driven environments. **Mindset and attitudes** • Commitment to uphold ethical standards in the use of digital health. • Responsiveness to emerging ethical challenges in technology applications.
Development Level	• **Introductory level**: This tool introduces students to fundamental ethical principles and challenges in healthcare technology, serving as a stepping stone to more advanced analysis and applications.
Learning Outcomes	The Ethical Analysis of AI and Data-Driven Technologies in Healthcare supports the **learning outcomes defined in Part 2 of the Digital Health module**, including: • Define digital platforms and data-driven decision-making. • Give examples of ways in which artificial intelligence can be helpful and when it can be harmful to healthcare of the future. • Summarize conclusions according to their importance after peer discussions on AI in digital health with a focus on ethics, drawbacks, and its potential. • Foster an ethical and responsible perspective in using digital tools within healthcare, emphasizing patient dignity and self-care. • Evaluate the effectiveness and appropriateness of artificial intelligence and data-driven decision-making.

https://digital-strategy.ec.europa.eu/en/policies/ehealth?utm_source
https://digital-strategy.ec.europa.eu/en/activities/digital-programme
[7] https://www.who.int/europe/teams/data-and-digital-health?utm_source

Advocacy and Policy Resources	
	• Turn narrative descriptions into numerical data that can be the basis for enhanced decision-making in a healthcare setting.
Teaching-Learning Strategies	• **Collaborative Research**: Students work in teams to research a specific ethical issue, such as the risks of data misuse or the implications of opaque decision-making algorithms. Teams incorporate their findings into a structured report.
Educational Materials	• Articles, reports, and studies on AI ethics in healthcare. • Reading materials and OERs that support Part 2 of the Digital Health module
Support Materials	• Examples of well-written ethical analyses to guide students in structuring their reports.
Evaluation Tools	• **Team Research Report Assessment**: Evaluate the depth of analysis, clarity of ethical reasoning, and quality of proposed solutions.
Tool	**Business Plan**
Description	A **Business Plan** is a structured document that outlines the goals, strategies, market opportunities, and financial planning for implementing a proposed solution or venture. In this activity, students will collaboratively create a comprehensive business plan for an innovative sleep medicine solution, addressing market analysis, value proposition, and implementation strategies, and present it to faculty or industry experts for feedback.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Insight into the process of taking a product from prototype to market. • Understanding of intellectual property and funding strategies for startups. **Research skills** • Financial forecasting and business model testing. **Life skills** • Leadership and management skills necessary for startup success. • Effective pitching and presentation skills for securing investment. **Mindset and attitudes** • Entrepreneurial spirit with a focus on innovation and market disruption. • Ethical considerations in business practices, particularly in the health tech field.
Development Level	• **Introductory level**: The activity is focused on introducing students to the fundamentals of business planning, focusing on key components such as market analysis, value proposition, and basic financial planning. With structured guidance and templates, it helps students build confidence in organizing ideas and applying business strategies to real-world challenges in healthcare.
Learning Outcomes	The **Business Plan** supports the **learning outcomes defined in Part 3 of the Entrepreneurship module**, including: • Navigate the funding landscape for health tech innovations. • Understand intellectual property rights. Prepare and deliver an effective pitch to potential investors.
Teaching-Learning Strategies	• **Group assignment:** Students work in teams to create a comprehensive report detailing their business plan for an innovative sleep medicine solution, including market analysis, value proposition, operational strategies, and financial planning, with a focus on presenting their observations and proposed strategies clearly and professionally.
Educational Materials	• Reading materials and OERs that support Part 3 of the Entrepreneurship module
Support Materials	• Tutorials on budgeting and financial forecasting. • Strategy guides for healthcare startups.

Advocacy and Policy Resources	
Evaluation Tools	• **Team Report Assessment**: Assessment of the clarity and comprehensiveness of the business plan. • **Peer Feedback**: Groups present their maps to peers for constructive feedback.

Source: eSleep_dHealth Curriculum

3.1.2.5 Evaluation and Monitoring Tools

These tools focus on assessing the effectiveness, usability, and outcomes of healthcare interventions and learning processes. They help students track progress, evaluate the success of their solutions, and reflect on their learning and application of sleep healthcare concepts. The table below provides a detailed overview of the evaluation and monitoring tools used within the course.

Table 7 Evaluation and monitoring tools

Evaluation and Monitoring Tools	
Tool	**Concept Map**
Description	A collaborative visual tool for mapping and understanding relationships between foundational concepts in sleep medicine, including wakefulness, sleep physiology, sleep disorders, and their implications for health and healthcare.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Theories on the functions of sleep • Circadian rhythm of wakefulness and sleep • Sleep homeostasis • Acute and chronic sleep deprivation • Species and gender differences in sleep • The neurophysiology and neurobiology of wakefulness and sleep • Sleep hygiene **Life skills** • Engage in effective communication with students from diverse backgrounds. • Implementation of assertiveness in communication. • Effective time management for collaborative work. **Mindset and attitudes** • Valuing and appreciating the contributions of collaborators from various disciplines. • Developing the resilience to navigate setbacks and challenges. • Fostering a curious and critical mindset.
Development Level	• **Introductory level**: This tool is focused on the acquisition of foundational knowledge and fostering interdisciplinary thinking in sleep medicine.
Learning Outcomes	The **Concept Map** supports the **learning outcomes defined in Part 1 of the Sleep Medicine module**, including: • Understand the foundational concepts of wakefulness and sleep, and scope of sleep research and sleep medicine. • Define the sleep quality and its importance in healthcare. • Describe the physiological processes involved in the regulation of wakefulness and NREM and REM sleep. • Recount, discuss, and evaluate the outcomes of inadequate sleep hygiene and acute and chronic sleep deprivation.
Teaching-Learning Strategies	• **Group assignment:** Students work in small groups, promoting teamwork and active participation. Each group collaboratively constructs a concept map during seminars or workshops, with

Evaluation and Monitoring Tools	
	roles distributed to ensure equal contribution (e.g., researcher, mapper, presenter).
Educational Materials	• Concept mapping tools • Reading materials and OERs that support Part 1 of the Sleep Medicine module
Support Materials	• Examples of concept maps in similar contexts. • Instructions and rubrics for constructing and presenting concept maps.
Evaluation Tools	• **Peer Feedback**: Groups present their maps to peers for constructive feedback. • **Self-Reflection**: Each student submits a brief reflection on their role, group dynamics, and learning outcomes.
Tool	**White Paper**
Description	• A **White Paper** is a formal document that presents a comprehensive exploration of a specific topic, synthesizing research findings and offering evidence-based solutions or recommendations. The students use the White Paper to explore key topics in sleep medicine, such as sleep regulation, stage differentiation, and the impact of sleep deprivation. It will serve as a tool for synthesizing research findings, fostering teamwork, and developing actionable insights to address challenges in digital healthcare.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Sleep research overview. **Research skills** • Acquire the knowledge and skills necessary to conduct a literature search. • Conduct a critical literature review on specific topics in a group setting. **Life skills** • Engage in effective communication with students from diverse backgrounds. • Implementation of assertiveness in communication. • Effective time management for collaborative work. **Mindset and attitudes** • Valuing and appreciating the contributions of collaborators from various disciplines. • Developing the resilience to navigate setbacks and challenges. • Fostering a curious and critical mindset.
Development Level	• **Introductory level**: This tool introduces students to collaborative research and writing, helping them develop foundational skills in literature review, critical thinking, and teamwork while exploring key healthcare topics.
Learning Outcomes	The **White Paper** supports the **learning outcomes defined in Part 1 of the Sleep Medicine module**, including: • Understand the foundational concepts of wakefulness and sleep, and scope of sleep research and sleep medicine. • Define the sleep quality and its importance in healthcare. • Describe the physiological processes involved in the regulation of wakefulness and NREM and REM sleep. • Recount, discuss, and evaluate the outcomes of inadequate sleep hygiene and acute and chronic sleep deprivation. • Understand and discuss the concept of sleep as an interdisciplinary area and explain possible collaborations of experts with different background in education and research in sleep and practice in sleep medicine.

Evaluation and Monitoring Tools	
Teaching-Learning Strategies	• **Group assignment:** The White Paper is implemented through group work, where students collaborate to conduct research, share insights, and produce a cohesive document. This approach fosters teamwork, peer learning, and the development of communication and organizational skills.
Educational Materials	• Access to research databases (e.g., PubMed, Scopus, Google Scholar). • Templates for structuring and formatting a white paper. • Instructional guides on academic writing and research methodologies. • Reading materials and OERs that support Part 1 of the Sleep Medicine module
Support Materials	• High-quality examples of published white papers. • Checklists for quality assurance (e.g., structure, clarity, citation accuracy).
Evaluation Tools	• **Peer Feedback**: Each student submits a reflection on the effectiveness of time management and their contributions during the collaborative project. • **Self-Reflection**: Each student submits a brief reflection on their role, group dynamics, and learning outcomes.
Tool	**Online Quiz**
Description	• The **Online Quiz** is an interactive and digital assessment tool used to evaluate students' understanding of fundamental concepts related to sleep disorders and their diagnostics. It features multiple-choice and true/false, that test knowledge related to hypersomnias, parasomnias and movement disorders of sleep. Designed as a formative assessment, it provides immediate feedback to reinforce learning and help students identify areas for improvement.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Narcolepsy and other hypersomnias • Parasomnias • Sleep Walking • REM sleep behavior disorder • Restless legs syndrome (RLS) and Periodic limb movement disorder (PLMD)
Development Level	• **Introductory level**: The Online Quiz is ideal for testing foundational knowledge and is suitable for students new to the field of sleep medicine. It supports the introduction and reinforcement of key concepts of the sleep disorders.
Learning Outcomes	The **Online Quiz** supports the **learning outcomes defined in Part 5 of the Sleep Medicine module**, including: • Describe the most important characteristics of primary and secondary hypersomnia, associated with excessive daytime sleepiness, hypersomnias of central origin, parasomnias, and sleep-related movement disorders. • Describe the most prevalent parasomnias. • Name and discuss the importance of sleep-related movement disorders such as restless legs syndrome (RLS) and periodic limb movement disorder (PLMD). • Use acquired theoretical knowledge in recognizing sleep-related movement disorders in polysomnographic recordings.
Teaching-Learning Strategies	• **Individual Learning**: Quizzes are taken independently to test each student's comprehension and application skills. Students use immediate feedback to address knowledge gaps.

Evaluation and Monitoring Tools	
	• **Formative Assessment**: The quiz serves as a low-pressure evaluation, designed to help students self-assess their understanding.
Educational Materials	• Reading materials and OERs that support Part 5 of the Sleep Medicine module
Support Materials	• Concise summaries of key concepts covered in the quiz.
Evaluation Tools	• **Automated Grading**: The quiz platform provides instant scoring to assess individual knowledge.
Tool	**Learning Cards**
Description	**Learning Cards** are student-created flashcards designed to condense and summarize key course concepts into simple, digestible formats. Students use learning cards to reinforce memorization, synthesize information, and engage in peer learning by sharing and reviewing cards with classmates. Students use online tools to create learning cards covering the content related to hypersomnias, parasomnias and movement disorders of sleep.
Applicability	Inclusive Digital Healthcare with a Focus on Sleep Medicine Disorders
Skills and Dimensions Covered	**Knowledge** • Narcolepsy and other hypersomnias • Parasomnias • Sleep Walking • REM sleep behavior disorder • Restless legs syndrome (RLS) and Periodic limb movement disorder (PLMD)
Development Level	• **Introductory level**: This activity is ideal for beginners, helping students develop foundational knowledge and familiarity with course content. It fosters initial understanding and retention of fundamental concepts of the sleep disorders. in an engaging, student-led manner.
Learning Outcomes	The **Learning Cards** activity supports the **learning outcomes defined in Part 5 of the Sleep Medicine module**, including: • Describe the most important characteristics of primary and secondary hypersomnia, associated with excessive daytime sleepiness, hypersomnias of central origin, parasomnias, and sleep-related movement disorders. • Describe the most prevalent parasomnias. • Name and discuss the importance of sleep-related movement disorders such as restless legs syndrome (RLS) and periodic limb movement disorder (PLMD). • Use acquired theoretical knowledge in recognizing sleep-related movement disorders in polysomnographic recordings.
Teaching-Learning Strategies	• **Individual Learning**: Students independently create learning cards from course materials, encouraging personal engagement with the content.
Educational Materials	• Reading materials and OERs that support Part 5 of the Sleep Medicine module
Support Materials	• Structured templates for students to organize information (e.g., topic on one side, explanation on the other).
Evaluation Tools	• **Instructor Feedback**: Teachers review a sample of the cards to ensure alignment with course objectives and provide guidance for improvement.

Source: eSleep_dHealth Curriculum

3.1.3 Evaluation and Continuous Improvement Framework

Evaluation and continuous monitoring are essential to ensure that Social Innovation Incubators achieve their intended objectives and generate lasting impact. This section outlines a structured approach to

assess the effectiveness of incubator activities, measure student engagement, track innovation outputs, and evaluate long-term outcomes.

The evaluation strategy combines quantitative and qualitative metrics through a Key Performance Indicator Dashboard, longitudinal follow-up studies, and systematic feedback loops. Together, these components enable incubator teams and institutional stakeholders to:

- Monitor progress toward defined goals and benchmarks
- Identify opportunities for improvement and refinement of activities
- Capture the broader impact on students, alumni, partnerships, and the health innovation ecosystem
- Ensure that the incubator remains responsive to evolving needs in sleep medicine and digitalh health.

By implementing this framework, higher education institutions can adopt a data-informed approach to decision-making, strengthen program design, and demonstrate the value of social innovation initiatives to internal and external stakeholders.

1. Key Performance Indicator Dashboard

A Key Performance Indicator (KPI) Dashboard provides a clear and structured way to measure the incubator's performance against its strategic objectives. KPIs should cover multiple dimensions to capture the full impact of incubator activities:

- **Student Engagement Metrics**: These indicators track participation, commitment, and learning outcomes. Examples include:
    - Number of students enrolled and actively participating in incubator activities.
    - Completion rates of innovation projects or courses.
    - Satisfaction levels and self-assessed skill development.
- **Innovation Output Measures**: These indicators evaluate tangible innovation outcomes produced by students and teams:
    - Number of prototypes or digital health solutions developed.
    - Start-ups or ventures launched.
    - Research outputs, publications, or patents.
- **Partnership Development Indicators**: These metrics assess the breadth and depth of collaboration with external stakeholders:
    - Number and diversity of industry, healthcare, and community partners engaged.
    - Joint initiatives and co-creation projects completed.
    - Sustainability of partnerships over time.

- **Long-Term Impact Assessments**: These indicators capture the broader and lasting effects of the incubator:
    - Alumni career progressions in health innovation or entrepreneurship.
    - Adoption or scaling of incubator-developed solutions within healthcare systems.
    - Contributions to regional or institutional innovation ecosystems.

The dashboard enables real-time monitoring and data-driven decision-making. By tracking progress against these KPIs, incubator teams can identify areas for improvement, demonstrate outcomes to university leadership and stakeholders, and guide strategic planning for future programme cycles.

2. Longitudinal Study Framework

To capture the lasting impact of Social Innovation Incubators in sleep medicine and digital health, it is essential to implement a longitudinal tracking framework. This framework monitors participants' outcomes over time, ensuring that the incubator contributes to sustainable skills development, innovation outputs, and institutional impact.

Key components of the longitudinal framework are:

- **Follow-Up Protocols**: Structured follow-ups allow teams to track progress at multiple intervals after programme participation:
    - **6-Month Follow-Up:** Assess short-term skill retention, project continuation, and immediate application of learned concepts.
    - **1-Year Follow-Up:** Evaluate medium-term outcomes, including further development of prototypes, engagement in new projects, and career progress.
    - **3-Year Follow-Up:** Assess long-term effects on professional trajectories, entrepreneurial activities, adoption of innovations, and contributions to the health ecosystem.
- **Alumni Tracking Systems**: A centralized database should be established to monitor the career paths, academic progress, and entrepreneurial engagement of participants. This system can track:
    - Employment in health technology, sleep medicine, or related sectors.
    - Initiation of start-ups or ventures.
    - Involvement in research, publications, or professional collaborations.
- **Impact Measurement Tools**: To evaluate outcomes effectively, multiple tools should be used, combining quantitative metrics with qualitative insights:
    - **Surveys and Questionnaires:** Collect data on skills application, satisfaction, and professional development.

    - **Interviews or Focus Groups:** Gather in-depth insights on alumni experiences, challenges, and contributions to healthcare innovation.
    - **Case Studies:** Document specific examples of incubator projects that achieved impact in sleep medicine and digital health.
- **Data Analysis and Reporting**: Collected data should be systematically analyzed to identify trends, highlight successful practices, and inform program refinement. Reporting should include:
    - Aggregated metrics for cohorts over time.
    - Comparative analysis of outcomes between participants and baseline expectations.
    - Recommendations for enhancing incubator design and impact.

3. Feedback Loop Mechanisms

Continuous feedback is essential for ensuring that Social Innovation Incubators remain responsive, effective, and aligned with the needs of students, stakeholders, and partner institutions. Feedback loops provide structured ways to collect, analyze, and act upon input from all participants in the incubator ecosystem.

Key components of feedback loops are**:**

- **Regular Participant Surveys**: Surveys are designed to capture participant experiences, satisfaction, and suggestions for improvement:
    - **Pre-Program Surveys:** Assess initial expectations, skill levels, and learning needs.
    - **Mid-Program Surveys:** Monitor ongoing engagement, identify challenges, and adjust program delivery in real-time.
    - **Post-Program Surveys:** Evaluate overall satisfaction, skills gained, project outcomes, and perceived value of the incubator experience.
- **Stakeholder Feedback Collection:** Collecting input from partners, faculty, healthcare providers, and community representatives ensures the incubator meets external needs and expectations:
    - Structured interviews or focus groups with stakeholders to gather qualitative insights.
    - Feedback on project relevance, collaboration effectiveness, and contribution to organizational or societal goals.
    - Mechanisms to capture ongoing suggestions for improvement in partnership engagement and resource allocation.
- **Continuous Improvement Protocols**: Feedback must be systematically analyzed and acted upon to drive program refinement:
    - **Quarterly Review Meetings:** Incubator teams review survey results and stakeholder feedback to identify patterns and priorities for improvement.

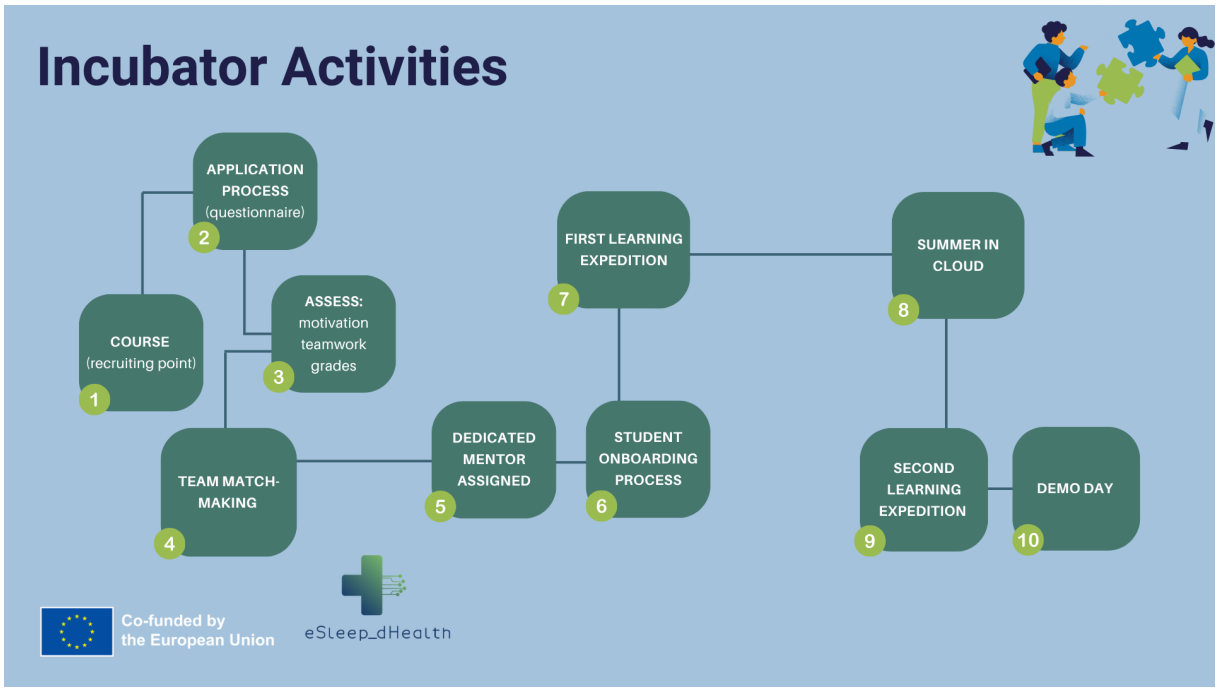
- **Action Plans:** Define clear, measurable steps to address issues, enhance engagement, or update training materials and tools.
- **Documentation:** Record decisions, changes, and rationale to ensure institutional memory and accountability.
- **Iterative Updates:** Incorporate feedback into curriculum updates, project design, and program structure on an ongoing basis.

4 Implementing the Social Innovation Incubator

Social Innovation Incubator is designed to be adaptable for various university settings. Each step, from recruiting students to facilitating team collaboration and supporting project development, provides a foundational structure that universities can customize to fit their unique contexts. The outlined activities serve as a general framework to help institutions introduce and implement a Social Innovation Incubator programme effectively.

The inclusion of multiple universities fosters a unique and collaborative 'cloud-based' model that overcomes traditional barriers of time and place, effectively addressing challenges like student disconnection across institutions. This inter-university incubator framework enriches the diversity of ideas and experiences, while also enhancing the adaptability and scalability of the model to meet varied academic and practical needs, delivering substantial value to all participants.

The graphic below illustrates the core components of the process, including application, assessment, team formation, mentorship, and the final pitch presentation. These steps foster a supportive environment for students to innovate, collaborate, and refine their ideas, making the incubator model accessible and flexible for diverse academic and social innovation objectives.



Graphic 1 Incubator activities

The table below outlines the steps for establishing a Social Innovation Incubator.

Table 8 Social Innovation Incubator Activities

Phase	Description	Duration	Resoruces
Course (Recruiting Point)	Participation in the course is essential as it provides foundational knowledge and skills that are critical for success in the incubator. The Sleep Medicine module equips students with an understanding of sleep-related healthcare challenges and innovations. The Digital Health module introduces emerging technologies and their applications in healthcare, fostering digital literacy and technical proficiency. The Entrepreneurship module develops an entrepreneurial mindset and strategic thinking, enabling students to identify opportunities and create impactful solutions. Together, these modules ensure participants are well-prepared, informed, and capable of contributing meaningfully to the incubator process. At the end of the course, students are presented with their first real-world challenge, which serves as a practical introduction to the incubator. This initial challenge allows students to assess whether they want to continue participating in the incubator, providing a clear opportunity to prepare for the application process. Additionally, it enables students to demonstrate their readiness and commitment to developing innovative solutions aimed at addressing the presented healthcare or digital health challenge. This step ensures that participants can actively engage in problem-solving and showcase their potential to contribute to meaningful social innovation.	Sleep Medicine module: 6 weeks Digital Health module: 3 weeks Entrepreneurship module: 3 weeks	OERs
Application Process	Following the course, a public call for students' participation marks the beginning of the incubator process. This includes promotional activities to inform students about the opportunity, outlining the goals, expectations, and benefits of the programme. The call ensures inclusivity and attracts motivated individuals with diverse backgrounds and interests. After the public call for participation is announced, students are invited to submit their applications for the incubator. The application process involves completing a detailed questionnaire designed to assess their motivations, skills, and interests. Clear guidelines for student selection are established to ensure fairness and transparency, prioritizing candidates who demonstrate a strong interest in social innovation and a willingness to engage in team-based problem-solving. As part of the selection process, students are also required to deliver a Personal Elevator Pitch, a concise presentation in which they showcase their ideas, strengths, and vision for social innovation. This step provides an opportunity to evaluate their communication skills, creativity, and ability to present ideas effectively, helping the selection committee identify participants best prepared to contribute meaningfully to the incubator.	2 weeks	Promotional materials Online application form Presentation guidelines Pitch templates Scoring rubric
Assess	The Assess phase follows the submission of student applications and serves to evaluate applicants' readiness for the incubator. Using the information provided in the application forms and detailed questionnaires, students are assessed on their motivation, teamwork skills, and academic performance. Additional methods, such as brief interviews or evaluation of submitted materials (e.g., initial project ideas), may also be used to gain a more comprehensive understanding of each candidate's potential. The purpose of this phase is to identify individuals who demonstrate the ability and enthusiasm to engage in collaborative	1 week	Evaluation rubrics Scoring templates

Phase	Description	Duration	Resoruces
	problem-solving and innovative thinking, ensuring that selected participants are well-prepared to contribute meaningfully to the incubator activities. The evaluation should include the following categories: • **Motivation and Commitment:** Evaluates the student's enthusiasm for social innovation, interest in sleep medicine and digital health, and willingness to fully engage in incubator activities. • **Teamwork and Collaboration Skills:** Assesses the ability to work effectively in diverse teams, communicate constructively, and respect others' perspectives. • **Problem-Solving and Critical Thinking:** Measures the capacity to identify challenges, analyze complex information, and propose creative and feasible solutions. • **Entrepreneurial Mindset:** Assesses curiosity, initiative, adaptability, and strategic thinking relevant to innovation and business development. • **Digital Literacy and Technical Awareness:** Evaluates familiarity with digital tools, platforms, and health technology applications. • **Communication and Presentation Skills:** Measures clarity, coherence, persuasiveness, and professional delivery in both written and oral communication, including the Personal Elevator Pitch. • **Course Performance:** Evaluates overall academic performance across all modules, including completion of assignments, quality of outputs, and active participation. Each category should be evaluated on a scale from 1 to 5, and students demonstrating the strongest overall performance across all categories should be selected to continue into the Incubator.		
Team Match-making	Following the assessment and application process, a structured team match-making process is implemented to ensure that students are grouped into diverse teams that maximize collaborative potential. Each team should be composed based on: • **Skills Complementarity:** Each team should include members with diverse skill sets to ensure a well-rounded approach to problem-solving. This includes technical, research, and business-oriented skills. • **Diversity of Interests:** Teams should bring together students with varied focus areas and passions to stimulate creativity and avoid overlap. • **Experience Balance:** Mix students with prior experience in healthcare, technology, or innovation with those who are new to these domains. This ensures knowledge transfer, mentorship within the team, and exposure to different approaches, strengthening team learning and problem-solving potential. • **Personality and Collaboration Potential**: Consider interpersonal traits that affect team dynamics, including adaptability, leadership, teamwork. This careful composition ensures that each team has a balanced mix of competencies, fostering effective collaboration and innovation.	1 week	
Mentor Assignment	Each team should be assigned a designated mentor who provides continuous guidance, support, and expertise throughout the incubator programme, with a particular focus on applying design thinking methodologies. The mentor's role is to facilitate effective team dynamics, encourage iterative problem-solving, provide	Recruitment: 4 weeks prior to programme start	Mentor onboarding manual

Phase	Description	Duration	Resoruces
	constructive feedback, and help students refine their ideas into actionable solutions. Additionally, each team should have access to expert in specific domains relevant to their challenge, such as sleep medicine or digital health. These expert ensure that students have access to specialized knowledge and practical insights when addressing technical or clinical aspects of their projects. If a team requires the assistance of a domain expert, they should first consult their designated mentor, who will facilitate the connection. This structure ensures that teams can integrate creative, user-centered innovation processes with evidence-based, field-specific guidance, making their solutions both innovative and practically relevant. Mentors are recruited through partner universities, healthcare institutions, industry networks, and innovation hubs. The selection should be focues on individuals with: • Proven expertise in relevant fields (e.g., clinical practice, digital health technologies, innovation management, business development). • Experience or interest in mentoring student teams and supporting early-stage innovation. • Availability to commit to regular mentoring sessions throughout the incubator. • Strong communication skills and openness to working in interdisciplinary and multicultural teams. Selected mentors should participate in a structured onboarding and training programme to ensure a shared understanding of the incubator's goals and methods. Training is divided into short, focused modules: • **Module 1: Introduction to the Incubator Programme** ○ Overview of objectives, structure, phases, timelines, and expected mentor involvement. ○ Roles and responsibilities of mentors. • **Module 2: Design Thinking Facilitation** ○ Practical guidance on how to support teams. ○ Techniques for encouraging creativity and structured problem-solving. ○ Strategies for guiding teams without providing solutions directly. • **Module 3: Effective Communication and Feedback** ○ Methods for giving constructive and actionable feedback. ○ Approaches for conflict resolution and supporting team dynamics. ○ Best practices for inclusive and respectful mentoring. • **Module 4: Diversity and Inclusion in Innovation** ○ Training on fostering inclusive team environments. ○ Awareness of cultural differences and approaches to support equitable participation. To ensure mentorship is effective and well-coordinated, a simple and clear tracking system should be introduced. This system should foucs on three essential tools: • **Mentoring Schedule** ○ At the beginning of the programme, each team and their mentor agree on a regular meeting	Training: 1–2 weeks before team formation Mentorship: Continuous throughout the incubator	

Phase	Description	Duration	Resoruces
	schedule (e.g., weekly or bi-weekly online/offline sessions). ○ These meetings follow the key phases of the incubator to align mentoring with team progress. • **Short Meeting Notes Template** ○ After each session, either the mentor or a designated team member completes a short one-page template. ○ The template includes: ▪ Date and participants. ▪ Key discussion points. ▪ Decisions made / next steps. ▪ Any specific support needed (such as, referral to an expert). • **Final feedback** ○ Provides an overview of the team's growth, mentor's perspective on their innovation, and suggestions for further development.		
Student Onboarding Process	To ensure that new participants are well-prepared, informed, and confident to engage in the incubator programme, Welcome and Orientation Package Templates defines onboarding sets expectations, provide essential resources, and fosteer early engagement and team cohesion. It should include: • **Programme Overview** ○ Detailed schedule of learning expeditions, mentorship sessions, and Demo Day. ○ Clear explanation of key milestones and deliverables. • **Team and Mentor Information** ○ List of assigned mentors, their expertise, and contact details. ○ Overview of team members with skills, interests, and backgrounds to facilitate early collaboration. • **Tools and Resources Guide** ○ Overview of main tools and materials for the First Learning Expedition, Summer in Cloud and Second Learning Expedition. • **Support Contacts** ○ Practical guidance on communication channels, technical support, and administrative procedures. Expectation-Setting Framework will clarify responsibilities, goals, and behavioural expectations for participants, fostering accountability and alignment. It should include: • **Roles and Responsibilities** ○ Clear definition of student roles in teams (research, design, prototyping, presentation). ○ Expectations for mentor engagement and participation in learning expeditions. • **Engagement Expectations** ○ Minimum participation requirements in workshops, virtual collaboration, and feedback sessions. ○ Guidelines for timely submission of assignments and deliverables. • **Collaboration Guidelines**	1 week before the start of the First Learning Expediti on	Student Onboarding Process Manual

Phase	Description	Duration	Resoruces
	○ Principles for effective teamwork: active listening, constructive feedback, shared decision-making. ○ Conflict resolution protocols and channels for raising concerns. • **Learning and Innovation Goals** ○ Short-term goals for each phase (First Learning Expedition, Summer in Cloud, Second Learning Expedition). ○ Long-term goals aligned with incubator objectives: innovation creation, solution testing, and presentation readiness. • **Evaluation Awareness** ○ Overview of assessment criteria for individual and team performance.		
First Learning Expedition	The First Learning Expedition represents the first intensive sprint within the incubator programme, designed to immerse students in a hands-on, collaborative innovation experience. This five-day sprint focuses on addressing the challenge presented at the end of the course, providing students with their first opportunity to apply the knowledge and skills gained through the course in a practical context. During this phase, students work in their newly formed teams and engage in a structured design thinking process to explore the challenge, generate ideas, develop prototypes, and test potential solutions. The sprint is organized through a series of interactive workshops, feedback sessions, and practical assignments that guide teams through each stage of the design thinking methodology. A key objective of this expedition is to strengthen team collaboration and dynamics. Through intensive work on a shared challenge, students learn how to leverage their complementary skills, coordinate effectively, and build trust within their teams – laying the foundation for their future work in the incubator. The First Learning Expedition marks a critical step in transitioning from theoretical learning to practical innovation, enabling teams to experience real-world problem-solving in a structured, time-bound format. The sprint follows the five key phases of design thinking, with active involvement of end-users at critical points to ensure the development of solutions that are grounded in real needs: • **Empathize:** Teams begin by exploring and understanding the presented challenge in depth. They analyze the context and engage directly with end-users to map their needs, experiences, and pain points. • **Define:** Using the insights gathered during the Empathize phase, teams synthesize their findings and articulate a clear and focused problem statement. This shared understanding ensures that all team members are aligned on the challenge they aim to solve and sets a clear direction for ideation. • **Ideate:** In this stage, teams participate in structured brainstorming to generate a wide range of potential solutions. The focus is on encouraging diverse perspectives and exploring different approaches before narrowing down to the most promising concepts that address the defined problem.	6 days	Workshop Materials (whiteboards, post-it papers, markers) Pitch Preparation Guides

Phase	Description	Duration	Resoruces
	• **Prototype:** Teams transform their selected ideas into tangible low-fidelity prototypes. The goal is to rapidly visualize the proposed solution in a way that can be shared, discussed, and tested. • **Test:** Teams conduct testing sessions that again involve end-users, mentors, and peers. By gathering structured feedback, they identify areas for improvement and iterate on their prototypes to refine the solutions. This phase highlights the importance of user-centered design and continuous learning. Teams present their solutions in a structured pitch format, showcasing their design process, key insights, and proposed innovations. They receive targeted feedback from mentors. At the end of the First Learning Expedition, students are introduced to the new, main challenge that they will address in the incubator during Summer in the Cloud and the Second Learning Expedition. This step ensures that teams understand the problem they will address and continue developing solutions that are impactful and user-centered.		
Summer in Cloud	Summer in Cloud is a remote working period in which student teams continue their collaboration after the First Learning Expedition. During this phase, teams focus on analyzing the challenge presented at the end of the First Learning Expedition. The primary goal is to gain a deep understanding of the problem and the needs of potential end-users. As part of this work, each team is expected to develop a report provoding a tructured overview of the existing solutions addressing the identified challenge, highlights gaps in the current market or service provision, and identifies potential opportunities for innovative interventions. Preparing this report allows students to systematically assess the landscape of solutions and understand where their future innovation efforts can make the greatest impact. Teams have the opportunity to consult with their designated mentors, who provide guidance, feedback, and support throughout this period. This ensures that groups can clarify doubts, refine their research approaches, and align their findings with practical and user-centered innovation principles. By engaging in research, stakeholder interviews, and preliminary analysis, students prepare themselves to develop innovative solutions in the upcoming Second Learning Expedition. This phase encourages independent and team-based work, enhances digital collaboration skills, and ensures that each group is fully prepared to ideate and prototype solutions effectively.	2 months	Templates and guidelines for the Report
Second Learning Expedition	The Second Learning Expedition is the follow-up, hands-on sprint during which teams work intensively to develop innovative solutions based on the challenge introduced at the end of the First Learning Expedition and further studied during Summer in Cloud. The focus is on applying design thinking to create practical, user-centered solutions.	5 days	Workshop Materials (whiteboards, post-it papers, markers) Pitch Preparation Guides
Demo Day	Demo Day marks the culmination of the incubator activities and the Second Learning Expedition. During this event, each team presents their fully developed solution, showcasing the results of their design thinking process from the initial challenge through ideation, prototyping, testing, and refinement. Teams prepare and	1 day	Evaluation rubrics for panelists

Phase	Description	Duration	Resoruces

	deliver Pitch Presentations that highlight the problem addressed, the innovative solution, user-centered design elements, and potential impact.
	
	The event involves a panel of mentors, experts, and stakeholders who provide constructive feedback, evaluate the quality and feasibility of solutions, and recognize outstanding achievements. Demo Day also serves as a platform for teams to demonstrate their communication, collaboration, and strategic planning skills, while gaining exposure to potential partners, investors, and the broader innovation ecosystem.
	
	Teams are assessed across six main dimensions, each rated on a scale of 1 to 5:
	• **Problem/Solution Fit**
	  ○ Clarity in defining the problem and relevance to end-users.
	  ○ Appropriateness of the proposed solution in addressing the identified need.
	• **Feasibility of the Solution**
	  ○ Practicality of implementation, technical viability, and alignment with available resources.
	  ○ Consideration of potential risks and mitigation strategies.
	• **Innovativeness**
	  ○ Originality of the idea and novelty compared to existing solutions.
	  ○ Creativity in approach, methodology, or application of technology.
	• **Sustainability of the Business Model**
	  ○ Viability of long-term operations, scalability, and financial sustainability.
	  ○ Consideration of market, social, and environmental impact.
	• **Presentation of the Solution**
	  ○ Clarity, persuasiveness, and structure of the pitch.
	  ○ Ability to engage the audience and convey the key message effectively.
	• **Market Potential**
	  ○ Assessment of target users, market size, and adoption potential.
	  ○ Strategic positioning and competitive advantage.
	• **Use of Digital Technologies**
	  ○ Effective integration of digital tools to enhance solution functionality or delivery.
	  ○ Demonstration of technical skills and innovative technology application.		

5 Student Challenge Management

Effective student collaboration is essential for the success of incubator activities. Working in diverse, multidisciplinary, and often virtual teams requires students to develop strong communication, collaboration, and presentation skills.

Key elements for successful student collaboration include:

1. **Cultural Sensitivity and Inclusivity:** Students must be aware of and respect diverse cultural backgrounds, communication styles, and professional experiences within their teams. Sensitivity to differences fosters trust, reduces conflict, and encourages open idea sharing.
2. **Clear Digital Communication:** Virtual collaboration requires concise and effective communication using online platforms. Students should use appropriate channels for different types of messages, maintain professionalism, and clarify expectations to avoid misunderstandings.
3. **Team Dynamics and Role Definition:** Successful teams establish clear roles and responsibilities early on. Students must understand their own strengths and areas for growth, recognize the complementary skills of their peers, and adapt to the team's needs to maintain balance and efficiency.
4. **Remote Team-Building and Engagement:** Teams should actively engage in ice-breaking exercises, collaborative problem-solving sessions, and structured check-ins. These activities promote cohesion, trust, and motivation, which are critical for long-term team performance.
5. **Progress Monitoring and Accountability:** Teams are encouraged to set clear milestones, track progress, and use digital tools for documentation and reporting. Regular updates ensure alignment with incubator goals and allow early identification of challenges.
6. **Presentation and Pitching Skills:** Effective communication of ideas is crucial. Students need to practice presenting their solutions clearly and persuasively to mentors, peers, and external stakeholders, highlighting innovation, feasibility, and potential impact.

Effective collaboration among students is a cornerstone of successful innovation in incubator programs. Working in multidisciplinary teams – often in virtual environments – requires strong communication, cultural awareness, and the ability to coordinate tasks and responsibilities efficiently. To support students in developing these essential skills, a set of curated resources has been compiled. These resources provide guidance on cultural sensitivity, digital communication best practices, remote team-building activities, and progress tracking tools. By utilizing these tools, students can strengthen teamwork, maintain engagement, and ensure productive collaboration throughout the incubator experience.

The resoruces include:

- https://www.culturemonkey.io/employee-engagement/managing-cross-cultural-remote-teams/?utm_source=
- https://everhour.com/blog/remote-collaboration/?utm_source=
- https://thedigitalprojectmanager.com/tools/best-time-tracking-for-remote-teams/?utm_source=
- https://teambuilding.com/blog/virtual-team-building-activities?utm_source=.

6 Long-term Sustainability

Ensuring the long-term sustainability of the incubator is essential to maintain its impact beyond the project's implementation period. A structured sustainability approach will enable the incubator to continue supporting innovation and strengthening regional healthtech ecosystems over time. This involves developing operational models that allow the incubator to evolve through different lifecycle phases, establishing strong alumni and support networks, ensuring the transfer and continuation of resources, and diversifying funding sources. By combining institutional strategies, community engagement, and financial resilience, the incubator will remain a dynamic platform for innovation well after the project ends.

1. Incubator Lifecycle Management Model

Long-term sustainability is a critical component of the incubator model, ensuring that its impact extends well beyond the duration of individual programme cycles. To achieve this, a structured Incubator Lifecycle Management Model is introduced, which provides clear guidance for managing the incubator's activities and supporting projects across four key stages: Start-up, Growth, Maturation, and Evolution. This model enables continuous innovation, strategic development, and ecosystem integration.

- **Start-up Phase**: The start-up phase focuses on establishing a strong foundation for both the incubator and participating teams. Key actions include:
    - **Operational Setup**: Defining governance structures, roles, and communication channels within the incubator.
    - **Team Onboarding**: Welcoming new participants with orientation packages, expectation-setting frameworks, and introductory training.
    - **Goal Setting**: Establishing clear objectives, milestones, and KPIs aligned with the incubator's vision and thematic focus (e.g., digital health and sleep medicine).
    - **Mentor Assignment**: Connecting teams with domain experts to guide their early development.
    - **Initial Resource Allocation**: Providing access to essential tools, digital platforms, and learning resources to support ideation and prototyping.

    This phase sets the tone for collaborative work, ensuring that teams have the necessary support and structure to progress effectively.
- **Growth Phase**: In the growth phase, the focus shifts to expanding and strengthening teams and their solutions. Key strategies include:
    - **Refining Business and Innovation Models**: Teams work on validating their value propositions, optimizing their business models, and identifying funding opportunities.
    - **Capacity Building**: Providing advanced training in regulatory navigation, intellectual property management, partnership building, and scale-up strategies.

- **Ecosystem Integration**: Strengthening links with external stakeholders – such as healthcare providers, technology companies, and policymakers – to ensure real-world applicability and potential adoption.
- **Performance Monitoring**: Implementing regular check-ins and progress reviews to assess team development and solution readiness.

This phase aims to build resilience and market readiness, ensuring that solutions can move beyond the pilot stage.

- **Maturation Phase**: The maturation phase prepares teams for long-term operational stability and potential independence. Key components include:
  - **Governance and Management Structures**: Establishing sustainable leadership and operational frameworks for each project.
  - **Regulatory and Ethical Compliance**: Supporting teams in meeting relevant regulatory standards for digital health solutions, including data privacy and clinical validation.
  - **Strategic Positioning**: Assisting teams in identifying market niches, competitive advantages, and scaling opportunities.
  - **Financial Sustainability Planning**: Developing long-term funding strategies, including grants, public-private partnerships, or investment opportunities.
  - **Impact Measurement**: Conducting evaluations to assess the effectiveness, scalability, and social impact of the developed solutions.

  This phase ensures that projects are not only innovative but also structurally sound and positioned for long-term success.

- **Evolution Phase:** The evolution phase focuses on adaptation, innovation, and ecosystem renewal to ensure the incubator remains relevant and impactful. Guidelines include:
  - **Continuous Innovation Cycles**: Encouraging teams and the incubator to integrate new technologies, respond to emerging challenges, and identify new opportunities.
  - **Feedback Integration**: Using stakeholder input, evaluation results, and longitudinal tracking to update incubator activities and strategies.
  - **Knowledge Transfer**: Sharing lessons learned, best practices, and case studies with future cohorts and partner institutions.
  - **Strategic Renewal**: Periodically reviewing and updating incubator goals, tools, and curricula to align with evolving policy frameworks and technological developments.

  This ensures that the incubator operates as a living ecosystem, capable of adapting and sustaining its impact over time.

2. Post-Project Sustainability Framework

To ensure that the incubator's impact extends beyond the project's duration, a Post-Project Sustainability Framework is established. This framework focuses on maintaining engagement, supporting continued development, and ensuring that the knowledge, resources, and networks built during the programme remain active and productive. It should include:

- **Alumni Network Development**: A structured alumni network will be created to maintain long-term connections between former participants, mentors, and partners.
  Key elements include:
  - **Community Platform**: Establishing a digital platform where alumni can exchange knowledge, share opportunities, and collaborate on new initiatives.
  - **Regular Events and Meet-ups**: Organizing annual or biannual gatherings (online and in-person) to foster networking, showcase progress, and encourage new collaborations.
  - **Mentorship Roles for Alumni**: Engaging successful alumni as mentors or guest speakers for future cohorts, thereby reinforcing a culture of peer learning and leadership.
  - **Knowledge Repository**: Collecting and sharing case studies, project documentation, and best practices contributed by alumni to inspire future participants.

    This network ensures a dynamic community that continues to grow and support innovation beyond the incubator's active phases.
- **Ongoing Support Structures**: To help teams sustain and scale their solutions, ongoing support mechanisms will be established:
  - **Advisory Support**: Providing continued access to mentors and experts who can guide teams through advanced development stages, regulatory processes, or investment preparation.
  - **Ecosystem Integration**: Facilitating connections with relevant stakeholders such as hospitals, research institutions, and industry partners to enable further testing and implementation.
  - **Access to Resources**: Offering alumni continued (though time-limited or tiered) access to selected incubator tools, training materials, and platforms.
  - **Funding Guidance**: Supporting teams in identifying new funding opportunities, investment channels, or participation in other EU programmes and accelerators.

    These structures ensure that promising teams do not lose momentum once the formal programme ends.
- **Impact Continuation Strategies**: To maintain and amplify the incubator's long-term impact, strategies will be applied to track, evaluate, and expand outcomes:
  - **Longitudinal Tracking**: Monitoring the progress of alumni teams over time to assess market uptake, scalability, and societal benefits.
  - **Impact Metrics**: Using predefined indicators to measure solution adoption, patient outcomes, digital innovation, and ecosystem growth.

- **Dissemination and Visibility**: Sharing success stories through publications, conferences, and online channels to enhance visibility and attract further collaboration.
- **Strategic Partnerships**: Strengthening ties with regional and EU-level stakeholders to create follow-up opportunities and support policy integration.

  Through these measures, the incubator's results continue to generate value long after the initial project cycle has concluded.

3. Funding Sustainability Models

To ensure the long-term operation and impact of the incubator, a comprehensive funding sustainability strategy is established. This strategy combines diversified funding sources, revenue generation opportunities, and partnership-based approaches, ensuring financial resilience and continuity beyond the initial project period. It should include:

- **Diversified Funding Source Strategies**: A balanced portfolio of funding sources is key to maintaining incubator activities over time, including:
  - **EU and National Grants**: Securing funding through programmes such as Horizon Europe, Interreg, Digital Europe, and national innovation funds to support operations, new cohorts, and scaling activities.
  - **Angel Investors and Venture Capital**: Establishing relationships with angel investor networks and venture capital funds that focus on early-stage health and digital innovation. These actors can provide follow-on funding for promising student solutions developed within the incubator, helping to transition from incubation to commercialization.
- **Revenue Generation Possibilities**: To complement external funding, the incubator will explore sustainable revenue models that can generate income for reinvestment into its activities, such as:
  - **Specialized Training and Workshops**: Offering design thinking, digital health, or innovation methodology programmes to external participants on a fee basis.
  - **Consulting Services**: Leveraging incubator expertise to provide tailored advisory support to healthcare institutions, start-ups, or regional stakeholders.
  - **Licensing of Tools and Educational Content**: Developing and licensing proprietary toolkits, frameworks, or educational materials, with options for premium access.
  - **Event Fees and Sponsorships**: Monetizing participation in high-impact events such as Demo Days or hackathons through sponsorship packages or registration fees.
- **Partnership-Based Sustainability Approaches**: Strategic partnerships are essential for long-term stability. The incubator will:
  - **Develop Shared Resource Models** with universities, hospitals, and innovation hubs to minimize operational costs and enhance reach.
  - **Pursue Joint Funding Opportunities** with ecosystem stakeholders to sustain and expand incubator activities.

- **Strengthen Industry Collaborations** by involving private sector partners in co-developing challenges, testing solutions, and co-investing in ventures.
- **Integrate into Regional Ecosystems** to ensure alignment with broader health innovation strategies and secure ongoing institutional support.

7 Conclusion and Next Steps

The Social Innovation Toolkit is a comprehensive, versatile resource designed to empower educators, students, and organizations to foster innovation and address pressing societal challenges. While its initial application focuses on digital health and sleep medicine, the Toolkit's adaptable structure and methodologies allow it to be effectively tailored to a wide range of topics, educational settings, and audiences.

The Toolkit provides a modular framework that can be customized to address various societal challenges beyond healthcare. The Toolkit includes a range of educational tools that are designed to be versatile and easily adaptable to various topics beyond its original focus. These tools provide structured methodologies and strategies that can be customized to suit the needs of different subject areas, ensuring their relevance across diverse educational and societal challenges.

The adaptability of these tools lies in their modular nature, allowing educators to align them with specific learning objectives and contexts. Whether addressing issues in healthcare, technology, sustainability, or community development, the Toolkit provides a flexible framework to guide innovation, collaboration, and problem-solving. This makes it an invaluable resource for fostering creativity and critical thinking in diverse fields while maintaining its core principles of user-centered learning and actionable outcomes. The Toolkit is designed as a flexible resource rather than a one-size-fits-all solution, enabling each incubator iteration to select tools that best align with its unique goals and challenges, ensuring a tailored and focused approach. Importantly, tools can be chosen selectively for each iteration, with the option to introduce new ones or vary their use year by year, depending on the evolving themes and priorities.

For example, Needs Assessment Tools, such as the Interviews, could be repurposed to assess challenges in fields like climate action (e.g., evaluating community awareness and behaviors) or mental health (e.g., understanding stress triggers in workplace environments), while Design Thinking Project, originally used to develop solutions for sleep disorders, can be applied to topics like improving accessibility in urban spaces or creating tools to support financial literacy in underserved communities.

By engaging multiple universities, this incubator model creates a collaborative and flexible framework that overcomes traditional barriers of time and place. This approach broadens the pool of perspectives and expertise, enriching the incubator experience for all participants. The inter-university collaboration enhances the incubator's scalability and accessibility, enabling it to effectively connect students and educators across institutions, address challenges and maximize shared resources for greater impact.

The incubator model is highly adaptable to both vocational and adult education, providing a dynamic framework for fostering innovation, practical skill development, and entrepreneurial thinking. In vocational education, it enhances hands-on learning by addressing industry-specific challenges, preparing students for immediate employment or entrepreneurial ventures. For adult education, the incubator supports reskilling and upskilling by aligning with the diverse needs of learners, empowering them to tackle real-world problems and create meaningful community impact. This flexibility ensures

that the incubator serves as a valuable tool for advancing education and addressing societal challenges in these contexts.

In vocational education, the incubator serves as a platform for students to engage in real-world problem-solving, bridging the gap between theoretical knowledge and practical applications. By incorporating incubator methodologies into vocational programmes, students gain access to structured, hands-on learning opportunities that enhance their skills, creativity, and entrepreneurial mindset.

- **Practical Skill Development:** Through incubator activities such as Design Thinking Projects, Business Plan Development, and Pitch Presentations, vocational students can work on industry-relevant challenges. For instance, students in technical fields can prototype solutions for energy efficiency or smart home systems, while those in hospitality can design innovative customer service solutions.
- **Encouraging Innovation:** The incubator environment encourages students to think beyond traditional boundaries, empowering them to identify gaps in their fields and create innovative solutions. For example, using the Opportunity Analysis Report tool, vocational students can explore market trends and develop strategies to address unmet needs in their industry.

In adult education, the incubator provides a platform for learners to address real-world challenges while acquiring new skills. It is particularly valuable for reskilling and upskilling initiatives, as it aligns with the diverse needs and experiences of adult learners.

- **Personalized Learning Paths:** Adult learners often bring varied professional and personal experiences to the table. The incubator accommodates these differences by offering tools such as the Ethical Analysis of AI in Healthcare or Digital Health Application Design, which can be tailored to individual goals, such as launching a small business or addressing specific community issues.
- **Focus on Lifelong Learning:** The incubator supports lifelong learning by fostering collaboration, critical thinking, and the practical application of knowledge. For example, activities like Research Papers in IMRaD Format encourage learners to engage deeply with the material and share their insights with peers.
- **Community Impact:** Adult education programmes using the incubator can focus on creating solutions for local challenges, such as improving access to digital literacy for older adults or addressing mental health awareness in workplaces. The Needs Assessment Tools help learners identify and respond to these challenges effectively.

The Social Innovation Toolkit demonstrates its value as a versatile and adaptable resource for a wide range of educational contexts. Its flexible tools and structured methodologies can be customized to suit various topics and learning environments, fostering creativity, collaboration, and problem-solving. By bridging the gap between theory and practical application, the Toolkit empowers learners and educators to address real-world challenges effectively, making it a powerful instrument for driving innovation and positive change across disciplines.