Exploring and Extending Human-Centered Design to Develop AI-Enabled Wellbeing Technology in Healthcare

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Abstract. Digital transformation and digitalisation are rapidly affecting the society. The gradually increasing applications of different types of AI into solutions and services are welcome, but there are associated risks. These include, for example, within human aspects of care undermining fundamental rights, ethical considerations, sustainability, and policies and regulations. This change permeates every societal level, but it is especially evident in the healthcare sector due to the ageing population and shortage of professionals. This situation also places pressure on the development of competencies among healthcare professionals. A human-centered approach in design and design methods can promote the development of AI-based solutions in transdisciplinary and cross-disciplinary processes encompassing numerous stakeholders, scientific orientations, and perspectives. There is a need for research and evaluation of Human-Centered Design (HCD) processes and design methods to develop and gain more insights for future development.

This study was conducted as research through design. It aimed to elucidate the application and insights gained from the adopted Service design process for AI-enabled services and HCD approach while developing AI-empowered solution, Voima-chatbot. One of this research's main conclusions and realization is the shift from purely HCD towards Life-Centered design of AI-enabled solutions with a human-in-the-loop. In addition, this project increased the understanding of the deep importance of having a transdisciplinary dialogue with developers during the process of developing digital well-being devices and combining different professional competencies to achieve the best working solutions.

Keywords: Human-centered design · AI-enabled solution · Transdisciplinary · Design process · Healthcare · eHealth

1 Introduction

In Europe, the working conditions in healthcare are undergoing major changes as digital transformation extends more and more widely to different job descriptions. The use of mobile technologies, telemedicine and other digital tools intended to support clinical

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decisions has improved health workers' performance and mental health, as well as their competencies [1]. Digitalisation also requires new ethical reflection skills from healthcare professionals to understand factors of guiding and promoting ethical approaches [2]. There is an urgent need for effective digital tools and technologies and an unprecedented rush to implement eHealth services, including telemedicine consultation and digital contact tracing, in countries across the WHO Region. Strategic alignments are made to support this change [1, 3]. The need for digitalisation is due to the ageing of the population in Europe [4], the shortage of healthcare professionals in all occupational groups [5, 6] and the aftermath of the COVID-19 pandemic [1]. Different kinds of AI applications are predicted to have a growing role in healthcare and wellbeing devices and services [7]. The recent European Artificial Intelligence Act is going to change the use of AI within the EU region in the upcoming years [8].

The maturity of healthcare information management varies from country to country. Also, citizens' skills in the use of digital technology vary in different countries. In Finland, almost 80% of adult age of citizens have at least a low level of digital skills [7].

There is also variation in digitalisation and informatics skills in different countries and between professions. The introduction and smooth use of new technology require expertise from the individual, but the maturity level of digitalisation in society and organizations is also important [9]. In healthcare, devices must meet the regulation for a medical device [10, 11], but wellbeing technology is also widely used by citizens, and they utilize the information they produce to maintain their own well-being [12].

Digitalisation is most welcome, but there are risks involved, for example, in terms of human aspects of care and undermining of fundamental rights [7]. Multiple health-related institutions and stakeholders, including World Health Organization (WHO), are promoting the adoption and scale-up of digital health technologies (DHT) innovations worldwide. These promotional initiatives aim to translate scientific research into action and enhance knowledge through scientific engagement, assessing and linking geographical needs with innovation pipelines, and implementing practical approaches that balance the benefits and risks of DHTs [13].

Studies have shown that mobile applications (apps) can effectively support lifestyle-related health. Demographic and personal factors of the target group should be considered when developing health apps. The inclusion of appropriate functionalities and their personalization can ensure a high uptake of health apps in workplaces [14].

Conversational AI and chatbots have been used in the last decade to improve access to mental health services [15–21]. Chatbots are automated systems which replicate users' behavior on one side of the chat communication. They are mimic systems which imitate the conversations between two individuals [22]. Chatbots can facilitate interactions with those who are reluctant to seek mental health advice due to stigmatization and allow more conversational flexibility [15, 16]. Threats to the chatbot include the cost of cloud services, the still-developing field of AI, and the unethical over-imitation of a human therapist or its replacement [16, 21].

When designing medical devices and wellness technology, it is crucial to consider evidence-based design and experience-based approaches in service design [23]. The ethical perspective is also essential [2], particularly during the design process, which involves transdisciplinary cooperation with professionals from various sectors [24].

Service design can offer a method to research and develop AI-enabled solutions in the complex healthcare sector. These approaches can inspire and support individuals to participate in the development process [25–27]. HCD is the design approach that centers people and their needs, motivations, emotions, behavior, and perspective in the development of a design. Both users and service provider stakeholders are involved in design activities during and potentially after the service design process, supporting the change that co-design brings [27]. Multiprofessional, cross-sectoral healthcare involving multiple care system levels is a design context that requires context-specific knowledge, such as evidence-based care and specific design competencies, to include the perspectives of diverse actors in design processes [26].

Service design can promote transdisciplinary and cross-disciplinary processes encompassing numerous stakeholders, scientific orientations, and perspectives. It can clarify how to work together to ensure all aspects are considered when innovating new or developing existing technologies [24].

This study aims to elucidate the application and insights gained from the Service design process with HCD approach while developing an AI-enabled empowering solution, Voima-chatbot. The paper provides a detailed account of the development phases, using the case of Voima-chatbot as an exemplar. The objective is to enhance understanding of the feasibility of the service design process with HCD approach in developing AI-enabled technological solutions and point out future research insights.

The research question is:

What are the implications and results of applying Human-Centric design in developing an AI-enabled technological solution?

2 Methods of HCD in Developing AI-Enabled Technical Solutions

This study was conducted as research through design, meaning that design was an integral part of the process, providing both the data for the research and the practical artefacts from the workshops and other interventions, such as the ideation questionnaire. By using research through design [28, 29], a dual benefit was obtained: the design process with HCD approach, along with the co-designed artefacts, helps to better understand both the factors affecting the development of an AI-enabled chatbot and gaining understanding of the healthcare workers occupational well-being.

2.1 Human-Centered Design (HCD) and Service Design

The HCD is the design approach that centers people and their needs, motivations, emotions, behavior, and perspective in the development of a design. HCD is a shift of viewing humans not as a part of the system but central in every aspect of the design. HCD has a long history, and it can play an essential role in dealing with today's complex care challenges [30, 31].

In HCD, as in all design disciplines using HCD principles, designers rely heavily on the tools, methods and insights from the Human Factor discipline, as illustrated by the definition of HCD by the International Standards Organization (ISO): 'Human-Centered Design is an approach to interactive systems development that aims to make

systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, usability knowledge, and techniques [32]. HCD includes many methods but is essentially a frame of reference and a value system to be considered and applied by the designer. HCD begins with a deep respect for the user, and a realization that the user is the most important partner in design [33].

Human-Centered Artificial Intelligence (HCAI) is based on the concept of human-centered technology development and combines HCD, artificial intelligence, and machine learning. This includes the fundamental starting points of understanding user needs and the contextual and sociotechnical factors of system design, as well as introducing new ones specific to AI as a technology. Designing AI with a human focus is crucial for end-users' well-being and for addressing ethical issues that may lead to unwanted societal-level consequences [34–36]. HCAI advocates for the development of AI applications that are trustworthy, usable, and based on human needs. Many Human-Centered AI principles include explainable, transparent, ethical, fair, trustworthy, responsible, and sustainable AI [34, 36].

Awad et al. [37] state that these rationalistic guidelines provide advice on the development (process) and application (product) of trustworthy, ethical, and robust AI. However, such general guidelines do not represent real-world complexity when laws and policies often evolve slower than technological development. Ethical principles and moral choices are not universal as surveyed and identified. Robustness does not represent real-world complexity as the social impact of AI is hard to predict or foresee. The humanistic design perspective may provide a more suitable approach to examining the societal impact of AI as laws may not be up-to-date, universal principles cannot answer context-specific ethical questions, and robustness does not prevent unintended consequences.

More research is needed to develop the design processes, methods, tools and HCD approach when dealing with today's challenges with digital AI-enabled services in complex healthcare contexts.

It is also posited that HCD is prone to sampling bias by using methods that often rely on studying a relatively small sample in-depth. By default, not everyone can participate in the sessions, resulting in under- or overrepresentation of certain groups (a selection bias). End-user input might be biased and limited, leading to an overreliance on fresh end-user input. End-users are only a subset of the people who should be heard during eHealth design, and HCD tends to overlook ethical, societal, and political aspects [38, 39]. Developing diverse design teams can prevent machine biases in the design of AI systems. Building AI systems that overcome biases is not only a matter of having more diverse, and diversity-minded design teams as AI systems themselves can help identify for example gender and racial biases [31]. These are all significant aspects and objectives for developing the design process.

'Design' is a broadly defined term used for both the process of designing and the outcome of that process. Service design employs the double diamond model and design thinking and methods for designing new services [40]. The development project adapted and utilized the current service design process for AI-enabled services from the original version created by Jylkäs et al. [41, 42] seen in the Fig. 1. This process model which is based on this original double-diamond model [40].

This process has three layers in the 10-phase service design process: business, design, and technology. The case example of "Voima-chatbot" development is used to describe how Human-Centric design approach was utilized in the service design process for AI-enabled services and what was learned during the development process.

Jylkäs et al. [41, 42] observed that the 10 process phases— 'discover', 'define', 'ideate', 'design', 'prototype', 'test', 'develop', 'implement', 'operate', and 'scale'—are more sufficient when communicating the main activities in designing AI assistants.

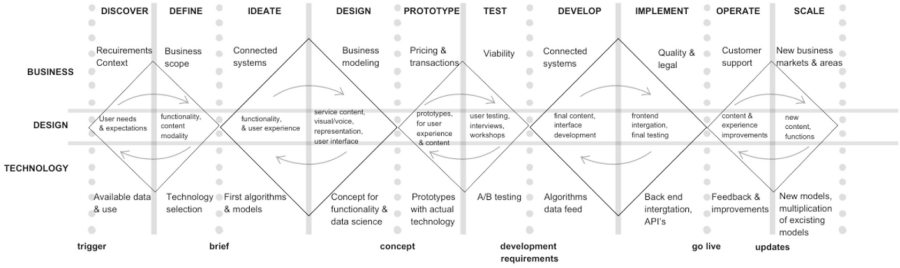

Fig. 1. Service design process for AI-enabled services. (Picture: Laura Tahvanainen, 2024, adapted from the original version created by Jylkäs et al., 2019 under the CC BY-NC-SA 4.0 DEED license [41, 42].

Designers need to recognize their role, ideology, and socio-economical processes in which they are embedded to design AI systems beneficial for society [43]. It is found that in many of the companies there is a clear separation between the AI and UX (User experience) teams. UX practitioners are not considered to be a part of the AI team, nor are they involved in the early-phase development [44].

The phases of the Service design process with the Human-Centric design approach and the technological development process will be presented later in the intervention chapter of this article. For the transdisciplinary design perspective and process it is important to notice that there are different ways and methods to measure and follow development and realization of things in different disciplines and approaches. For example, Technology Readiness Levels (TRL) are a type of measurement system used to assess the maturity level of a particular technology. There are nine technology readiness levels, with TRL 1 being the lowest and TRL 9 the highest. The TRL scale was developed at the National Aeronautics and Space Administration (NASA) in the 1970s as a standardized technology maturity assessment tool for complex system development [45].

By incorporating the Human-centered approach in the design of AI systems, the focus of the design challenges moves away from purely technical problems to the enhancement and support of human capabilities through the AI system [31].

3 Case Intervention: Applying HCD and Technological Development Process to Develop Voima-Chatbot

The development process of Voima-chatbot was part of a wider project that focused on the well-being of healthcare workers with pre-existing system stresses relating to resource constraints, crisis management, growing demand, recruitment, and retention. The project involved several phases from 2021 to 2023, with different methods, participants, and results (see Table 2).

Voima-chatbot was developed to build a scalable digital well-being service (non-medical device) that supports the well-being of healthcare professionals with empowering and solution-focused methods. Voima-chatbot utilizes an asset-based approach, which means that it works within the individual's own world of meanings, supporting a functional interpersonal relationship and pursuits towards activating one's own abilities, skills, strengths, and assets to enable a positive change [46, 47].

Voima-chatbot is an AI-enabled technological solution that uses a conversational AI platform to operate. Conversational AI is based on several advanced technological components, such as Natural Language Processing (NLP), Machine Learning, intent recognition, entity extraction and speech-to-text converters [48]. Voima-chatbot is not a medical device or therapy [11]. Its area of use is in the early prevention level as a well-being device.

Table 1 provides a comprehensive overview of the development process in the project, detailing the various phases, methods used, participants involved, and the deliverables at each stage. This chapter highlights the current Service design process for AI-enabled services adhered to an HCD approach, but also the problems that were resolved or not resolved with HCD approach and what are the findings for future development of service design process for AI-enabled services with HCD approach in healthcare. This model is illustrated earlier in Fig. 1.

Next, this article presents and evaluates the phases seen in Table 1. Based on the Service Design process with Human-Centered approaches and HCAI principles.

3.1 Discover and Define Phases of the Development Process

During the discover and define phases HCD methods like workshops and questionnaires were conducted with healthcare professionals and students to identify factors affecting occupational wellbeing and to gather content for the chatbot's intent tree. A stakeholder map was created, and existing applications and chatbots were benchmarked and tested. Using qualitative analysis helped design an investigation of a phenomenon of interest and helped construct the intent tree for the chatbot. The stakeholders recognized were healthcare professional, healthcare organization, project group, technical development group, the server holder, regulation, and legislation of the AI-enabled chatbots and data security and safety regulation.

The qualitative desktop study revealed that prior research [16, 21] has gathered perceptions and viewpoints about chatbots. This helped the project group to build understanding about the chatbots and helped with the ideation questionnaire. The key discoveries encompass positive and negative aspects for developing chatbot and opportunities for healthcare sector.

Table 1. Development phases of the chatbot with Technological readiness level (TRL)

Design Phase (timing) + TRL	Method (Level)	Participants	Results
Discover (2021–2022)	Workshops in healthcare organizations (Design)	Healthcare professionals n = ca. 100	Enhancing and hindering things affecting the occupational well-being of the healthcare workers, Content for the intent tree in the chatbot
Discover (2021)	Virtual workshops (Design)	Healthcare professionals n = 30	Enhancing and hindering things affecting the occupational well-being of the healthcare workers. Content for the intent tree in the chatbot
Discover (2021)	Qualitative questionnaires together with project partner (Design)	Students n = 437 Healthcare professionals n = ca. 4000	Enhancing and hindering things affecting the occupational well-being of the healthcare workers. Content for the intent tree in the chatbot
Discover (2021)	Qualitative Desk-top study on previous research (Design)	Project group and student's thesis work done in the project n = ca. 20	Enhancing and hindering things affecting the occupational well-being of the healthcare workers
Discover (2022) TRL 1	Stakeholder map (Design)	Project group n = ca. 6	Stakeholders for developing the chatbot
Discover (2022) TRL 1	Desk-top study on research and Benchmarking and testing of the existing applications and chatbots (Business)	Project group n = ca. 6	Information and experiences on using chatbot for supporting mental well-being, existing applications and chatbots

(*continued*)

Table 1. (*continued*)

Design Phase (timing) + TRL	Method (Level)	Participants	Results
Define (2022)	Ideation questionnaire of the chatbot (Design, business)	Healthcare professionals and students n = 77 (n = 64 for chatbot persona)	Information and feedback from the focus group about the idea of the chatbot, user insights for the use of the chatbot and the chatbot persona
Define (2022) TRL 1	Mockup (Design)	Project group n = ca. 6	The basic idea of the chatbot, including basic visuals and conversation flow
Define (2022)	Ethical considerations (Technology, design, business)	Project group and organization n = ca. 8	Anonymous service, service level of the chatbot (not a medical device)
Define (2022)	Meaning and use area of the chatbot (Business)	Project group n = 10	Identifying the use area of the chatbot
Ideate (2022)	Ideation questionnaire of the chatbot (Design, business)	Healthcare professionals and students n = 70	Information and feedback from the focus group about the idea of the chatbot, user insights for the use of the chatbot and for the chatbot persona
Design (2022)	Chatbot character, name, fonts, colors, way of talking (Technology, design, business)	Project group and Bachelor students n = 15	Chatbot persona
Design (2022) TRL 2	Empowering conversation flow (design, technology)	Project group and technical professionals n = 15	Basic/ground idea for the empowering conversation flow
Design (2022)	Ideating and designing digital service paths for the Chatbot (Design, business)	Master's students n = 30	Integration ideas to other services, data management plans

(*continued*)

Table 1. (*continued*)

Design Phase (timing) + TRL	Method (Level)	Participants	Results
Prototype (2022) TRL 3	Mockup (Design, technology)	Project group n = ca. 6	The basic idea of the bot, including basic visuals and conversation flow
Prototype (2022) TRL 1	Testing empowering conversations online person-to-person (Design, technology)	Healthcare professionals and students n = 10	Information for the empowering conversation flow
Prototype (2022) TRL 5	Empowering conversations in Slack platform person-to-person (Design, technology)	Project group n = ca. 4, Healthcare professionals n = 10 and students n = 20	Information for the empowering conversation flow, test- and training data for the intent tree in the chatbot
Develop (2023) TRL 2 &TRL 6	Technical development of empowering conversation flow (Technology)	Project groups & technical professionals n = ca. 15	Technical scope for the empowering conversation in the chatbot platform
Develop (2022–2023) TRL 6	Intent tree in chatbot platform (Design, technology)	Project group & technical professionals n = ca. 15	Intents in the intent tree in the chatbot platform
Develop (2023) TRL 6	Test & training data for the chatbot platform (Technology)	Project group & technical professionals n = ca. 15	Only some of the intents were tested during the first user testing
Implement (2023)	Information safety and security of the chatbot (Technology, design, business)	Safety and security professionals from the technical side and project group n = ca. 15	Data collection and storage, privacy statement, anonymity
Implement (2023) TRL 7	User testing (Technology, design, business)	Healthcare professionals and students n = ca. 90 n = 11 online testing healthcare units and n = 2 onsite testing healthcare units	User experience, usability, feedback on empowering conversation, improvements, test-/training data

(*continued*)

Table 1. (*continued*)

Design Phase (timing) + TRL	Method (Level)	Participants	Results
Implement (2023)	Qualitative feedback questionnaire, open questions, and Likert 1–5 (Technology, design, business)	Healthcare professionals and students n = 24	User experience, usability, feedback on empowering conversation, improvements, test-/training data
Implement (2023)	Implementation plan and future insights (Technology, design, business)	Project group and organization	Future development plans and projects, improvements, in.egration

The benchmarking resulted in the identification of several applications such as Woebot, an AI-powered chatbot that uses Cognitive Behavioral Principles, Dialectical Behavior Therapy, Mindfulness, Symptom Tracking/Self-Monitoring, Psychoeducation & Information [49]. Wysa, an AI-enabled mental health app, uses Cognitive-behavioral therapy (CBT) techniques, meditation, breathing and mindfulness exercises, and micro-actions to help users build mental resilience skills through its conversational interface [50]. ChatPal, a chatbot application, uses Positive psychology to support users' mental health and wellbeing. The scripts used in the ChatPal chatbot are freely available as an output from the ChatPal project [51].

Based on the benchmarking data, it was found that existing applications and services employ various methodologies and techniques for conversation flow. All applications utilized evidence-based and clinically validated methods such as Cognitive-Behavioral Therapy (CBT) and positive psychology (PP), albeit with different emphases. No applications were found that exclusively used Solution-Focused Brief Therapy (SFBT) or Empowering methods. After testing the existing applications and chatbots, it was observed that conversations quickly led to predetermined answers and conclusions. CBT tends to be more problem-solving oriented, whereas SFBT sessions had significantly higher positive content than CBT sessions [21, 52]. Research and practices around occupational well-being have traditionally been focusing on the problems causing the issues [53, 54]. The asset-based approach is an evidence-based, human-centered approach formed from different theoretical and practical elements connected to each other [23].

These tasks provided general information on chatbots and confirmed the solution-focused and empowering approach in chatbots. This also meant innovation on the chatbot's main conversation flow when the chatbot is asking the questions instead of the person. In healthcare, the importance of evidence-based approaches is paramount.

When comparing these methods and process to Jylkäs et al. [41, 42] model and HCAI principles [36] at this phase it was recognized that methods that were used helped to understand healthcare worker and the context where the chatbot is going to take place. It also provided understanding on what has already been done with supportive

conversational chatbots and AI. Ethical, data regulation and legislation were recognized, but these are currently missing from Jylkäs et al. [41, 42] model. It was also clear that the development process had already began without the actual technology provider. Business level in Jylkäs et al. [41, 42] model in this case is healthcare sector. Our research pointed out the need for an evidence-based approach and early recognition on whether the solution will be a medical device. Stakeholder mapping conducted during this research revealed a demand for new tiers for the model. Some aspects were discerned later during this research, such as sustainability. This indicates a necessity for novel methods for the mapping during the process that can be applied and revisited as needed. Recognizing the product's lifecycle impact at a global or national level is important.

3.2 Ideate and Design Phases of the Development (TRL Level 1)

The ideation questionnaire for a chatbot was designed to gather insights from healthcare professionals and students in diverse age groups (N = 77). This facilitated the acquisition of user feedback regarding the suitability of this solution for the intended objective. No technological innovation can have an impact if it is not adopted [14].

The questionnaire was divided into two parts: the idea of the chatbot and the chatbot persona. The respondents indicated a willingness to use the chatbot across various contexts and preferred platforms for using the chatbot. Feedback on the chatbot mockup was predominantly positive, with the chatbot seen as a tool for reflection, aiding those with difficulty speaking to others, enhancing occupational well-being, and providing quick help. The chatbot persona questions helped shape the Voima-chatbot character and persona and provided insights into prejudices towards the chatbot idea.

During this phase, the project team critically evaluated the questionnaire from a human-centered design viewpoint. They questioned the adequacy of the information gathered and the depth of user understanding achieved. They also scrutinized whether the methods employed sufficiently captured the necessary user needs. This introspection served as a valuable insight into the process.

One of the main findings from phase and feedback was that the chatbot is not a person and the expected lack of empathy. The design of artificial empathy is one of the most essential issues in social robotics. Based on views from developmental robotics, empathic behaviors are expected to be learned through social interactions with humans [55]. This also contributes to the HCAI transparency of AI since it is important for the person to know that there is AI talking and not a real human. The results from the ideation questionnaire were similar to previous research.

3.3 Prototype and Test Phases of the Development Process (TRL Levels 4–6)

The prototyping and testing phases were divided into two parts. The first part involved empowering, asset-based conversations online conducted by master's degree students. Students offered these conversations to healthcare professionals as part of their relevant methodological studies. The second part of the prototyping was in the Slack application utilized for training and prototyping written person-to-person empowering conversations between the master's students and healthcare professionals. The aim was to simulate chatbot conversation and gather insights for the chatbot's conversation flow.

Feedback from the participants in the first prototype was positive, indicating a need for such an approach. The second prototype yielded various results for development and valuable test and training data for the chatbot and helped build an understanding of the interaction and "tone of voice". Challenges arose due to the lack of verbal cues and visible expressions in the online interaction. It was difficult for participants to let go of the idea of playing a "chatbot" and focus solely on the conversation.

The design perspective utilized interventions through prototyping to also examine the emerging ethical dilemmas in the interactions between people and AI systems. The implication of these choices indicates that design researchers need to consider various aspects of human implication in the design experiment beyond merely paying close attention to human and social factors [31].

Prototypes of the solution are efficacious and cost-effective means to evaluate in a realistic context. In this research, these elicited emotions and challenges towards the solution that were advantageous in the development phase. Prototypes also aided in building confidence that this solution is feasible.

3.4 Develop and Implement Phases of the Development (TRL Levels 2–6 and TRL 7)

The technological development and kick-off phase marked the commencement of the AI-powered chatbot platform. Training Conversational AI, not an IT project, involves providing example questions or requests for the neural network to analyze and understand semantics. Modern NLP-optimized networks require only a few questions per intent, an NLP term referring to a user's area of interest or request [48].

The first model of the asset-based foundational conversation in the chatbot platform was collaboratively created and evaluated with the platform provider. This new approach in the conversation flow required development by the platform provider. Existing knowledge from empowering conversation was integrated to build the empowering conversation flow, which typically consists of five stages or phases [47, 56]. A novel approach requiring technical resolution was the chatbot asking questions instead of the person. The intent tree, which can be described as a classification or "catalogue" built on the intents of a user, was structured by combining these five stages [47, 56] to a classification model with two levels of components (Table 2). This intent tree, necessary for the proper functioning of the AI, helped the technical team determine the required technical properties and coding.

User testing was conducted with a closed webpage set up for online testing. Various healthcare units were approached for user testing. The testing period yielded 91 conversations, about half of which were complete. Post-testing, participants were instructed to fill out a questionnaire, including scaled and open questions addressing various aspects of the chatbot. A modest number of participants responded to the questionnaire after testing. The aim was to understand the performance of the empowering conversation and whether users found it meaningful and would recommend the chatbot to others. Feedback indicated that the chatbot's repetitive questioning caused frustration, and some of its questions were difficult to understand.

Questions regarding the chatbot persona received a slightly higher average score. The overall rating of the chatbot was slightly above the midpoint on Likert scale 1–5. Written

Table 2. Empowering foundational conversation flow in the chatbot

Basic Empowering conversation flow
Baseline survey Likert scale 1–5 1. Building a connection Joint phase questions 1.1 I still wish to clarify my challenge 1.2. I wish to continue to goal clarification
2. Desire for change/Goal clarification Joint phase questions 2.1. I still wish to clarify my desire for change 2.2. I wish to continue mapping my assets next 3. Mapping and promoting of the assets and strengths Joint phase questions: 3.1 I still wish to continue mapping my assets 3.2 I wish to continue planning the start of the journey 4. Start of the journey Joint phase questions: 4.1.1. I still wish to think about the change 4.2 I wish to continue 5. Conclusion and review Feedback survey: Likert scale 1–5

feedback revealed that participants noticed the mechanical nature of the conversation. Positive feedback highlighted the chatbot's ease of use, low threshold, clarity, immediate availability, and ability to help recognize targets and positives. However, there was consensus on the need for further development, with negative feedback focusing mainly on the lack of empathy and personal approach. This was also boosted by a notable incident when the chatbot incorrectly predicted self-harming intentions, highlighting the need for quality test data. Following this, all intents were turned off, and only the empowering conversation flow was tested.

This phase underscored the importance of effectively understanding and measuring user emotions in human-centric design. It was recognized that developing the chatbot's intent tree and responses required more authentic user conversations. Finding a test group and the need for more active feedback collection methods beyond a simple questionnaire was challenging. It is imperative to employ diverse methods to comprehensively understand the target group, for instance, from varying age groups, geographical regions, and backgrounds. This phase also pointed out the importance of openness from the HCAI point of view. This phase also highlighted the meaning of transdisciplinary work on data information safety and security aspects and the chatbot user testing on the actual Voima-chatbot platform. The design process's previous work significantly contributed to the technological development. Feedback from the technological platform provider was positive.

This phase encompassed inventive dialogues on how to construct an empowering AI-enabled solution. The technical development team grasped the empowering conversations process [46, 47, 57]. The project team had knowledge of AI-enabled solutions [36, 41], eHealth and informatics [7], data security and human-centered design [34, 41, 58].

3.5 Operate and Scale Phases of the Development (TRL Levels 8–9)

In the context of typical technical development processes, the development period of Voima-chatbot (2022–2023) has been relatively brief. Currently, Voima-chatbot is still in the nascent stages of technical development and will require ongoing enhancements in the future. While plans for new applications and integrations have been conceptualized, they have not yet been actualized.

4 Discussion and Future Insights

The objective of this research was to augment the comprehension of the feasibility of the HCD approach in creating AI-enabled technological solutions. This was accomplished during the development process of an AI-enabled solution, Voima-chatbot. The application and insights derived from the service design process, which utilized HCD design approach for AI-enabled services with 10 phases [41, 42] is presented in Fig. 1. The model incorporated three levels: technology, business, and design.

In addressing the research question - 'What are the implications and results of applying Human-Centric design in the development of an AI-enabled technological solution?' - a methodology of research through design was employed.

These development process phases produced information analyzed through HCD and HCAI point of views. Results emphasized the importance of observing transdisciplinary and cross-disciplinary processes, which involve numerous stakeholders and scientific orientations when working in the healthcare context.

This study has identified various strategies that merit integration into the model delineated by Jylkäs et al. [41, 42]. The healthcare context [23, 26], where understanding the various factors at play is crucial, but also research and evidence-based research when applied in healthcare [23]. It is mandatory when there is a development process for medical devices [10, 11].

Ethics and sustainability [2, 35, 38] factors guiding and promoting ethical activities contribute to the realization of the reflective process of ethical and sustainable activities. In ethical problem-solving, professionals base their judgement on legislation and ethical guidelines as well as on the ethical basis of social and healthcare. Ethical activities are promoted and facilitated, for example, through ethical management, organizational structures, and operational culture [2]. Sustainability also refers to Future insights into AI-enabled services. AI-enabled technological solutions are constantly developing [59]. Information safety and security, regulations, laws, EU data interoperability and policies [7, 8, 11]. It is one of the fundamental elements to decide if the application is a medical device or not. The categorization as a medical device brings a plethora of laws and regulations that necessitate careful consideration throughout the process [11]. Throughout this process, deliberations were held regarding the scope of the device and the possibilities of technical solutions. At the inception of this process, a decision was made to engineer a device aimed at promoting well-being.

Enhanced understanding of the development process, user needs, and expectations during the development process was cultivated through the application of Human-Centered design methodologies employed in the developmental stages (refer to Table 2). This research posits that the design process can foster and elucidate collaborative efforts

when stakeholders are acknowledged during the process. This ensures comprehensive consideration of all facets when innovating new technologies or refining existing ones [25, 26], for example, Technology Readiness Levels (TRL) [45].

User-testing technique yielded data indicating a need for more understanding of human behavior, interactions, and the human-machine relationship. It was also acknowledged that conventional approaches, such as questionnaires, might be too simplistic, with the small number of participants skewed for obtaining this information. It would be beneficial to enhance understanding of different facets of human-AI interaction, such as emotions, cognition, assets, mutual learning, or failure/success. Interfaces such as chatbots are shared boundaries between the sociotechnical systems of computers, connecting hardware, software, and human users. Ethnographical research can incorporate technical walkthroughs and interfaces to complement participant observations in local settings where interfaces are accessed. Interface ethnography can be utilized with multi-sited fieldwork designs since interfaces are components of transnational networks and mediate between different actors [60].

Pervasive themes for all stages of the development process were comprehending the context where the user and the intended technological solution are situated. Collecting user insights and genuine material for testing from diverse range of people. Humans can provide training data for machine learning applications and directly perform tasks that are challenging for computers in the pipeline with the assistance of machine-based approaches. This is a way to avoid biases [38, 61]. Developing the AI solution with transdisciplinary team is essential. It was learned that when healthcare professionals are involved in the process understanding on AI-enabled services was built among the participants [9, 13, 26].

Accompanying the findings of this research to the existing Jylkäs et al. model, it was contemplated that a broader perspective and implications of implementing Life-Centered design ought to be addressed incorporating Human-Centered design [35, 62]. This research could inform the development of similar AI-enabled health technologies by presenting a need for updating a new model and methods for the design process with a Life-centered design approach of AI-enabled solutions that could be prototyped and tested in the following research. Life-centered design, for example, expands human-centered design to include consideration for nature and vulnerable humans by merging practices such as circular design, biomimicry, systems thinking, and futuring, and aligning designers with global goals, such as the United Nation's Sustainable Development Goals [62–64]. As life-centered design is still emerging, its practices vary and is practiced by only a few. More research is needed to evaluate Life-centered design in digital services that utilize AI.

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