Exploring Cognitive Load In Simulation-Based Training

A Case Study Of A Medical Training Platform

Master Graduation Thesis

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Msc Design for Interaction

TU Delft

Laerdal

helping save lives

Master Thesis
Delft, September 2025

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Abstract

This Master's Thesis examines cognitive load and usability heuristics in simulation-based training, specifically through a case study of a medical training platform developed by Laerdal Global Health, known as LIFT Scenarios. The study aims to determine the extent to which usability heuristics help reduce the cognitive load experienced by observers while using LIFT Scenarios during medical simulation training.

Following the Improving Improvement model, the research systematically addresses the behavioural and user interface factors that influence cognitive load throughout the application. Each design phase employs various methods, including user tests, interviews, heuristic evaluations, and prototyping. A total of 20 participants were involved in the research activities, excluding observations. The application of usability heuristics positively impacted the ranking of the prototypes. However, a significant portion of the cognitive load associated with LIFT Scenarios is intrinsic, stemming from task difficulty or the skills of the facilitator. This research utilizes quick testing and evaluation methods that are both feasible and adaptable.

Acknowledgements

I am grateful to have had the opportunity to work with cognitive load and usability heuristics in a practical way, and meaningful way during my master thesis. It would not have been a success without the people who supported me along the way. Thank you to the people who helped me throughout this journey.

TO THE TEAM

Thank you to my TU Delft Supervisors Himanshu and Tilman for helping me understand cognitive load and cognitive science better. I appreciate all your time and effort that was put into this project, pushing me to be a better researcher.

Thank you Laerdal Global Health team; Sakina, Ole, Camilla, and Steve. You have all been a pleasure to work with and shown me what a good working environment can look like. Thank you for all your support in this project, answering endless questions and supporting my progress throughout. You have all truly shown me what kindness is.

Thank you Yuanzhen Cai, for helping me navigate the thesis.

TO MY FRIENDS

Thank you Nanditha for being a great friend, mental support and productivity buddy. I look forward to planting more trees with you.
Thank you Harshita for supporting me emotionally, mentally and practically throughout this project I do not know how I could have done this without you!
Thank you Dimpy for being my productivity buddy and discussing my project with me.
Thank you Chiara for supporting me throughout my thesis.

TO THE PARTICIPANTS

Thank you to all the Master and Phd students who partook in the user testing, without you this thesis would not have been the same.

Thank you to the Simulation Experts, for taking their time to share their expertise.

Thank you to the Simulation Centre in Norway for allowing me to observe 2 days of simulation.

TO MY FAMILY

Thank you Isak for helping programme the code charts test and for being a data consultant throughout the project. Thank you for always being there for me.

Thank you Mom, Dad and Lisa for allowing me to film the scenario with you all and for helping me with the report.

Thank you João for being my rock and supporting me throughout the process.

Table of Content

Executive Summary

This report provides a comprehensive analysis and evaluation of the LIFT Scenarios, an app based memory aid designed to help facilitators through a simulation training with healthcare professionals refreshing their non technical and technical skills. LIFT scenarios was developed to allow for expansion of use and is used in 105 facilities in Tanzania. Through an in-depth examination, this report aims to understand the product's usability and cognitive load for its intended users while also generating and testing possible solutions to reduce the cognitive load.

1. INTRODUCTION

The introduction chapter focuses on the motivation behind this thesis, the research questions and the scope.

2. METHOD

The method chapter is an overview of the methods and theoretical frameworks used

3. UNDERSTANDING THE CONTEXT

The understanding the context chapter, explains and examines the system of the product LIFT Scenarios and the aspects chosen to focus on, including usability, simulaton training and cognitive load. It focuses mostly on understanding the system and its components through literature and interviews.

4. DEFINING THE PROBLEM

The defining the problem chapter defines the problem through a combination of individual and user tests. Furthermore it analysis the problem and defines main problems.

5. DEVELOPING THE SOLUTION

The developing the solution chapter focuses on taking the main problems and adressing them through brainstorming and prototyping resulting in two prototypes to test and evaluate.

6. COLLECT THE EVIDENCE

Collecting the evidence chapter focuses on testing the prototypes developed in chapter 5.

7. FINAL REDESIGN & TEST PLAN

The final redesign chapter addresses some of the overlooked elements from the tested prototypes and develops them further. Additionally this chapter focuses on creating a test plan poster for how to measure cognitive load.

8. CONCLUSION & REFLECTION

The Conclusion and Reflection chapter answers the research question, reflects over the entire and suggests ideas for future research.

Vocabulary

ABBREVIATIONS

UH- Usability Heuristics + Definition

- (UH1)-(UH10) Usability Heuristic(UH) + Number (1-10)

UI- User interface

LO- Learning Objectives

LIFT - Learning Improvement and Facilitation Tool

SBL- Simulation Based Learning

LDHF- Low Dose High Frequency training

SESAM- Society for Simulation in Europe

LTM- Long Term Memory

WM- Working Memory

DEFINITIONS

USABILITY- The efficiency, effectiveness of a user to be able to perform a certain task.

USABILITY HEURISTICS- Ten heuristics, that are rules of thumb about common usability issues or things to keep in mind.

USER INTERFACE- The visual layout and appearance of an application or software

COGNITIVE LOAD- The mental effort to complete a certain task.

MEMORY AID- Something that is used as a reminder, to reduce the need for recall and focus on recognition.

RECALL- Retrieving something from long term memory without any clues. *For example remembering What is the capital of Tanzania?*

RECOGNITION- Retrieving something from long term memory with clues, that help activation. *For example remembering Is Dodoma City the capital of Tanzania?*

FACILITATOR- A person who conducts the training

CHAMPION- The name for facilitator in the context of LIFT Scenarios.

PRACTITIONER- The healthcare professional going through the scenario

ACCELERATOR- Shortcuts or ways to make the platform or product work quicker. *For example to save something you can click Ctrl + S*

INFORMATION PROCESSING- The way humans process information.

SIM BEGIN- The simulation methodology training for facilitators before conducting a training.

CHAPTER 1

Introduction

Introduction 1

1.1 Background

Simulation-based Learning (SBL) is used to practice real-life situations in a controlled, safe environment where practitioners can make mistakes without consequences. Within the medical field, it is used to learn new skills, refresh skills, and assess learning.

Simulation training in the healthcare sector has become increasingly popular, as it allows practitioners to practice essential skills in a low-stakes environment, leading to improved patient safety and staff confidence *(Forstrønen et al., 2020)*. Simulation training is not inherently successful, it requires a specific structure and competent facilitation. Facilitating a session is a complicated task *(Mommers et al., 2023; Cheung et al., 2019)*. The complexity of this task has led to the development of memory aids for facilitators.

Memory aids serve to reduce the task difficulty and mental load factors that contribute to cognitive load, thereby simplifying the facilitator's role. Cognitive load refers to the mental effort to process information or complete a task.

Memory aids help facilitators with cognitive offloading, allowing them to rely less on their memory capacity and instead utilize a system that facilitates memory recall. Since there is a lot of information that is considered important to facilitate a session, the memory aids contain a lot of information. This excess of information and the way it is displayed increases the intrinsic and extraneous cognitive load that it seeks to deter.

Simulation trainings consist of various aspects: the brief, the simulation, the debrief, and the documentation. Each training part brings different obstacles that increase the facilitators cognitive load, which this thesis aims to understand and address through the use of usability heuristics.

Usability heuristics is an analysis tool to measure the ease of using a product or service, focusing specifically on the User interface (UI). This tool can explore the extraneous load of memory aids present due to the abundance of information in the simulation trainings. To explore this in detail, this thesis focuses on a memory aid which exists in the form of a digital application "LIFT Scenarios" offered by Laerdal. LIFT = Learning Improvement and Facilitation Tool

1.1.1 ABOUT LAERDAL

This thesis is conducted in collaboration with Laerdal Global Health, a sister company to Laerdal Medical. Laerdal Global Health has a mission to reduce mortality associated with childbirth for the mother and the new-born.

Laerdal focuses on saving lives by creating high-quality training equipment, including products ranging from CPR dolls to learning platforms. Laerdal created an application called LIFT Scenarios to serve as a memory aid for facilitators going through various medical scenarios.

1.2 Design Opportunity

This thesis aims to explore whether the facilitator's role as an observer during simulation practice can be simplified by applying usability heuristics.

According to the ISO 9241-11- Guidance on usability, usability is defined as "the extent to which specific users can use a product to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" *(Bevan, 2001)*. Focusing on effectiveness and efficiency, by using parts of the 10 usability heuristics, including consistency and standards, user control and freedom, recognition over recall, and system and real-world *(Nielsen, 1994)*.

1.3 Design Goals & Research Questions

The goal of this thesis is to explore the extent to which **usability heuristics can aid in reducing cognitive load experienced by the observers** while using LIFT Scenarios during medical simulation scenarios. Thus, the following research questions have been posed:

Q.1. To what extent can LIFT Scenarios be simplified without losing its accuracy?

Q.2. Can the usability metrics application enhance workflow?

Q.3. What does the Ideal simulation Scenario look like?

Q.4. What does the facilitator /Observer do to prepare?

1.4 Scope

This project focuses on the microscale of the product, by delving into its ease of usability and User Interface (UI) for the phone application. The primary focus is on the platform and the user. This thesis focuses on "LIFT Scenarios" as a memory aid and does not delve into other memory aids for facilitators. Through this project, I will address information processing, cognitive load, and usability heuristics at a base level. To dive deeper into these concepts will be out of scope due to the time constraints and limited resources of this Master's thesis.

See Appendix A for Project Brief.

The project aims of exploring how to improve LIFT Scenarios holistically for simulation training of healthcare professionals, and not for medical students. There is an emphasis on the role of the facilitator, rather than the individuals being facilitated. Improvement will be made by addressing elements such as the cognitive load through using usability heuristics as the primary tool of investigation.

1.5 Significance

Various parts of this thesis are relevant and significant to future research. Firstly, simulation training is becoming more and more relevant within the medical field. Therefore, understanding the role of the facilitator and the cognitive load of going through a training is crucial to help develop better training sessions.

Secondly, this thesis considers other important aspects of the simulation, such as digital training and memory aids. Digital training enhances scalability, allowing for the quick adaptation of a training platform to new circumstances, thereby reducing the barriers to conducting and receiving proper training. Researching a digital training platform is therefore relevant. By redesigning the memory aids, cognitive load can be adjusted to enhance workflow.

Lastly, as the world becomes more digital and advanced, it is essential to manage the cognitive load of information and services to prevent overwhelming users.

1.6 Personal Positioning

I have worked with Laerdal before as part of a course where we explored redesigning a CPR training Platform in the course Project Usability and User eXperience Assessment in Design *(UXAD ID4256-17)* . I am therefore aware of their products and methodology. As a Master student pursuing the MeDisign specialisation, I have taken courses such as E-health *(IDEM210*) and Design in Health

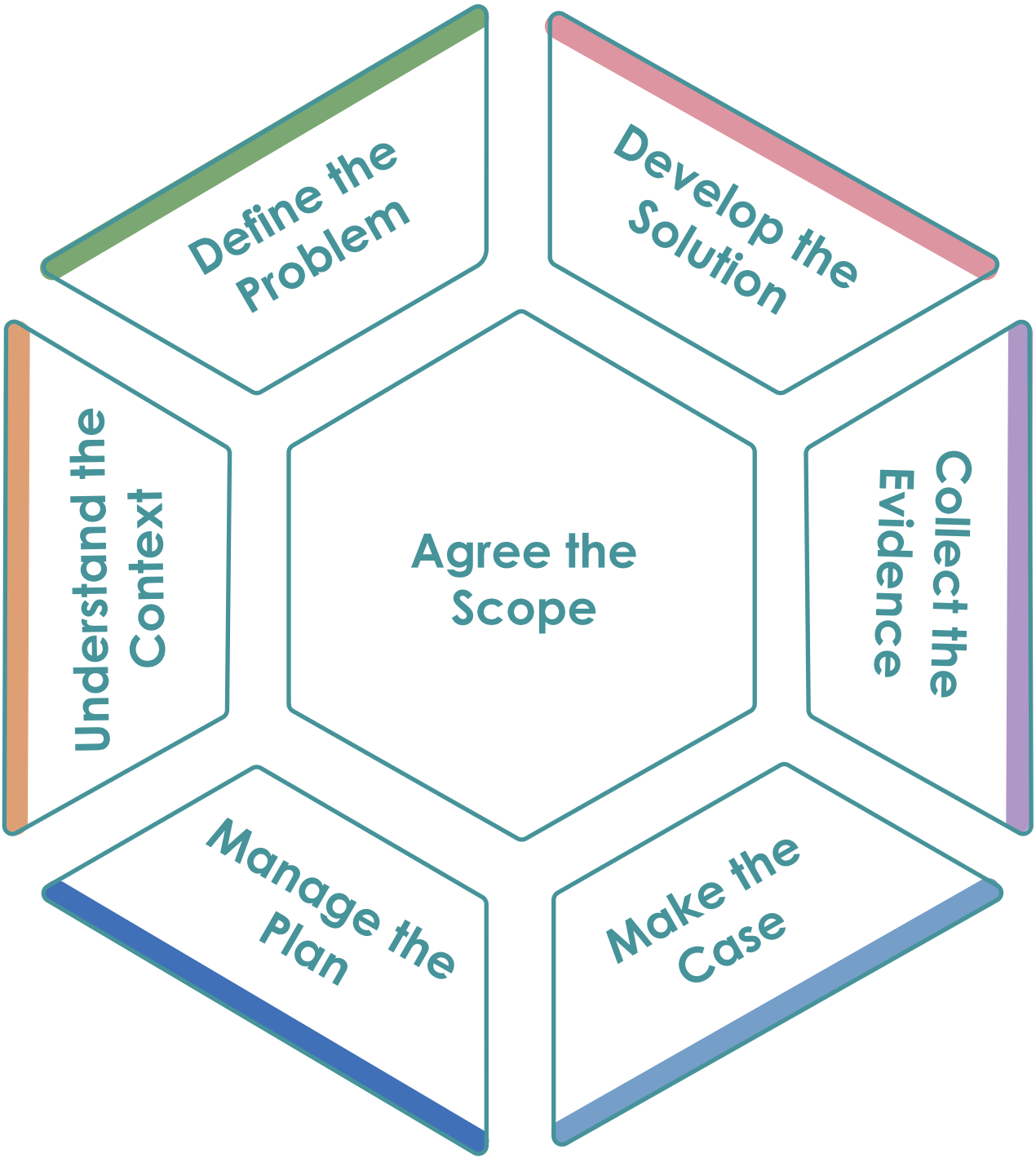
(IDEM208), where I focused on behaviour change and hospital environments.

I wanted to work on this project because of my inherent curiosity for things that impact human behaviour, designing training platforms, and for the potential impact.

I am fascinated by human behaviour and things that impact it, such as usability and cognitive load. Not only does the cognitive load aspect interest me, but working on a training platform, I have worked as a gymnastics teacher, focusing on skill improvement, and teaching is meaningful to me. Furthermore, I have a desire to do good, to make a positive impact, and to contribute to something in society. LIFT Scenarios has a fantastic goal of reducing the mortality rate associated with birth for women and infants. The idea that I could influence the training of health care professionals to help prepare them for situations where they save someone's life is very inspiring and motivating.

However, since I am outside the context of use, I am not able to thoroughly test the various aspects of the application within the actual context. This makes it difficult to assess the validity when applied in Tanzania or Nigeria. Analyses of the app are done with international master students, who are accustomed to specific design standards and practices. Furthermore, the limited availability and language barrier of healthcare professionals in the Netherlands have caused limitations in the design of the tests or research sessions.

Research Approach 2



2.1 Approach
2.2 Context
2.3 Analysis
2.4 Brainstorming
2.5 Testing

2.1 Approach

This thesis employed a variety of methods and approaches. Projects always require adaptation to a variety of methods. This project is no different; however, specific methods act as initial inspiration points, including the Cambridge Improving Improvement model

Fig 2.1.1 Overview Of Improving Improvement Model Steps

From Https://Www.Iitoolkit.Com/Process/Introduction.Html

2.1.2 IMPROVING IMPROVEMENT MODEL

The improving improvement model is a toolkit for system change including practical guidance and resources. It is developed from the framework presented in the Royal Academy of Engineering's report

"Engineering Better Care- a systems approach to health and care design and continuous improvement" *(Royal Academy of Engineering, 2017).*

This report served as a foundational document, providing key insights and principles that were instrumental in the development of the toolkit. This toolkit is chosen for its wide variety of resources, such as questions to ask and tools to use in various stages of the design process. The method helps navigate the initial doubt of design projects.

Although this method acted as an initial source of inspiration, it was not used strategically; however, it acted as a point of reference throughout the project.

This Thesis focused mainly on the steps

- Understanding the context
- Defining the problem
- Developing the solution.

2.1.3 RESEARCH ETHICS

This Thesis has received an HREC *(Human Research Ethics Committee)* Approval at TU Delft.

Each of the parts of this Thesis used a variety of methods. The following sections aim to provide an overview of the methods used and explain their rationale. For more information on how the methods were used, refer to the associated chapter.

2.1.4 OVERVIEW

See figure 2.1.2 for an overview of all methods used in the chapters of this report

This chapter discusses the theoretical framework and reasoning behind using certain methods. The tools and methods are used to understand the context, for analysis, for testing and for brainstorming. The methods are categorized into the respective themes.

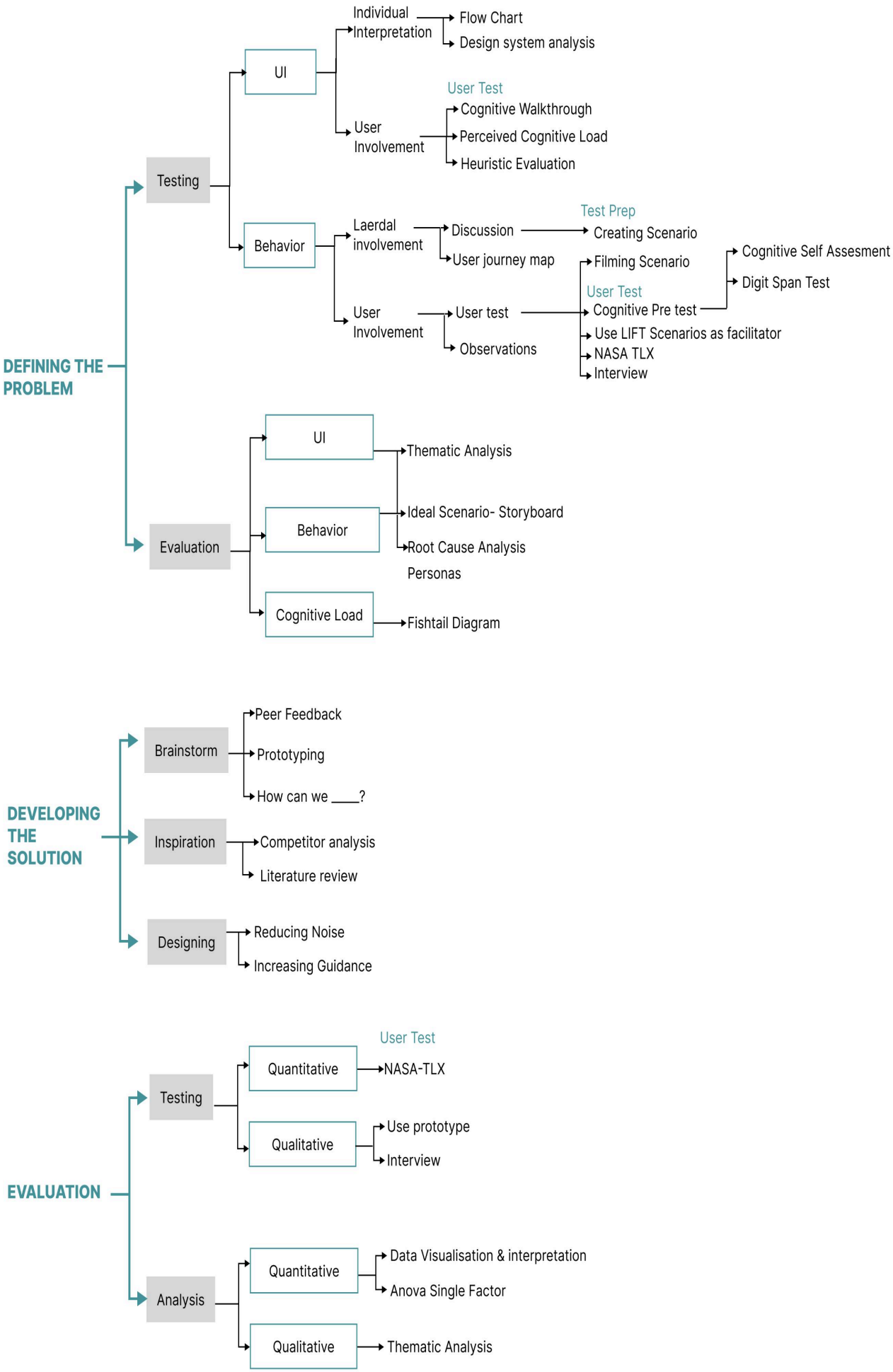


Fig 2.1.2 Overview Methods Used Throughout Different Stages Of The Design Process

2.2 Context

The methods used to understand the context varied depending on the part of the context. The following sections explain the methods used.

2.2.1 DISCUSSION WITH STAKEHOLDER

When understanding and developing a product with a company or stakeholder it is important that they are continually consulted throughout the process. They are the experts of the product and corresponding vision. Questions to ask the stakeholders at the various stages of the design process can be seen in Improving Improvement model.

2.2.2 LAERDAL REPORTS

AIM: To understand the development of the app, reviewing the shared material was done, which aided in getting more in-depth knowledge of the development of LIFT scenarios as well as the theory behind it.

2.2.3 WALKTHROUGH OF APP

AIM: To familiarize oneself with the app and its features. A walkthrough of the app enables the highlighting of complex or confusing features that can be clarified with the company.

2.2.4 INTERVIEWS

Interviews help gain knowledge and perspective from users or experts. In this thesis it is used to understand how different facilities go about training as well as understand what experts consider successful training to help navigate the breadth of literature about simulation training in the healthcare sector.

2.2.5 OBSERVATIONS

Field observations using LIFT scenarios was able to put it into a context and view how it was used in a real scenario *(HaptiMap, 2009)*. Field observations are useful for seeing more natural behaviours, however often lead to a large amount of data.

2.2.6 LITERATURE REVIEW:

AIM: To understand simulation training, cognitive load and usability heuristics.

Literature review gives an overview of what is already known so we can build upon that knowledge and ensure that what we create can fill a research gap or explore something that is relevant.

2.3 Analysis

2.3.1 FLOW CHART

A flowchart aims to find the relationship between the pages to understand the overall flow.

2.3.2 DESIGN SYSTEM ANALYSIS

To understand the application, how the various sections fit together and how the pages work, a reverse engineering of the design system is done. This Design system analysis comments and reflects on the pages act as a way to understand the current structure and UI elements that make up the application in this case, LIFT Scenarios.

2.3.3 STORYBOARD

Story boards help visualise the product in context and possible use cases *(HaptiMap, 2009; Mulder, 2022)*.

2.3.4 FISHTAIL DIAGRAM

Fishtails diagrams are used as a way to get to the underlying, less obvious problems *(Ishikawa, K (1968) Guide to Quality Control, JUSE, Tokyo) Resource available on Improving Improvement.*

2.3.5 PERSONAS

Personas help describe the various types of users of the product. By establishing pain points and needs it can be easier to design with multiple users in mind. *(HaptiMap, 2009; Persona | Usability Body of Knowledge, n.d.)*

2.3.6 ANOVA TEST

An ANOVA single factor test determines the p-value of three or more sets of data, enabling the comparison between three sets of Data.

2.3.7 ROOT CAUSE ANALYSIS

Root cause analysis is done through asking why multiple times to get to underlying causes. *(Improving Improvement Model).*

2.3.8 COGNITIVE WALKTHROUGH

A cognitive walkthrough is a cheap way to test the usability of a system *("How to Conduct a Cognitive Walkthrough," 2025)*. Cognitive walkthrough of the application clarifies the pages that are more difficult to interpret, therefore may require more cognitive resources either out of necessity or from extraneous cognitive load *(HaptiMap, 2009).*

2.3.9 HEURISTIC ANALYSIS

A Heuristic Analysis following the 10 usability heuristics from Nielsen Norman Group worksheet. This was done as a way to systemically address the design heuristics and understand how they are addressed within LIFT scenarios *(Nielsen, 2024).*

2.3.10 USER JOURNEY MAP

-created in collaboration with Laerdal the journey map highlights the emotional and task difficulty of the various stages of the simulation training. Observer journey maps help align the "mental model" and communicate about the user to the team *(Gibbons, 2024).*

2.3.11 THEMATIC ANALYSIS

Thematic analysis is a way to analyse qualitative data through sorting data into common topics or themes. It is a widely used and flexible approach to sort data. *(Ahmed et al., 2025)*

2.4 Brainstorming

2.4.1 HOW CAN WE ___?

The How can we___? Technique helps brainstorm around a certain topic. When having clear design requirement how can we helps develop ideas around it.

2.4.2 PROTOTYPING

Creating prototypes serve as a way quickly test out ideas, reflect on them and improve upon the idea.

2.5 Testing

2.5.1 PERCEIVED COGNITIVE LOAD

The perceived cognitive load is used as a way to understand the cognitive load of the platform. Focusing on the mental effort and the task difficulty

The self assessment of cognitive load was based off of *(Ouwehand, K et al., 2021).*

2.5.2 CODE CHARTS VISUAL HIERARCHY

Code charts are used to test the focal point of an image. The image is shown for one second, followed by a grid of numbers and letters. The participant should then input the number they saw that relates to the image's focal point.

2.5.3 USER TEST

User tests give insight into how the product or system is used. A user test may consist of a variety of exercises. Generally, the user is asked to use the product for a specific purpose. Following up with questions or questionnaires.

2.5.4 COGNITIVE SELF ASSESSMENT

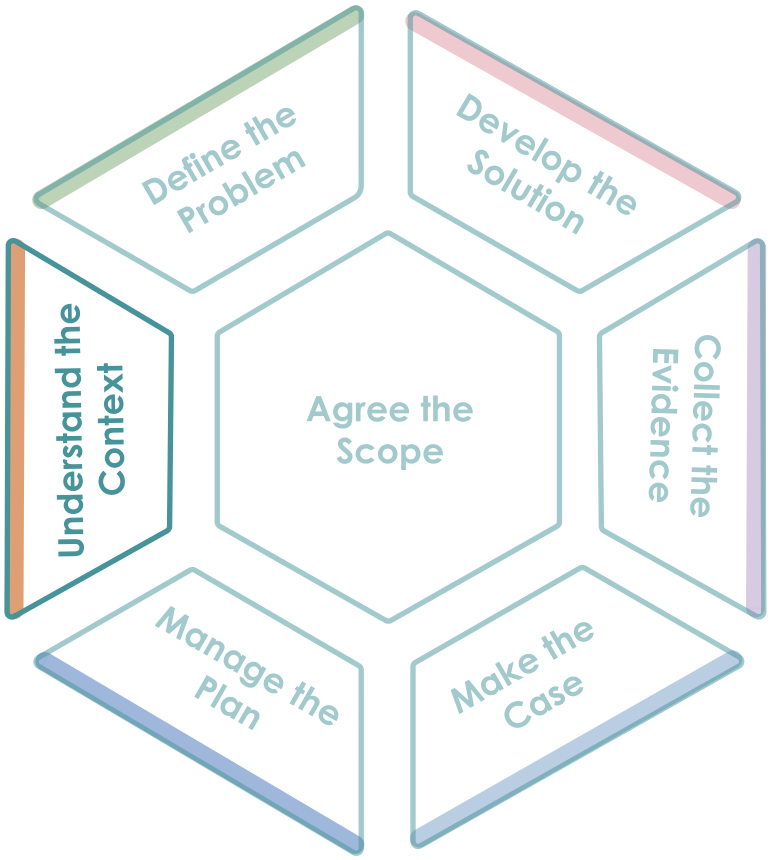
Cognitive self-assessment is a self- assessed questionnaire focusing factors with a potential influence on a participants attention, factors such as sleep, stress, caffeine, and attention disorders that all affect ability to focus.

2.5.5 DIGIT SPAN TEST

The digit span test aims to look at working memory capacity. This is used as a way to determine the starting point for participants. The digit span test asks participants to repeat a string of numbers they hear. The amount of numbers increase from 3-7 *(Cambridge Cognition, 2023).*

2.5.6 NASA-TLX

NASA-TLX is a tool for measuring subjective mental workload across six dimensions. Helps track the mental workload of a participant while performing a task. *(NASA Task Load Index | Digital Healthcare Research, n.d.)*



CHAPTER 3

Understanding the Context

Understanding the Context 3

Gaining an understanding of "LIFT scenarios" is the first step to recognizing what is important to examine and the purpose it serves this is accomplished by addressing the following questions:

- What is the Purpose?
- What do we do now?
- What are the elements?
- What affects the system?

These questions are part of the Improving Improvement model.

3.1. What is LIFT Scenarios?

LIFT scenarios is a app-based tool to help facilitators through a simulation training. It is created and developed by Laerdal Global Health.

3.11 WHERE IS LIFT SCENARIOS USED?

The physical location of use is an important part of understanding the context. The figure 3.1.1 shows the overview of how LIFT Scenarios is being used systemically. LIFT Scenarios is being used in healthcare facilities in Tanzania. This affects aspects such as the clinical language being used at each facility.

Swahili, the language used in clinics in Tanzania, differing from the English language used in the LIFT application, increases the intrinsic cognitive load since it adds complexity to the task for the facilitators. The simulation trainings are also held inside the clinic, either in a dedicated simulation room/space, or in the clinical area. This impacts the frequency of training, the accessibility, the dedicated time available, along with the application's reliability.

3.1.2 HOW IS LIFT SCENARIOS USED?

LIFT Scenarios is used by a facilitator, known as a **champion**, a person who has been appointed to facilitate the training. The application is designed to work on tablets and phones, with the most emphasis on tablets.

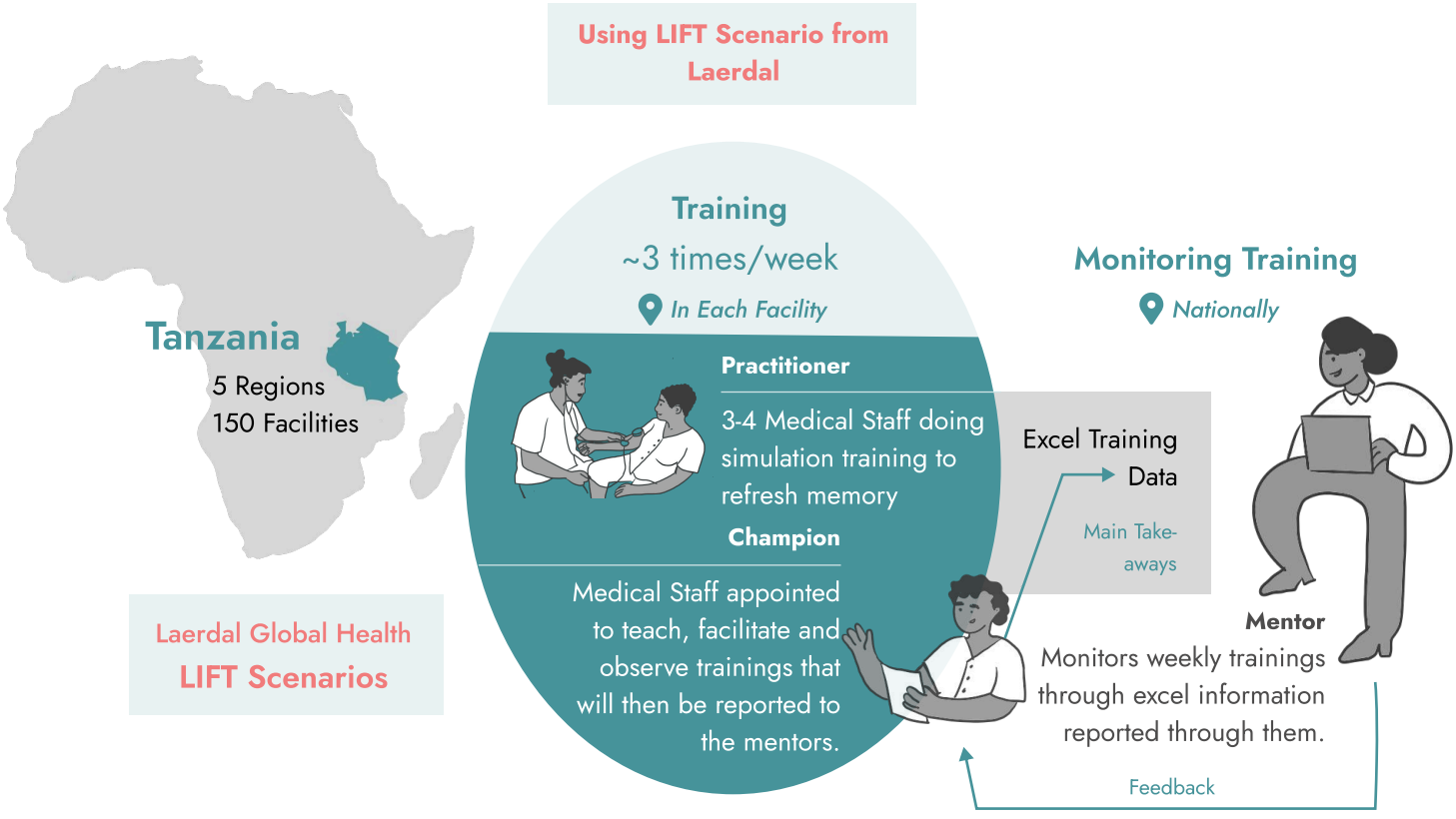


Figure - 3.1.1 Overview of LIFT Scenarios System use

The Champion plans and conducts the training for 3-4 medical professionals, practitioners, to help refresh their technical and non-technical skills. The trainings are done in the facility usually planned on certain days, especially on days when the clinic is less busy.
The training follows a simulation methodology and includes four steps:

1. the brief,
2. the simulation,
3. the debrief, and
4. the documentation.

Generally, a training takes around 1 hour to complete, with the session divided into five steps, as shown in Figure 3.1.2 LIFT scenarios is used 3 times per week at the facilities. Having the training in the facility allows for high-frequency, low-dose training (HFLD), which means that the trainings occur more frequently and for shorter periods of time. This kind of repetition allows for better recall and learning outcomes as a result. *(Low-Dose High-Frequency - Helping Mothers and Babies Survive, n.d.)*

3.1.3 HOW WAS LIFT SCENARIOS DEVELOPED?

The structure of the LIFT Scenarios was developed by Laerdal Global Health using simulation methodology, including learning objectives and effective debriefing, is an essential component of a successful training *(Barry Issenberg et al., 2005)*. See page 14 for more information.

LIFT Scenarios was developed as a way to scale the simulation training, making it more accessible and requiring fewer people. Originally, LIFT Scenarios was paper-based, where one staff member was responsible for compiling all the main takeaways into an Excel file. However, the success of the simulation training led to its scaling up, which meant that there was no budget for the data transcriber. The data transcription had to occur in another way.

That is where the LIFT Scenarios came in. It allows the champion to fill in the key takeaways, and the app will upload the key takeaways to an Excel file for the mentors to look at. This allows for mentors to help champions improve and gain an overview of the training that is happening.

3.1.4 WHO IS THE USER AND WHAT ARE THEIR CAPABILITIES?

An important part of understanding the context lies also in understanding the user of the app and their abilities. Each facilitator has gone through a SIMBegin course focusing on teaching the basics of simulation training methodology including how to conduct a proper brief and a good debrief. The debrief is based on the CORE methodology,

C= Context

O=Observations

R= Reflection

E= Enhancing Practice

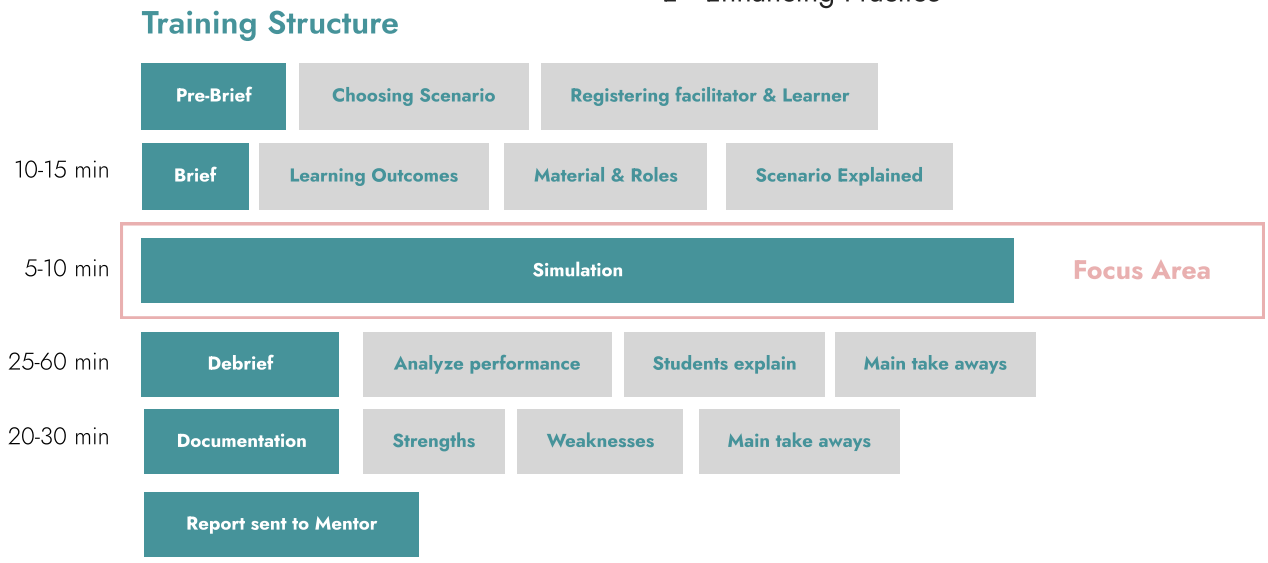


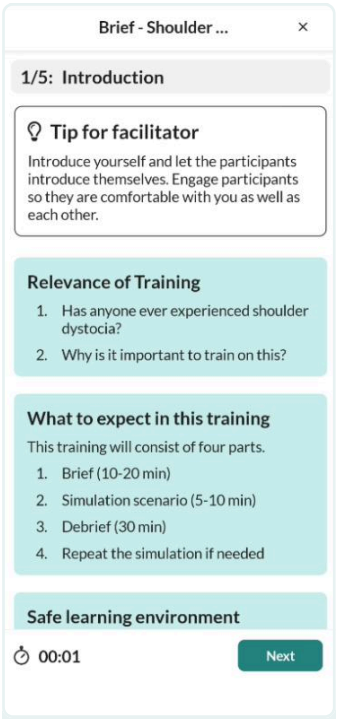
Figure- 3.1.2 Overview of LIFT Scenarios Steps of Training

Furthermore, The users are divided into two main groups: the new facilitator, with limited experience as a facilitator, and the experienced facilitator, who has practiced the scenarios many times and is comfortable going through a training. These two types of users experience and utilize LIFT Scenarios in different ways; therefore, it is essential to acknowledge their varying needs and experiences when planning and executing training with the aid of LIFT Scenarios.

Therefore, the task of facilitating the training causes extra intrinsic cognitive load.

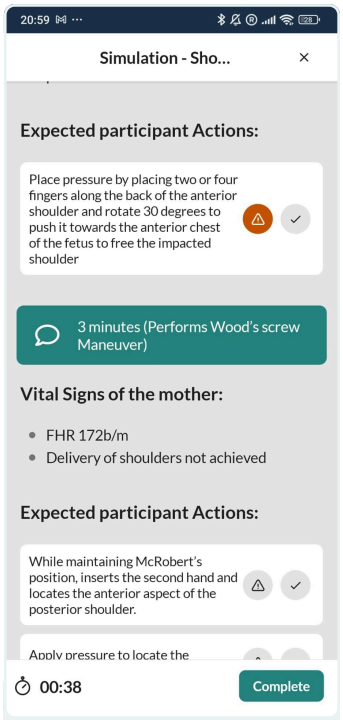
3.1.5 WHAT DOES LIFT SCENARIOS LOOK LIKE?

This section provides an overview of the main application screens within LIFT Scenarios, along with a brief description and expectations of those digital pages. This thesis focuses on adjusting and analysing the screens for the mobile application therefore the screens shown are the mobile version of the app. For more detailed information see page 27-33



BRIEF

Discussing learning objectives, roles and the scenario.



SIMULATION

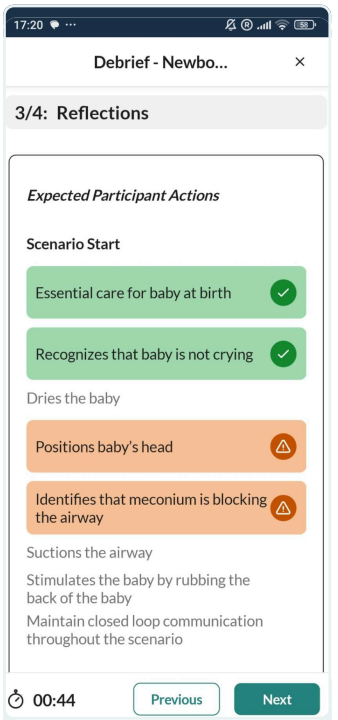
Observation checklist of expected participant actions during scenario

CREATE SESSION

Choosing a scenario, adding factilitators.

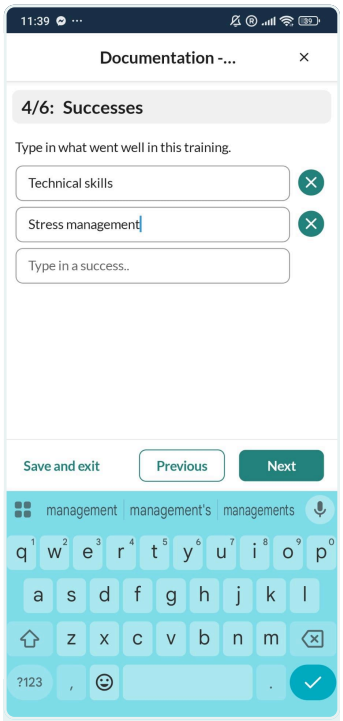
SESSION OVERVIEW

Overview of all the parts of the session



DEBRIEF

Giving feedback to participants and discussing what happened



DOCUMENTATION

Writing down key take aways

Figure. 3.1.3 Overview of LIFT Scenarios screens

3.2 What is Simulation training?

3.2.1 METHOD FOR UNDERSTANDING

Understanding simulation training is crucial for improving and applying best practices to future training materials, including LIFT Scenarios. Simulation training is understood in this thesis through literature review, Interviews with simulation experts, and observation at a simulation centre. The interviews helped navigate the extensive amount of literature on simulation training.

The literature review was conducted using key terms such as "simulation training," "medical training," "medical simulation training," "observing medical simulation training," "facilitating simulation-based training," and "SBL." in Google Scholar. The objective of this search was to understand the roles and challenges associated with observing and facilitating simulation training, what a typical training structure looks like, what is considered successful training as well as to gain insights into how simulation training is utilized within healthcare.

The Interview with simulation experts was conducted via online semi structured interviews, the experts were found via SESAM Network a community of simulation centres. In total two participants were interviewed. One a Professor at a University, teaching facilitators. The other focused on expanding and developing more simulation centres and facilities. See Appendix B for interview questions. The aim of the interviews was to help navigate the extensive literature on simulation.

This section aims to understand the structure of the training, key components to successful training, and the role of the facilitator.

Insights from Literature & Interviews

3.2.2 BACKGROUND

Simulation-based Learning (SBL) is used within many fields, including aviation, military, police, and the medical field. Within the Medical field, it is used to learn new skills, refresh skills, and assess learning. SBL is used by medical students as well as professionals, refreshing their current skills. The purpose of simulation training is to practice real-life situations in a controlled, safe environment where practitioners can make mistakes without consequences.

SBL focuses on everything from inter-team communication to mastering technical skills. Part of the simulation's success is the various scenarios chosen to practice, the quality of the facilitator, and the ability to recreate a simulation that resembles the real situation (Interview 1)

SBL-positive outcomes have contributed to its growing popularity within medical education. SBL increases patient safety and improves patient outcomes. Not only does SBL help patients, but it is also claimed to improve practitioners' knowledge, competence, self-efficacy, and confidence. *(Forstrønen et al., 2020; Oh, 2021)* This creates employee satisfaction and lower rates of burnout (Interview 1).

3.2.3 STRUCTURE OF TRAINING

Simulation training consists of various parts, including briefing, simulation, assessment, and debriefing. These parts are held by a teacher or facilitator who guides the participants through the training. The various parts of the training serve different purposes.

THE BRIEF: focuses on learning objectives and explaining the roles and scenarios so that the practitioners know what they will do and what the facilitator will focus on "assessing". The brief ensures that they are prepared for the training.

THE SIMULATION focuses on acting out the scenario, completing the task explained in the brief. The simulation needs to be as real as possible.

THE DEBRIEF: The debrief is "an instructor-guided conversation among trainees that aims to explore and understand the relationships among events, actions, thought and feeling processes, as well as performance outcomes of the simulation" *(Kolbe et al., 2015)* It consists of asking participants to reflect on their actions and the facilitator creating a discussion about how the simulation went, what can be improved, and how their performance compares to the expected and the learning objectives.

THE DOCUMENTATION: The documentation consists of writing down the learnings and key takeaways from the SBL. The documentation serves as a reference point for analysing the training and improvement throughout the sessions. It also aims to give concrete tips that practitioners can apply in practice.

3.2.4 ROLE OF THE FACILITATOR

"High-quality simulation-based education depends more on skilled facilitators than on elaborate simulator equipment."*(Forstrønen et al., 2020)*

The role of the facilitator is an important one in SBL. However, it is not an easy task. Even experienced facilitators struggle with the simultaneous tasks to perform.

THE TASKS: The role of the facilitator differs depending on the facility. Sometimes, the facilitator is just going through the training and not observing the simulation; other times, the facilitator is responsible for facilitating and observing (interviews 1 and 2).

TRAINING: According to Jaana: Maija Koivistoa article "Design-based research in designing the model for educating simulation facilitators", *(Koivisto et al., 2018)* "There is a need to improve simulation practice" and that "simulation pedagogy is widely used in nursing education but each teachers knowledge and skills relating to its use may vary substantially" but that " effective use of SBL is complex and educator preparation is recognized as being vital. However, generally, health educators are not given the time to gain relevant facilitator skills to deliver SBL effectively."(*Koivisto et al., 2018)*

Most facilitators do not receive formal facilitator education but learn on the job, most of the time in isolation.

Kathleen Finn argues that peer-to-peer feedback is essential for facilitator development, with a focus on feedback in the following areas.

"

1. Question strategies
2. Physical examination instruction
3. Engagement of multiple learner levels
4. Learner-focused training and teaching efficiency."

(Finn et al., 2011)

TOOLS: There are a variety of tools to aid facilitators in running a successful training, including scenario templates, notepads, co-observers, and predefined learning objectives. These are forms of memory aids that are used for cognitive offloading. This helps reduce the cognitive load of the observer since it does not require them to recall the various steps required for the effective simulation; however, it focuses on recognition. Recognition is shown to be way easier to retrieve information rather than recall; recall, however, aids in deeper learning.

New facilitators want to control the simulation in detail by following a structure, but experienced ones are more flexible and utilise the possibilities that arise. *(Forstrønen et al., 2020)*

Qualities of a good facilitator: In medical education, there is an assumption that a good practitioner will make a good teacher *(Finn et al., 2011)*. This assumption is not always the case. Good facilitators are considered to have "good non-cognitive traits, including personality types, relationship skills, non-verbal communication, and emotional states" *(Sutkin et al., 2008)*

According to Kathleen Finn et al.'s article "How to become a better clinical teacher: a collaborative peer observation process," When compared to cognitive traits, non-cognitive traits may be even more difficult for a teacher to develop *(Finn et al., 2011)*

3.25 EFFECTIVE TRAININGS

In the article *"Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME Systemic Review" (Barry Issenberg et al., 2005)* they outline the parts of the SBL leading to effective learning the top 3 include,

1. **PROVIDING FEEDBACK** where 47 % of the reviewed articles "reported that feedback is the most important feature of simulation-based medical education"
2. **REPETETIVE PRACTICE** where 39 % of the reviewed articles "reported that repetetive practice is a key feature of simulation-based medical education"
3. **CURRICULUM INTEGRATION** where 25 % of the reviewed articles "reported that integration od SBL into education is an essential feature of their effective use"

Other features mentioned were range of difficulty, multiple learning strategies, clinical variation, controlled environment, individualized learning, defined outcomes, simulator validity

3.2.6 FACILITATORS EXPERIENCE THROUGHOUT THE TRAINING

THE BRIEF: The brief generally focuses on defined goals the role of the facilitator here is simply to inform the participants of the defined goals.

THE SIMULATION: During the simulation part "Direct observation is essential to assess and provide feedback to medical trainees. "*(Cheung et al., 2019)* All aspects of behavioural skill were perceived as very important to observe *(Jepsen et al., 2015) In the Article "Development of instruments for assessment of individuals and teams non-technical skills in healthcare: a critical review'* they address the difficulty of observing behaviours which they categorized into three main points

1. Not everything can be observed
2. Not everything is observed
3. Interpretation of observed behavioural skills is difficult.

The facilitators also addressed that the practitioners ability to observe, sometimes outnumbered their self reported maximum.

"More so, observation and provision of feedback in behavioural skills can be regarded as deceptively 'simple' due to the availability of many easy-to-use frameworks. The contrary is the case, as feedback on behavioural skills remains challenging and requires trained faculty, even when applying robust frameworks" *(Mommers et al., 2023)*

THE DEBRIEF: The debrief is one of the most important parts of the training, debrief is the section where the facilitator gives feedback the top feature of effective training. However giving feedback is a challenging task. Kolbe et al. outlines the issues with debirefing including:

1. preference- consistent
2. Information sharing
3. lack of phycological safety
4. and ineffective debriefing models

There is a dilemma of offering honest feedback without damaging the relationship with the practitioners *(Kolbe et al., 2015)*

Kolbe provides the ways to manage these risks including

1. Respect to content with specific learning objectives
2. Structure (reaction phase, analysis phase, summary phase)
3. attitude (honesty, curiosity, positivity)
4. Setting

She also addresses the importance of integration of methodology such as circular questions the 5 Ws and correcting errors by targeting the underlying values rather than the action.

THE DOCUMENTATION: The documentation consists of writing down the learnings and key take aways from the SBL. This acts as a reference point to analyse the trainings and improvement throughout the sessions. As well as aims to give concrete tips that can be applied in practice.

Insights from Observations

3.2.7 KEY INSIGHTS FROM OBSERVATIONAL STUDY

As part of understanding simulation training in the medical sector the opportunity to observe simulation training at a facility arose, observing 2 days of simulation training where in some of the trainings the facilitators were using LIFT scenarios .

TOOLS USED:
The facilitators were responsible for the equipment as well as the training protocol during the sessions. Therefore throughout the training they would help participants locate and manage necessary equipment.

FACILITATOR:
The facilitators observed were all from the medical field and trained to be a facilitator this was evident since they managed to conduct efficient debriefs that focused on tackling the underlying values rather than the action.

STRUCTURE:
One interesting element is that they structured the various trainings so one would support the other. Focusing first on technical skills then applying those skills in a scenario. They combined skill simulation, theory and practice.

For more information about the observation of using the LIFT scenarios see chapter 4.

3.2.8 CONCLUSION

This section aims to give an overview of simulation training, as well as some of the difficulties facilitators face from the perspective of simulation training theory. This acts as a way to understand the facilitators and what they have difficulties with, so that it can be used as a starting point for understanding the problem and developing a solution.

3.3 What is Cognitive Load?

Apart from simulation training it is important to address the affect cognitive load has on factilitators, to understand the "Facilitators' limitations with respect to attention, focus and (in) ability to do concomitant tasks." *(Mommers et al., 2023)*

"Cognitive load theory emphasized that all novel information first is processed by a capacity and duration limited working memory and then stored in an unlimited long-term memory for later use." *(Sweller, 2019)* Cognitive load theory is often used for educational design, however can be applied to a variety of disciplines. Since training platforms are used for educational purposes cognitive load theory and information processing are relevant for developing good simulation training material.

METHOD

A literature review was conducted using google scholar with key terms such as 'cognitive load theory,' 'cognitive processing,' 'intrinsic cognitive load,' 'germane and extraneous cognitive load,' 'cognitive load and teaching,' 'cognitive load and simulation training,' 'measuring cognitive load,' 'reducing cognitive load,' 'cognitive load effects,' 'information processing,' and 'cognitive resources.' This search aimed to comprehensively understand cognitive load and its implications for learning and performance.

3.3.1 COGNITIVE LOAD CATEGORIES

Cognitive load is separated into three categories, germane, intrinsic and extraneous load.

INTRINSIC COGNITIVE LOAD is the complexity of the information being processed, related to element interactivity which is influenced by the users knowledge and the task.

(Sweller, 2019; Kirschner, 2002)

Intrinsic cognitive load can only be adjusted by changing what needs to be learned or the expertise of the learner.

GERMANE COGNITIVE LOAD is the overall resources required to learn, the working memory capacity. *(Sweller, 2019)*

EXTRANEOUS COGNITIVE LOAD is how the information is presented, the majority of instructional effects are due to extraneous load.

Instructional effects are things that increase cognitive load and can be adjusted.

Cognitive load research *(Paas & Sweller, 2012; Van Gog & Paas, 2008)* suggests that the germane load (Working memory) are the resources available to process the extraneous and intrinsic load.

GERMANE LOAD = **EXTRANEOUS LOAD** + **INTRINSIC LOAD**

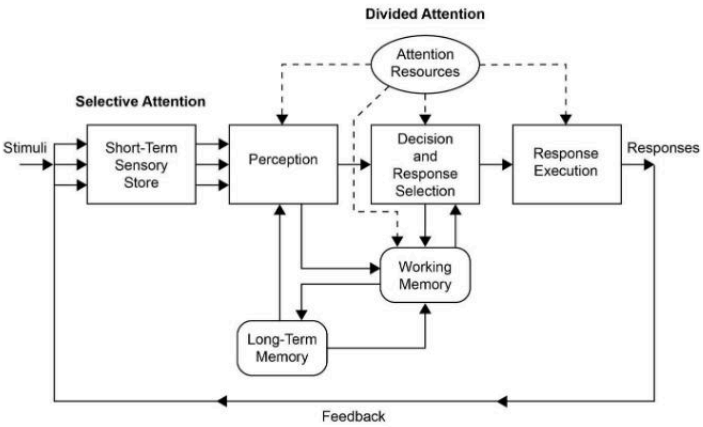


Fig 3.3.1 Lee et al (2017)'s "Human Information-processing Model of Cognition"

3.3.2 WORKING MEMORY AND ATTENTION

"WM contains information we are thinking about at any one time including what we have activated from LTM(long term memory)" *(Russel.J, 2020)*

Working memory is part of the germane cognitive

load. The working memory capacity is thought to be 7 units at a time (Branaghan & Lafko, 2020). WM is temporary, keeping information in WM requires effortful attention, through rehearsing the information, some of it can become encoded into LTM.

To understand working memory one must understand information processing, figure 3.3.1 shows the information processing model where stimuli is analysed through senses at the same time as knowledge and expectations from Long Term Memory (LTM) are processed. These two processes combine and yield a perception, the perception makes us aware of and interpret the stimuli in our environment

This model also highlights the limited pool of cognitive resources such as attention and working memory. Which makes it easy for the cognitive system to be overwhelmed.

An overwhelmed cognitive system leads to poor communication, ineffective learning and error. "These problems are a certainty in a complex, high stress, high consequence environment such as healthcare" *(Branaghan & Lafko, 2020)*

3.3.3 COGNITIVE LOAD EFFECTS

Cognitive load effects are studied effects that impact the experienced cognitive load. Therefore these effects can be utilised to increase the overall usability of the product or service. This part focuses on some of the cognitive load effects, that have a more direct application to LIFT scenarios. Therefore they are easier to examine within the product as well as apply. There are a variety of cognitive load effects *(Sweller, 2019)* addresses them all in detail.

A routined facilitator experiences high cognitive load when _____

Figure 3.3.2 Completion Problem

COMPLETION PROBLEM EFFECT is the idea that the problem is somewhat filled in and the user has to continue filling in the problem *(Mihalca et al., 2015)*.

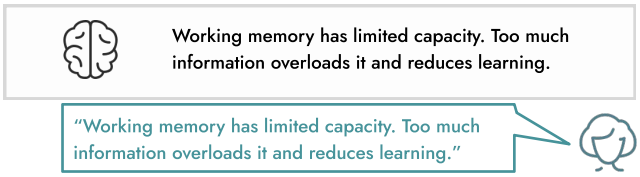


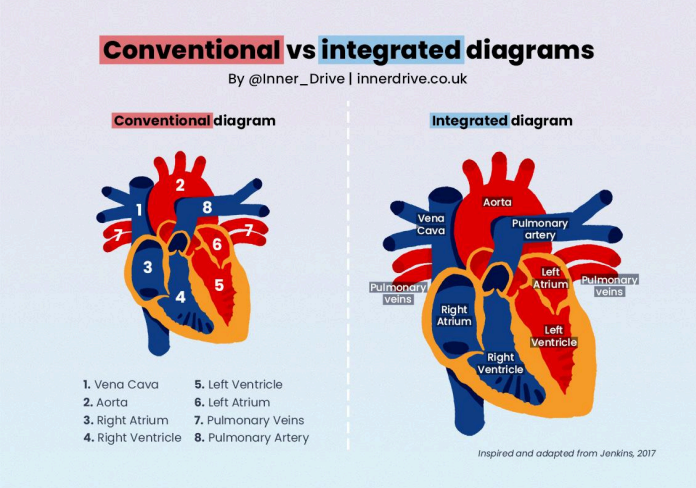
Figure 3.3.3 Redundancy Effect

REDUNDANCY EFFECT is that cognitive load is increased when multiple elements (text or image) say the same thing. Therefore requiring processing multiple times without gaining any significant knowledge.

TRANSIENT INFORMATION EFFECT is that it requires more cognitive resources to use transient information since it requires the learners to retain the information that is displayed for a brief amount of time. For expert learners continuous animations work well however novice learner are better suited for segmented animations.

MODALITY EFFECT Unlike the redundancy effect the modality effect says that the working memory can be divided into different processors for audio, visual and spatial input, therefore using more than one input increases the working memory capacity *(e.g. Baddeley 1992)*.

SELF-MANAGEMENT EFFECT The ability for individuals to apply cognitive load principles and self manage their own cognitive load.



@Innerdrive Figure 3.3.4 Conventional Vs. Integrated Diagrams

SPLIT-ATTENTION EFFECT "Split attention occurs when learners are confronted with two complementary sources of information, which cannot stand on their own but must be integrated before they can be understood."*(Sweller, 2019)* The figure above shows an example of this phenomenon a conventional diagram where the numbers correlate to places on the heart therefore each placement and number must be remembered in comparison to the integrated diagram that reduces the effect of split attention through integrating the sub anatomical part and name into the diagram integrating the two dependent pieces of information.

3.3.4 MEASURING COGNITIVE LOAD

Figure 3.3.5 gives an overview of the various ways to measure cognitive load through a flow chart. Measuring cognitive load can be done in a wide variety of ways. However the most common is through subjective rating scales, behavioural changes or physiological measurements. Furthermore different techniques are used at different times of the testing. A few are used during task or after the task. With an external or attached device or without. With direct or indirect subjective or objective measurements.

Subjective rating scales include self-reported questionnaires for example NASA-TLX or usability Questionaire, Rating task difficulty. .

Whereas objective measurements include behavioural and performance measures.

"Overall, among all the measurement methods of cognitive load, self-reported questionnaires, performance measures, dual task paradigm, facial expressions, linguistic features and mouse movements measurement methods are the least obtrusive in terms of data collection and analysis. " *(Darejeh et al., 2024)*

The positive aspect of choosing a method that is less obtrusive is that it allows for more testing to be done since analysis and collection is not as time consuming. With an understanding of the various methods to measure cognitive load an informed choice can be made for the specific test development.

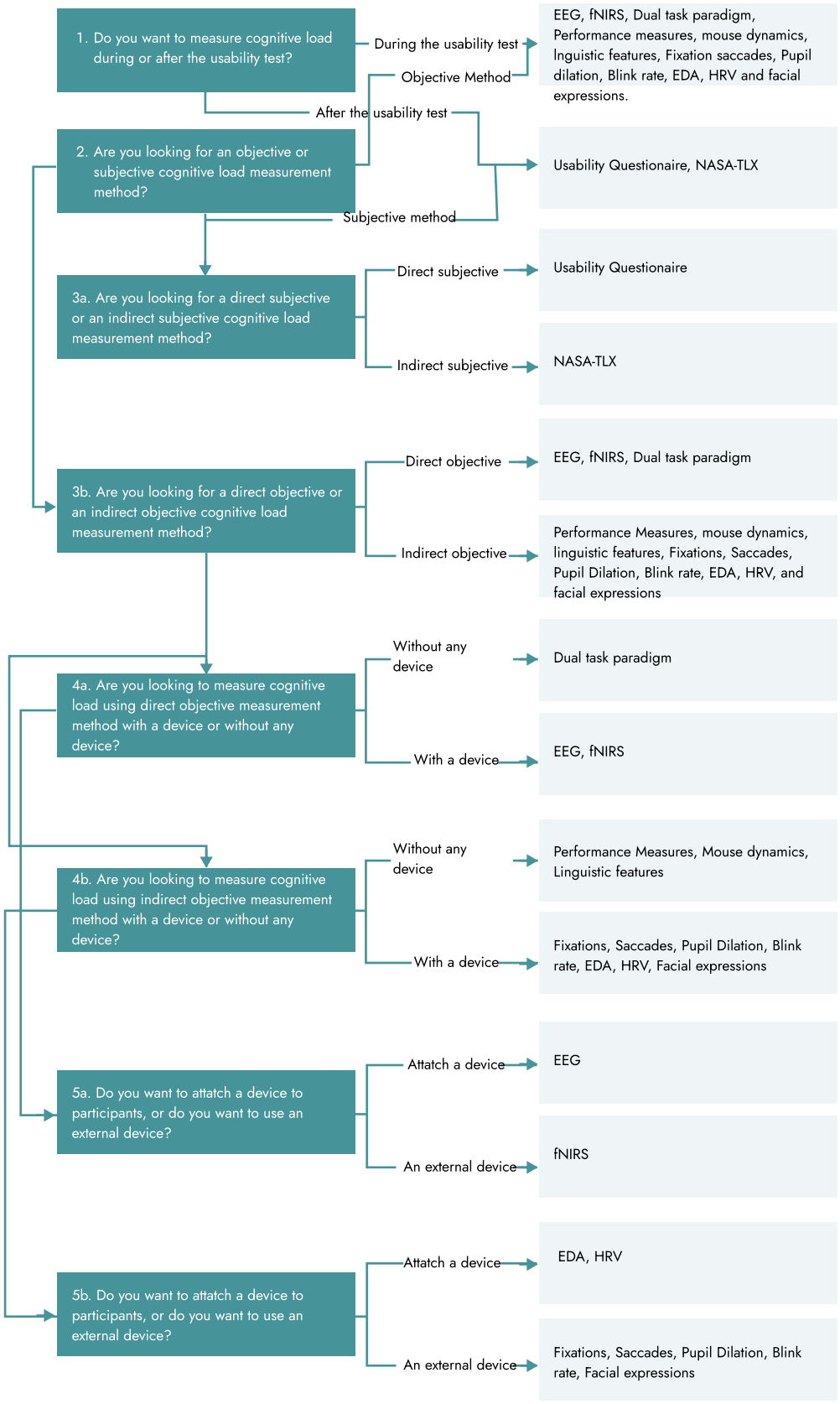
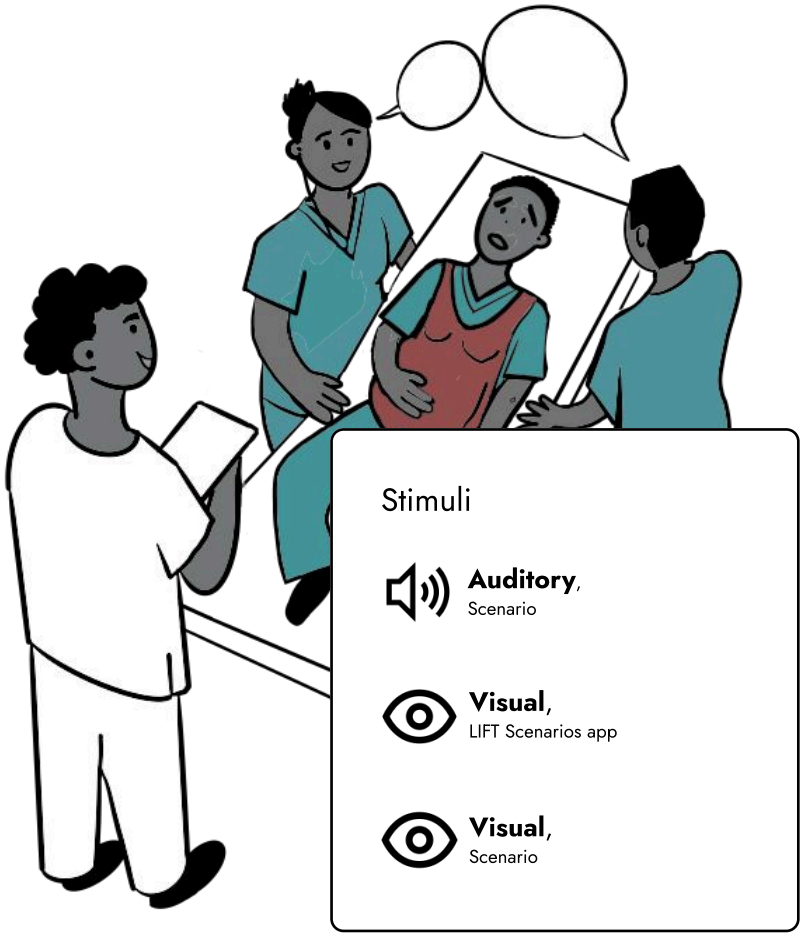


Figure 3.3.5 Darejeh et al (2024) "The framework for choosing appropriate cognitive load measurement method in the context of usability"

3.3.5 COGNITIVE LOAD & LIFT SCENARIOS

To understand the cognitive load that is a result of the environment affecting the facilitator's experience, it is important to address multiple aspects:

1. The in- situ nature of the Simulation training, requires participants and the facilitator to stop in case of an emergency, the facilitator has to be prepared to handle an emergency situation and can not put all the attention resources in the training.
2. Cognitive load is affected by what was experienced previously as well, therefore a stressful period in the clinic prior to the training affects the ability to observe and focus.
3. There are various forms of stimuli that have to be processed
   a. Visual stimuli from observing and from LIFT Scenario.
   b. Auditory Stimuli from observing the scenario
4. The facilitator is also responsible for addressing any difficulties with using the equipment therefore cannot fully focus on only observation.



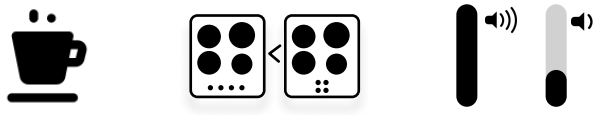
3.4 What is Usability?

Usability has a variety of definitions from efficiency, effectiveness, and accuracy. The point of usability is making it easier for a specific person or group of people to reach a certain goal. This can indicate that usability for some may in tern be counterproductive for others. There is no such thing as usability for all. However the Nielsen Norman group has identified 10 usability heuristics that have remained unchanged since 1994 (Nielsen, 2024). These usability heuristics encompass common usability flaws and what causes them. According to Nielsen they should be used as rules of thumb rather than strict guidelines. They serve as lenses from which to look at a product through to get deeper insight into potential usability flaws that in tern will increase cognitive load.

3.4.1 USABILITY HEURISTICS

1. **VISIBILITY OF SYSTEM** is the ability of the system to make the user aware of its current state. It deals with giving proper feedback to the user such as the button becoming indented after being pushed as a recognition of the user pushing the button.

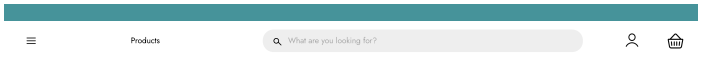
2. **MATCH BETWEEN SYSTEM AND REAL WORLD** is that the system speaks the users language. This deals with cultural connotation and iconography as well as natural mapping. Such as a coffee symbol indicating break in some cultures. For example, coffee has a connotation of a break in some cultures. It is easier to understand the correlating button to the stove on the right. It makes more sense for the volume button to increase upwards, not downwards.



3. **USER CONTROL AND FREEDOM** is the right to undo. Having clear back buttons or exit buttons.

4. **CONSISTENCY AND STANDARDS:** The consistency and standards look at two standards
   a. Firstly, the standards and consistency compared to other apps. According to Jacobs theory the majority of time the user spends looking at other apps therefore the icons and UI have to relate to what the user is used to.
   b. Secondly, there should be a consistency within the app or platform itself.

For example website shows the consistency among the placement for the search bar and shopping cart.



5. **ERROR PREVENTION** is the ability of the platform to aid in preventing errors such as slips(error from inattention) and mistakes (error from mismatch between mental model and deign). Prevent errors with good confirmation options and removing memory burdens and good defaults.

6. **RECOGNITION RATHER THAN RECALL:** Recognition over recall focuses on creating less burden on the user to remember information. This is based of the cognitive load of recalling information vs. recognizing information. This is based off the idea of activation which helps retrieve information from long term memory. Recognition aids in activation which makes it easier to retrieve necessary information since there are more cues.

7. **FLEXIBILITY IN USE:** Flexibility in Use focuses on the requirement of the platform to adapt to the varying needs of the users and expertise of the users. Novice users need more help whereas expert users need more accelerators and shortcuts. Accelerators are something that speed up commonly used tasks for example Ctrl + S is a quick way to save a document.

8. **AESTHETIC AND MINIMALIST DESIGN:** Aesthetic and minimalist design focuses on reducing extraneous load of the platform. Through removing unnecessary visual clutter(Noise) that requires additional processing. The idea is to balance minimalism and functionality. Ensuring, that every UI element serves a purpose.

9. **HELP USERS RECOGNIZE, DIAGNOSE AND RECOVER FROM ERRORS:** This Heuristic focuses mainly on the language used in the various error messages. The language should be simple and offer a solution to the problem.

10. **HELP AND DOCUMENTATION:** The user should be able to get help when they do not know or encounter a problem with the platform FAQ (Frequently Asked Questions) are a common version of help and documentation.

3.4.2 COGNITIVE LOAD AND USABILITY

Usability considered as effectiveness, efficiency and accuracy relates to Cognitive load in various ways.

Reducing cognitive load reduces the burden on the user and makes it easier to use the platform.

However, high cognitive load does not mean that the usability is poor, high cognitive load can also increase learning. Therefore, a platform that is more complex should aim to have low extraneous load so that there are more cognitive resources to process the high intrinsic cognitive load.

GERMANE LOAD = **LOW EXTRANEOUS** + **HIGH INTRINSIC**

This allows for the user to focus on the goal of the platform, learning the topic, rather than understanding the platform.

The majority of the usability heuristics focus on the ways to reduce extraneous cognitive load. Similar to the cognitive load effects (see page 17). That focuses on how the information is displayed to reduce intrinsic load and extraneous load. The usability heuristics can also be tied to information processing and the ability to retrieve information from LTM. Generally less cognitive load is required when there is good activation. The activation depends on how often something is seen and rehearsed. If there is a symbol or a part of the design that is not commonly used, activation becomes harder and therefore more working memory resources are put to identify the symbol, or it is simply ignored.

If the cognitive load of a system is higher than the available resources of the person using the system they may opt out of its use completely.

Therefore to increase the use of a platform cognitive load must be considered.

COGNITIVE LOAD & THE 10 USABILITY HEURISTICS: The 10 usability heuristics all relate to cognitive load and information processing.

1. When there is not proper feedback the user is required to guess what is happening and test out more methods requiring higher cognitive load.

2. When there is a lack of match between the real world and the system, caused by a mismatch in mental models users are forced to rethink how things are done requiring more attention resources and causes higher extrinsic cognitive load.

3. When the user is not able to easily go back they spend extra resources focusing on finding their way back rather than on the main task.

4. When there is a lack of consistency the user is required to learn and interpret a new system that may not match their mental model, therefore requiring more attention resources. When something is not familiar to a user, activation becomes more difficult increasing cognitive load.

5. Preventing errors reduces the cognitive effort of fixing errors.

6. Recognition requires less cognitive resources than recall therefore causes less cognitive load.

7. Flexibility in use helps manage the cognitive load of various expertise of users

8. Minimalist design yet functionable reduces extraneous cognitive load, through reducing noise and redundancy.

9. Clear direct help messages with actions to take help user reduce cognitive load.

10. Help and documentation focuses on teaching the user how to use the platform, increasing their level of expertise reduces intrinsic load.

The user interface is related to extraneous cognitive load since it dictates how information is displayed. Aligning with usability heursitics 8

When usability principles aren't followed and the cognitive load is too high there is a chance the product will be rejected by the user.

3.43 HOW TO MEASURE USABILITY

Usability can be measured in multiple ways including SUS (System usability Scale) and Heuristic Analysis aswell as user tests.

3.5 Conclusion

This chapter discusses the context of LIFT Scenarios, including its use, development, and structure. It also covers the content related to simulation training and the tools that will be utilized to analyse LIFT scenarios, specifically focusing on cognitive load and usability.

The chapter aims to answer the following questions:

- What is the Purpose of LIFT Scenarios?
- What does LIFT Scenarios do now?
- What are the elements in LIFT Scenarios?
- What affects the system?

The LIFT Scenarios purpose is to improve the training of medical staff to reduce mortality associated with birth. The elements of LIFT scenario include the structure and the parts of the training. The majority of this chapter discussed what affects the system including cognitive load and usability.

Cognitive load and usability are factors present in every service or task we undertake. Thus, addressing the cognitive load and usability of a software platform can influence its perception. Reducing extraneous cognitive load can enhance the platform's effectiveness by freeing up resources for completing the task at hand.

The role of an observer and facilitator can be challenging, especially for those who are new to it. While memory aids like LIFT scenarios are designed to reduce cognitive load, they cannot alleviate all challenges. It is crucial to consider the inherent difficulties of being a facilitator and to emphasize the importance of thorough training accompanied by peer-to-peer feedback.

3.6 Discussion

This chapter primarily focused on a literature review, interviews with simulation experts, an evaluation of the app, and various observations. Understanding the context of use proved to be quite complex and required significant time investment.

NOVEL CONCEPTS

Many of the concepts discussed, such as cognitive load, were new to the researcher, which further impacted the ability to progress in the overall approach.

FACILITATORS IN CONTEXT

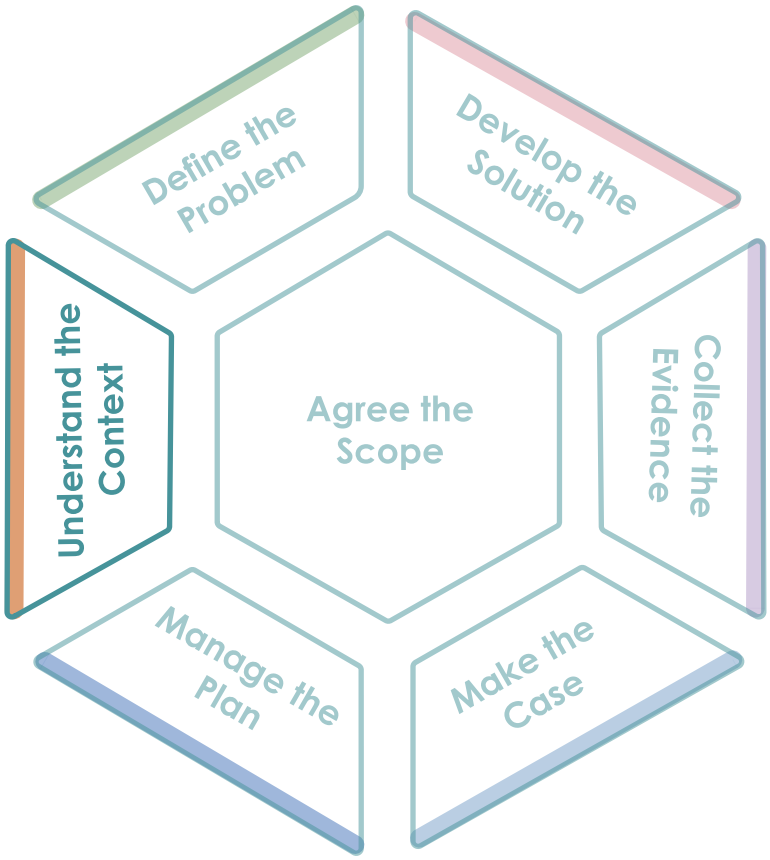
Additionally, there was no direct access to the real facilitators using LIFT Scenarios, meaning that all information gathered about them was second-hand. This limits the reliability of the insights collected.

LIMITED # OF EXPERT INTERVIEWS

Only two simulation experts were interviewed, resulting in a very small sample size that did not allow for in-depth analysis. However, these interviews served as a reflection and helped confirm that the approach to simulation training was appropriate, reinforcing insights drawn from the literature. For future research, implementing a brief survey for simulation specialists could yield more responses while being considerate of their limited time.

OBSERVATION INFLUENCE PERCEPTION

The observations conducted at the simulation facility were successful; however, they may have influenced perceptions of how LIFT scenarios are actually utilized in their intended context



CHAPTER 4

Defining the Problem

Defining the Problem 4

Defining the problem focuses on understanding how the LIFT Scenarios performs now from a UI, behavioural and systemic perspective. Current behaviour focuses on the facilitator. Answering the questions.

- How does LIFT Scenarios perform now?
- What does good performance look like?
- What is done well?
- What is the problem?

These questions are part of the Improving Improvement model.

This chapter focuses on two main sections testing and analysing, see figure 4.0.1 for the overview of the activities and tools used in this chapter.

Testing answers the question "How do we perform now?". Evaluation answers the question "What does good performance look like?", What is done well? and what is the problem?

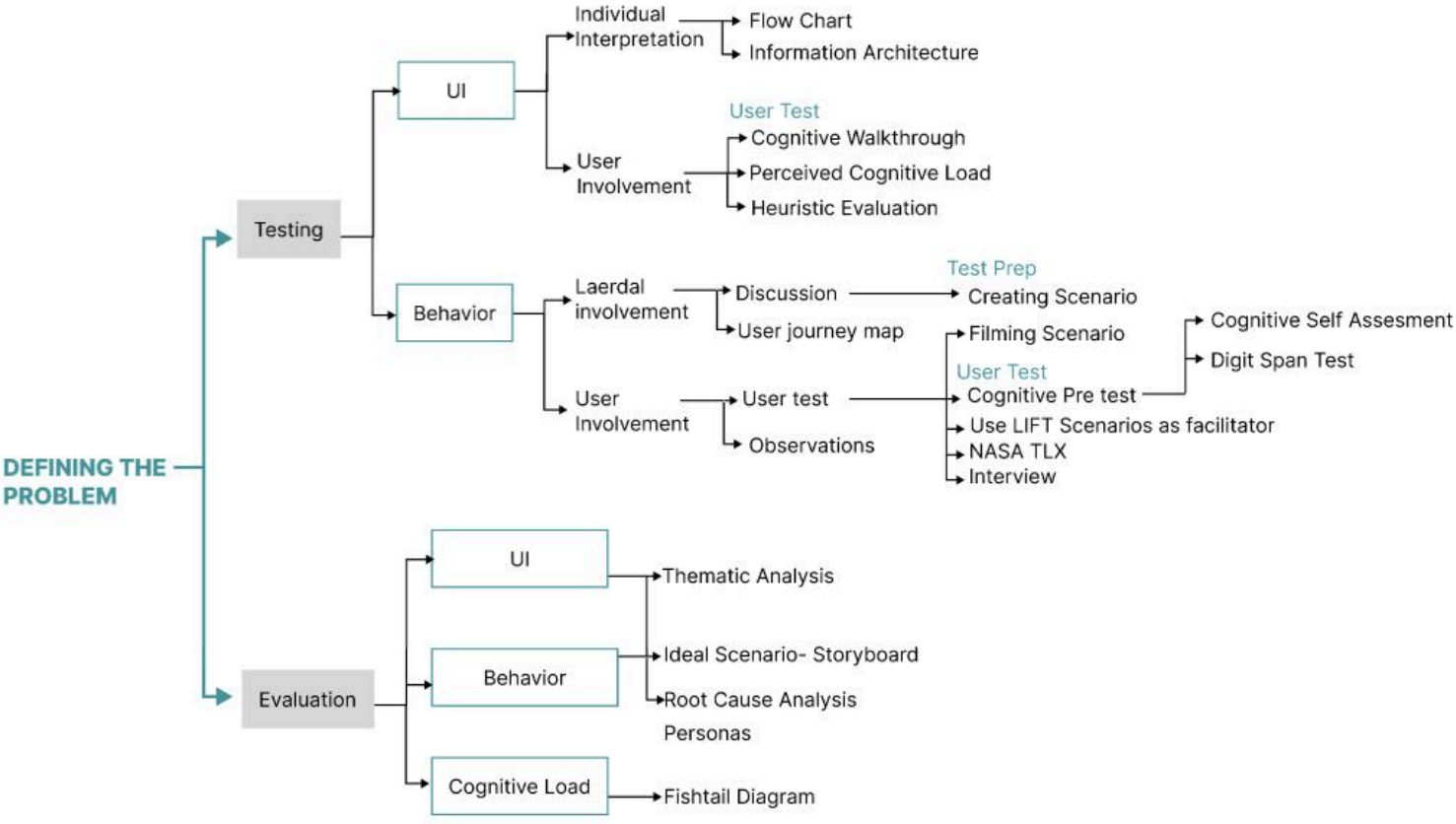


Figure 4.0.1 Overview of activities in Defining the Problem

4.1. Testing - UI - Individual Intepretation

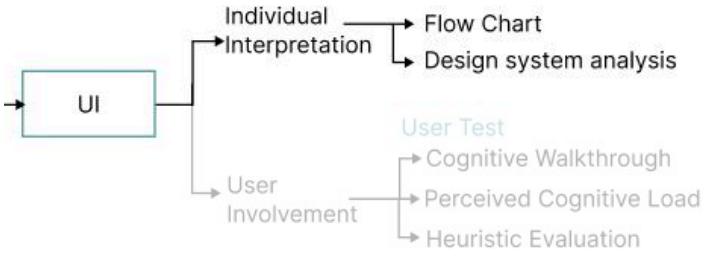


Figure 4.1.1 Overview of activities in Understanding UI

Understanding the User Interface (UI) aids in understanding the microscale of the application. The UI elements and their structure can cause additional extraneous cognitive load, influencing user behaviour. By comprehending the UI, we can begin to identify ways to reduce this extraneous cognitive load.

Understanding the current performance of the UI is achieved through individual interpretation and user involvement via user tests. The individual interpretation of the UI involved examining the design system and a flow chart. In comparison, the user test employed cognitive walkthrough, perceived cognitive load, and heuristic evaluation.

4.1.1 INDIVIDUAL INTERPRETATION

4.1.1.1 FLOW CHART

The flow chart is created by examining the app and tracking the relationships between its pages. This process provides an overview of how the pages function and connect to each other. It allows us to analyse the overall structure of the pages and understand how the app systematically operates. See Figure 4.1.2 for a visual representation.

See the whole flow chart in Appendix C.

Insights from Flow chart:

1. Planned and not submitted trainings go straight to the overview and not the preview page. Thus making it difficult for the facilitator to view the preview information used to prepare for a training.
2. Each of the subparts of the training are reached solely via the scenario overview.
3. The documentation starts on page 3
4. The session can be submitted with missing information.

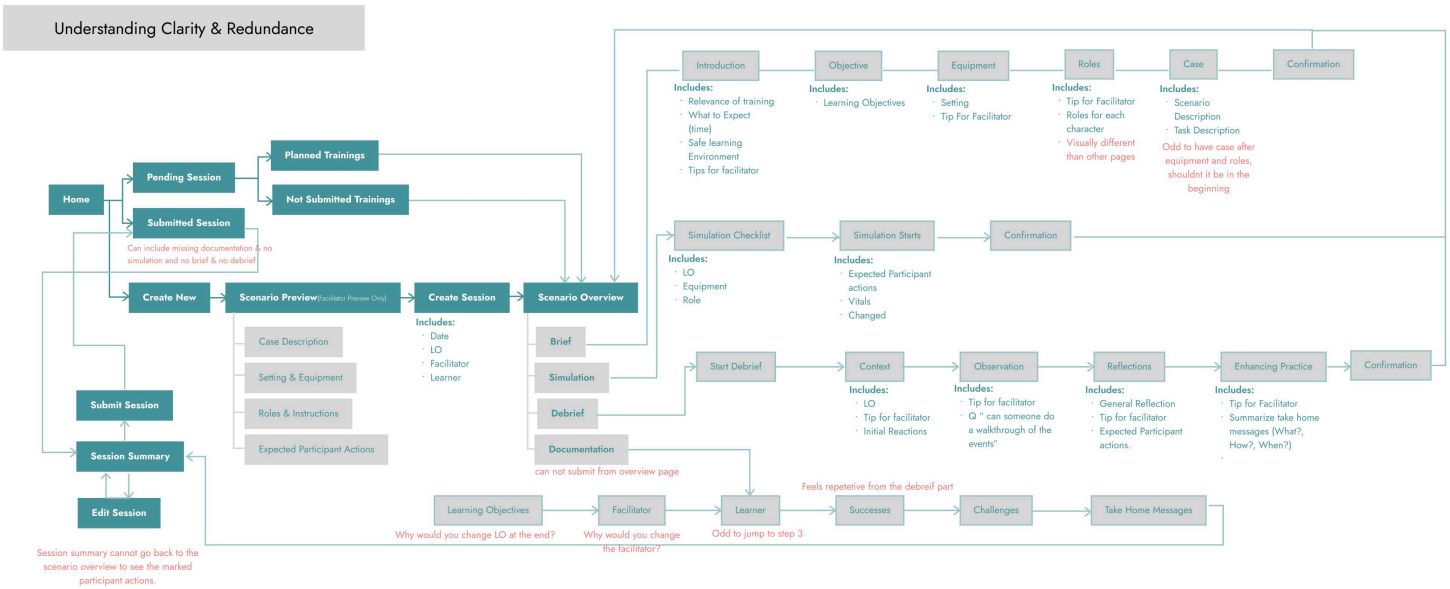


Figure 4.1.2 Flow Chart of LIFT Scenarios

4.1.1.2 DESIGN SYSTEM ANALYSIS

This section breaks down the information displayed in LIFT Scenarios through a design system analysis. First a cognitive walkthrough was done then the pages were divided into categories of reocurrant or seemingly important pages.

The app has main categories of pages including;

- information pages
- confirmation pages
- overview pages
- simulation pages
- documentation pages.

All the pages are broken down into their main elements in an effort to understand the overall system used in the app, how they chose to display the information. This helps understand potential extraneous cognitive load.

Information Pages

The information pages consist of a combination of steps and tips they occur throughout the app sections in pre-brief, brief and de-breif. They aim to inform and guide the facilitator. Giving relevant information to the instructor to help them through the training.

The information pages have the same general set up,

- A main title including the part of the training and the scenario chosen.
- Process bar
- Tip for facilitator
- Information boxes

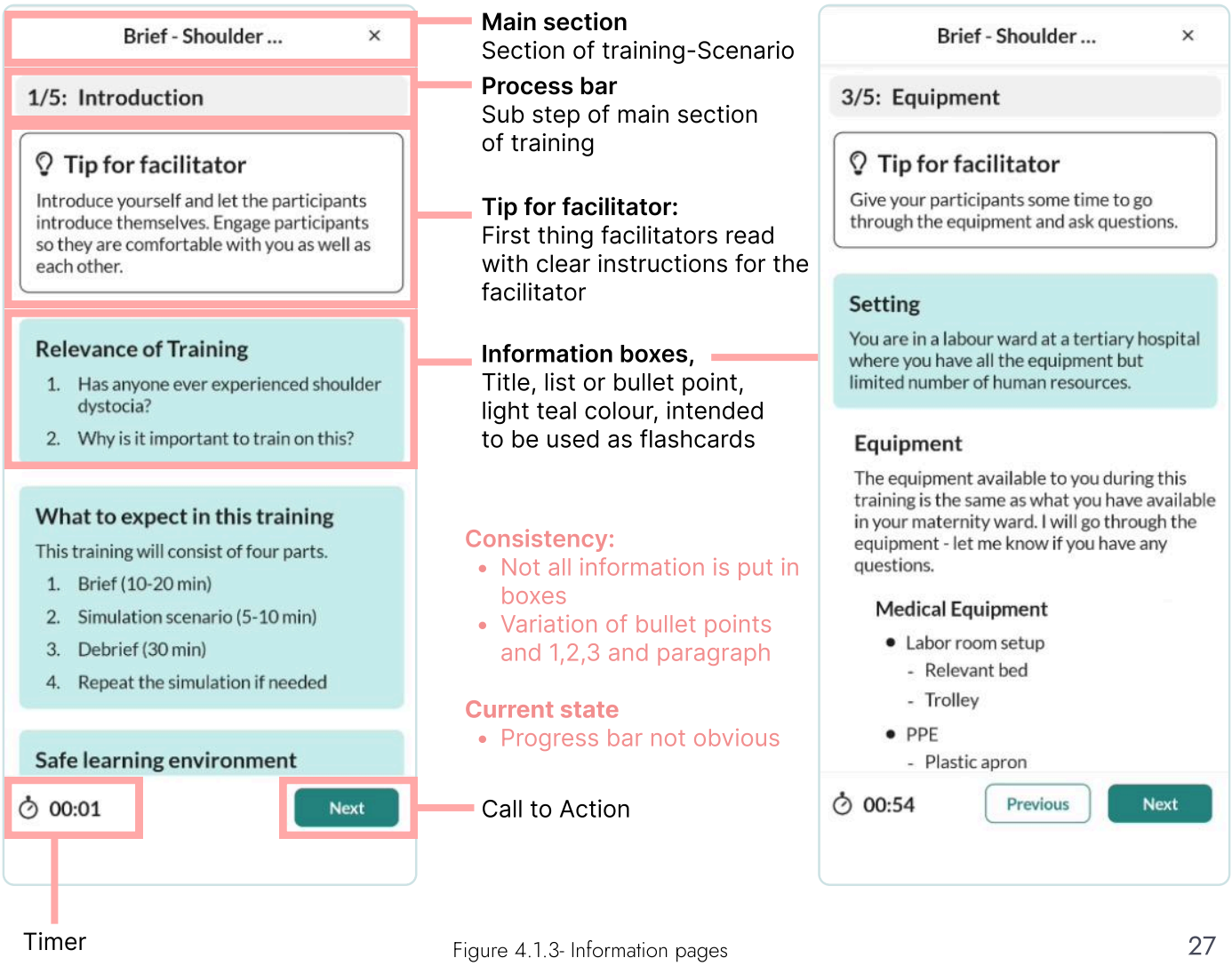


Figure 4.1.3- Information pages

Session overview pages

The Session overview is like the table of contents for the session. The basic structure is shown in figure 4.1.4

The session overview page is the main page of the training, providing the overall structure and serving as the initial point for all parts of the training. It connects the training sections and guides the user through the training by checking off the sections one by one and giving a sense of progress through the training.

Progress throughout the structure of the training is an important aspect of the session overview

Progress is shown through:

1. A clock that indicates waiting to start, or a tick mark indicating the section is complete
2. Gray text on the right-hand side that says "Not Started" or the time it took to complete that section.
3. Completed sections change colour to teal.

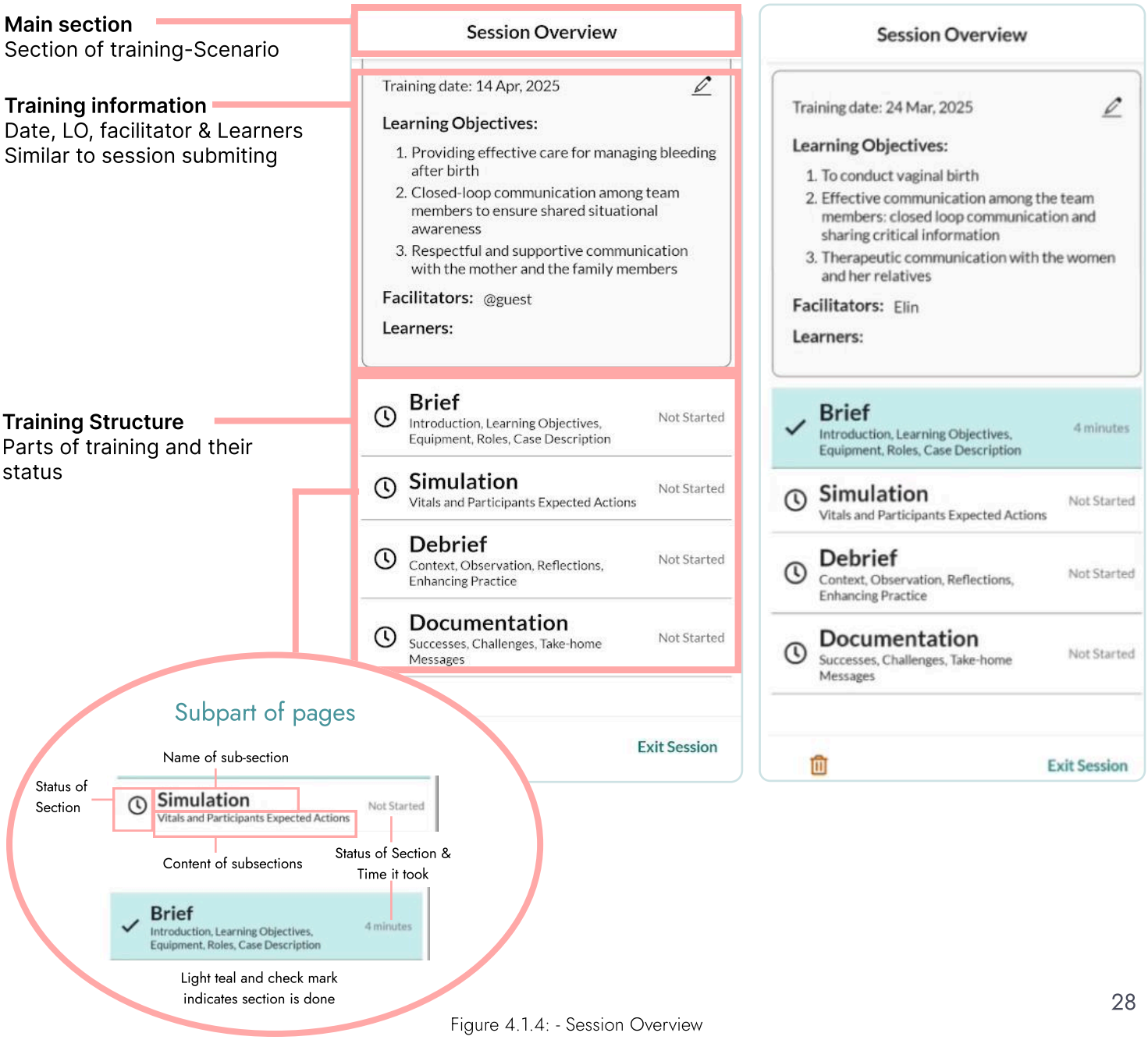


Figure 4.1.4: - Session Overview

Creating and submitting a session

The Session overview is like the table of contents for the session. The basic structure is shown in figure 4.1.5

The pages "Create a session" and "Session summary" are visually similar.

The "Create a session" appears when starting a new session serving to initiate a session with all the necessary information. The "Session summary" page appears when you complete documentation and submit the session. The session summary serves to give you an overview of what the goal of the training was and the key points mentioned in the documentation.

Both pages have similar layouts.

- The scenario name
- The date
- The LO
- The learners
- The facilitators

The session summary additionally has successes, challenges, take-home messages and key parts of the documentation.

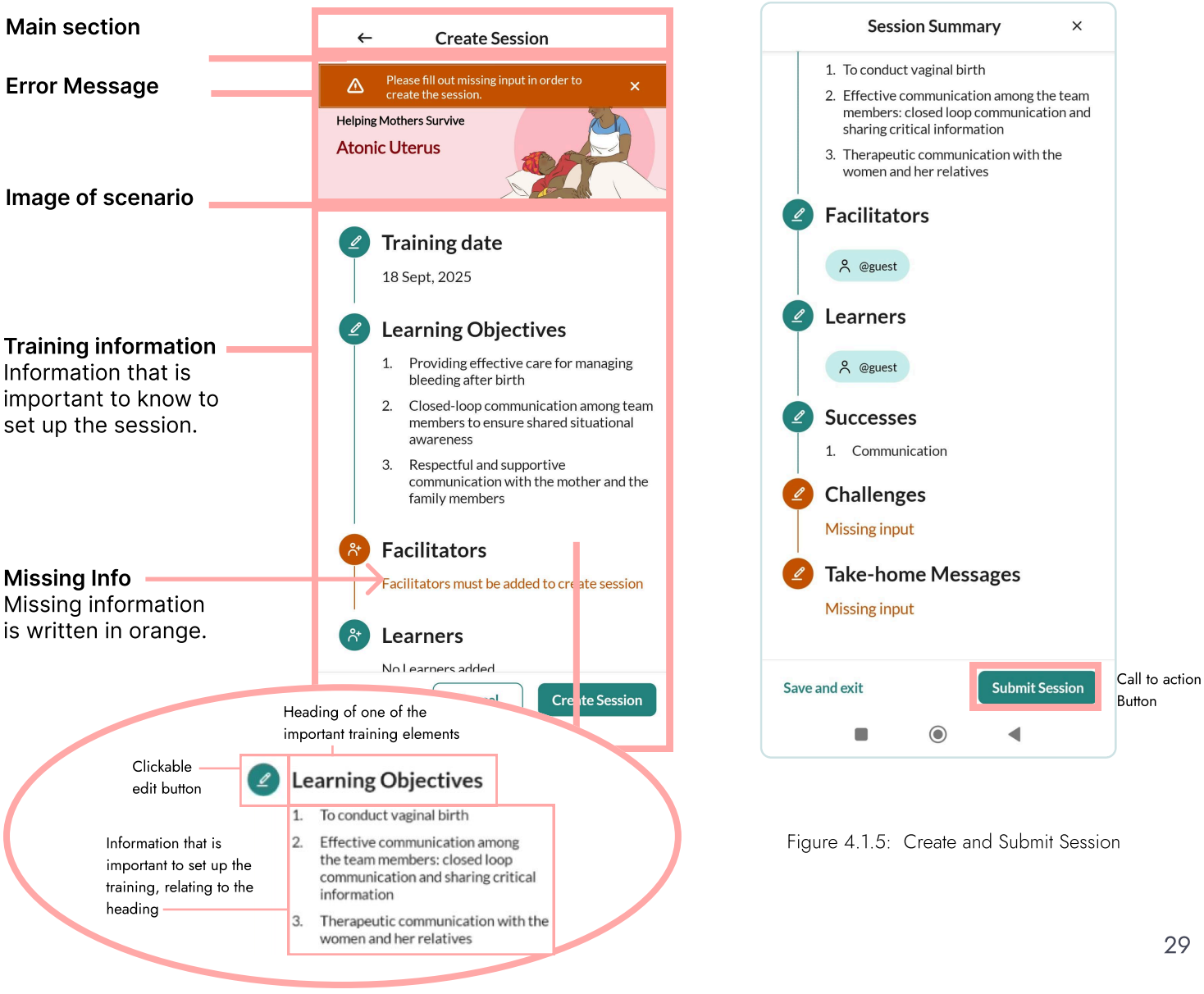


Figure 4.1.5: Create and Submit Session

Simulation pages

The simulation pages are used during the simulation as a checklist for observing the expected participant actions, simultaneously letting practitioners know of any important information such as vital signs.

The simulation pages' structure is unlike the other pages. It has a teal box indicating the time of the expected actions, as well as indicating what the facilitator should say, then expected actions, and vital signs. The expected actions are divided into separate boxes that are intended to be marked based on whether the practitioners have accomplished the task or not.

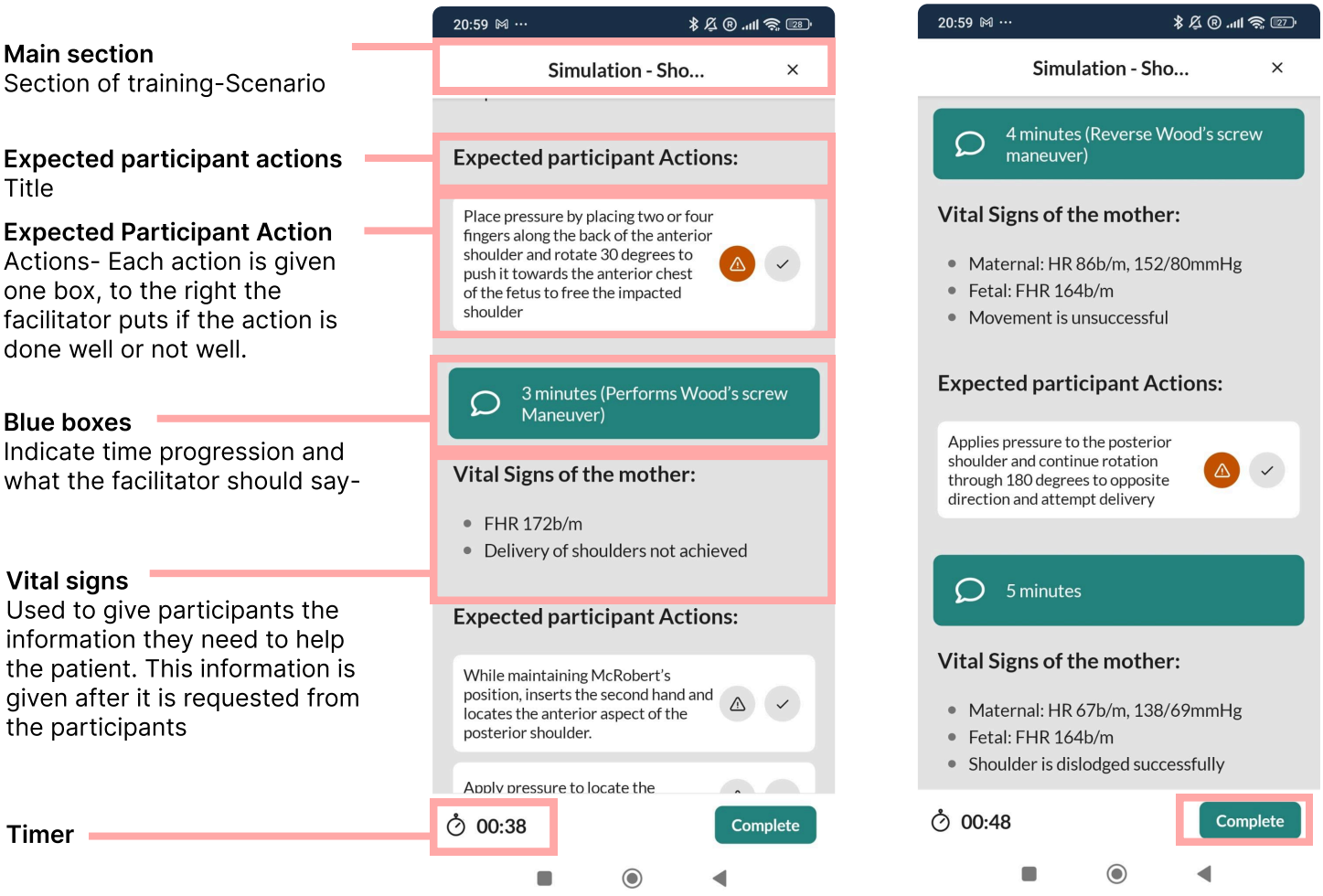


Figure 4.1.6:- Simulation

Creating and submitting a session

The documentation pages aims for users to input the key learnings from the training so that the training can be monitored via the national mentors, while also promoting continuous skill improvement of the practitioners within the facility.

The documentation pages are similar to each other,

The structure of the page allows for concise messages. The user writes down one point, one per box and can delete the line on the side.

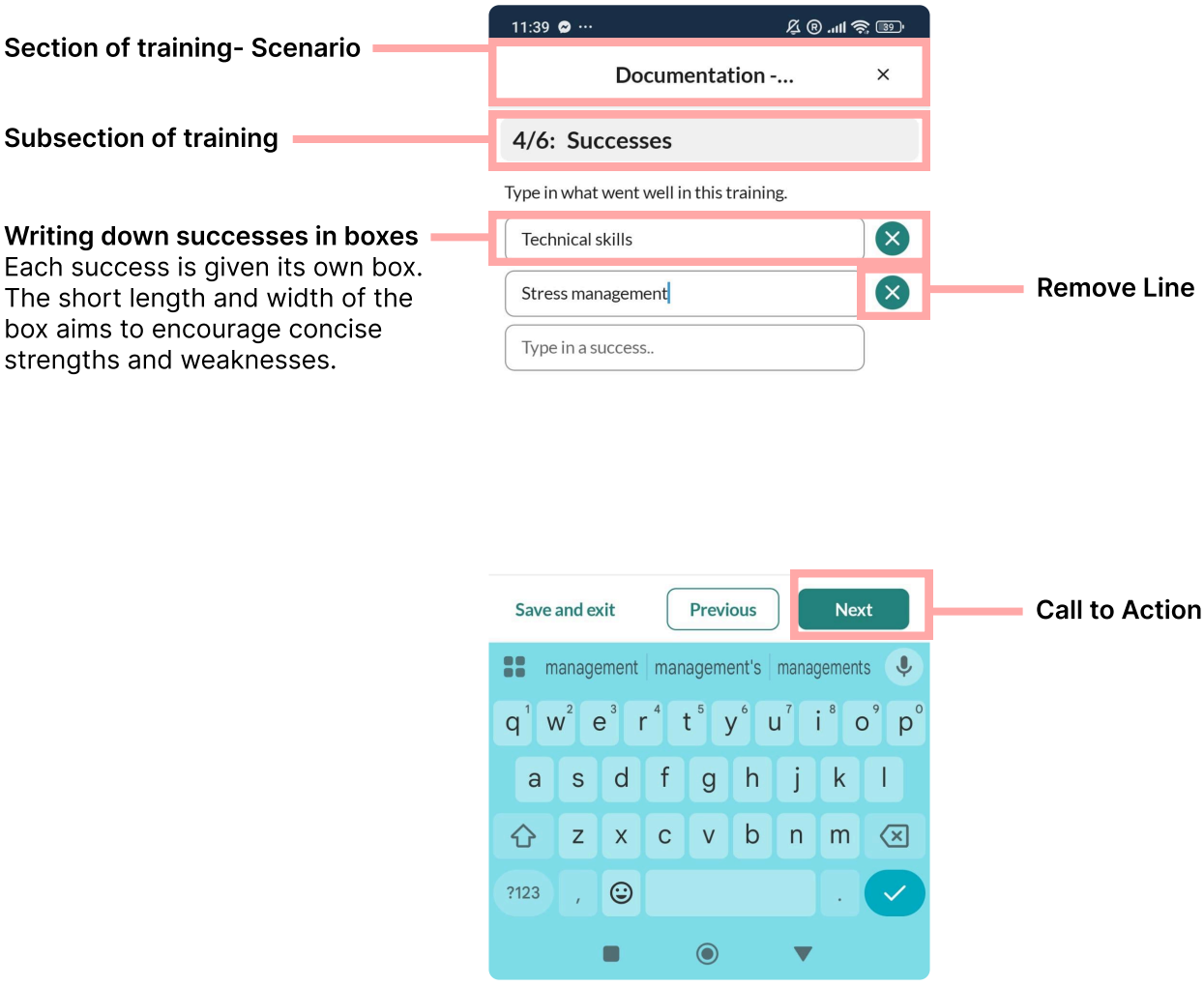


Figure 4.1.7- Documentation pages

Confirmation messages

Confirmation messages are used throughout the application this helps ensure that the users know the result of their actions, aligning with Visibility Of System (UH1).

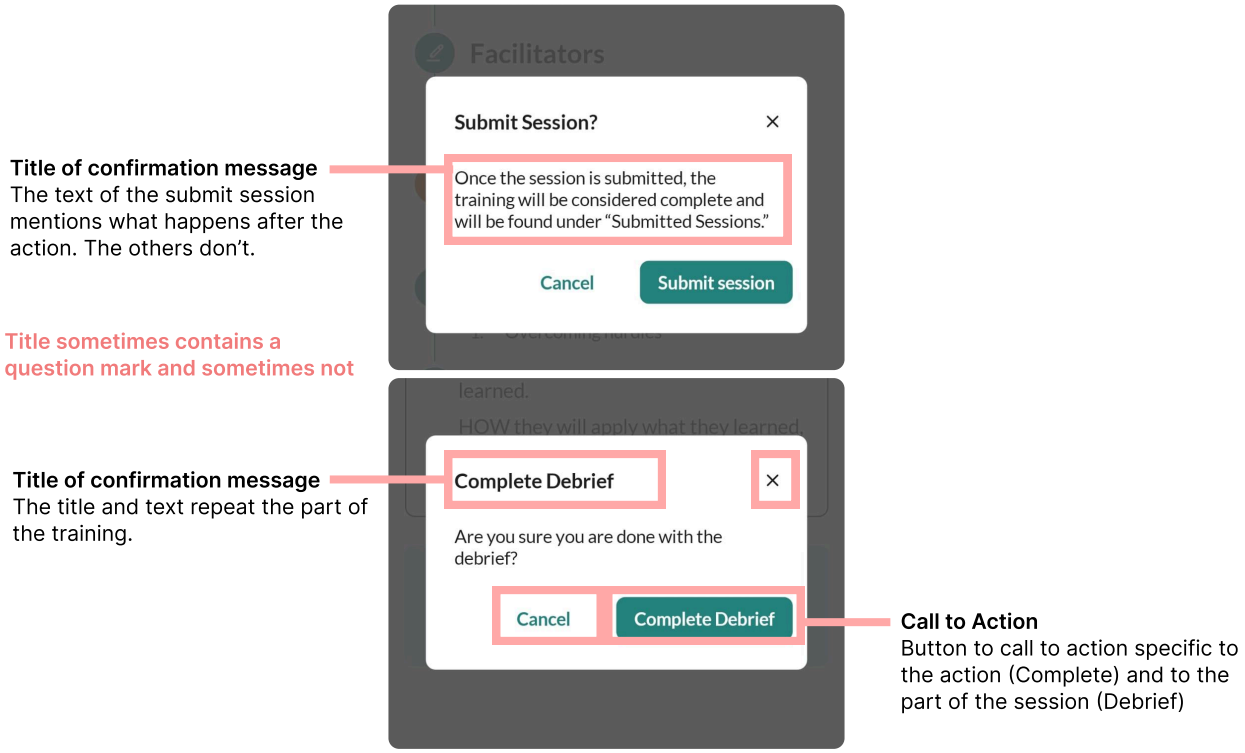
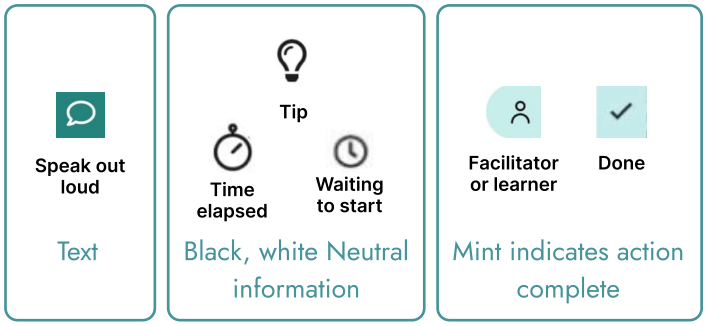


Figure 4.1.8- Confirmation messages

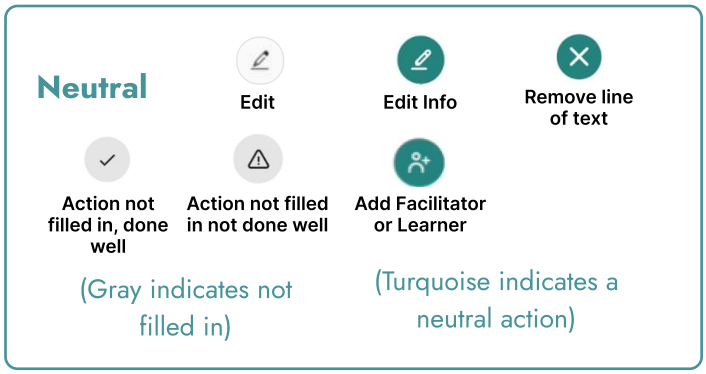
Symbols and Buttons

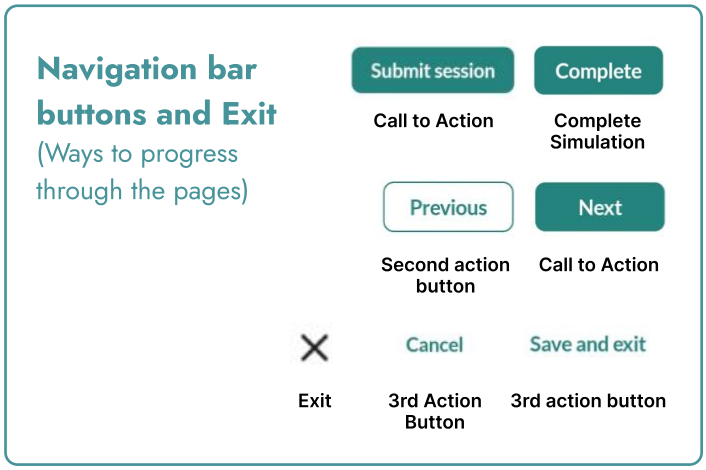
Throughout the UI of LIFT Scenarios, symbols and buttons are used that give information and help the user interact with the platform. The breakdown of the symbols and buttons used serves to understand the system as a whole and how the components and language work in this context. Ensuring that the symbols, colors, and meanings are consistently used throughout the app facilitates the user to know what to do, adding more clarity to the app, reducing extraneous cognitive load.

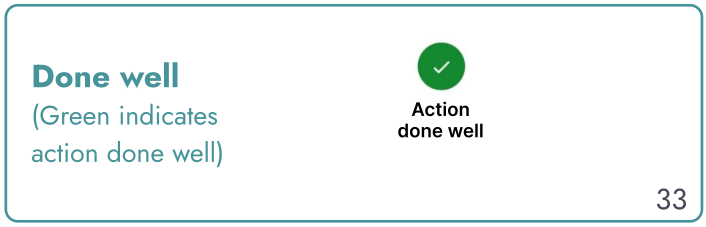
Symbols



Buttons







4.2. Testing - UI - User Involvement

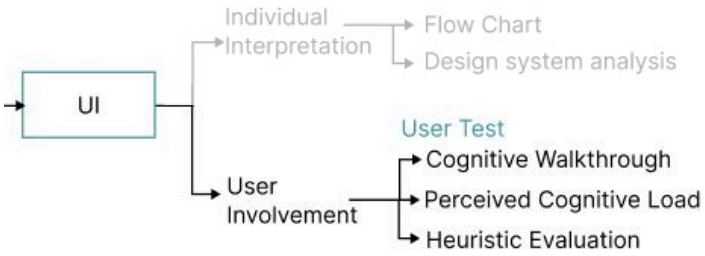


Figure 4.2.1 Overview of activities in Understanding UI

Apart from individual interpretation, user involvement helped to define the problem. Through cognitive walkthrough, perceived cognitive load and a heuristic analysis, the UI problems that required user involvement are defined.

4.2.1 PARTICIPANT RECRUITMENT

Participants were recruited through a message *See Appendix D0*, that was sent on the WhatsApp group of the master students at the faculty of industrial design. They were each given a 5 euro gift card for their participation. In total 5 participants international master and phd students partook in the test.

4.22 TEST STRUCTURE

The test lasted for ~70 min including a 10 minute break.

The test was structured in a way to let one exercise prime for another exercise. *See the full test structure in Appendix D1. See Appendix D2 for the script including interview questions.* Each participant received an informed consent form *See Appendix D3.*

The sessions were audio recorded and the cognitive walkthrough was screen recorded. The Evaluation sheets were scanned and uploaded to a TU Delft one drive, only accessed by the team.

The test consisted of three parts a cognitive walkthrough a perceived cognitive load and a heuristic analysis.

4.2.3 COGNITIVE WALKTHROUGH

AIM:

- To get the participants initial reactions to the app, as well as to help them get deeper understanding of the app so that they can easier do the Heuristic evaluation

METHOD:

- An introduction to the App.
- A cognitive walkthrough of the app where participants were asked to think out loud while going through a scenario.

4.2.4 HEURISTIC ANALYSIS

AIM:

- *To evaluate the UI of the application through the various lenses of the usability heuristics.*

METHOD:

- Participants were given the Nielsen Norman group heuristic Evaluation in a printed form *see example in Appendix D4 (Moran & Gordon, 2024R)* with an explanation.
- The participants were shown an example of the heuristic evaluation on another app, Too good to go, and an explanation.
- Participants were given 40 minutes to fill in the first 8 heuristics, they were informed to fill in the good and the bad. The last 2 were not used due to time limitation and assumption that they were not as relevant for the overall cognitive load, while using the system.

- The participants were asked to explain their findings after the heuristic analysis.

4.2.5 PERCEIVED COGNITIVE LOAD

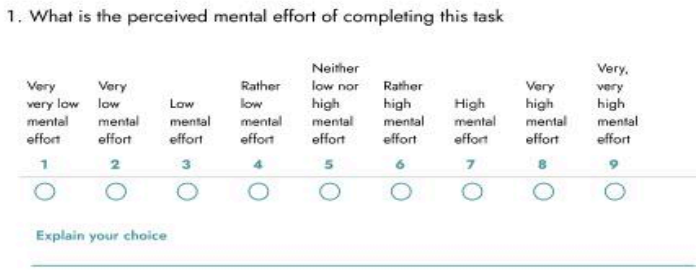


Figure 4.2.2- Percieved cognitive load sample question

AIM:

- To understand the cognitive load of the UI.

METHOD:

- Participants after doing the cognitive walkthrough were asked to fill in a questionaire with perceived mental load and perceived task difficulty.
- The self assessment of cognitive load was based off *(Ouwehand, K et al., 2021)* that uses the Likert scale with a simplified self-rating questionnaire focusing only on two questions perceived task difficulty (indicating perceived intrinsic load) and the mental effort (indicating germane cognitive load). However this study adds an explain your choice to aid in Interview questions.

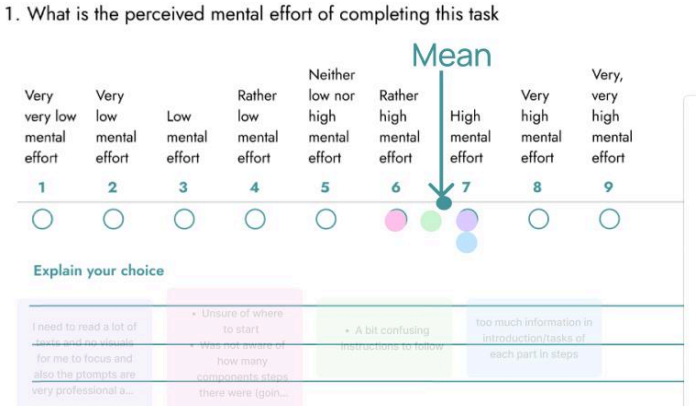


Figure 4.2.3- Percieved cognitive load- Mental effort- Results

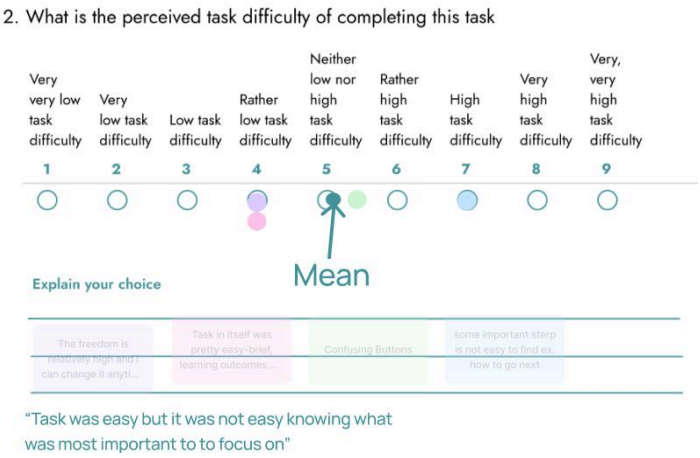


Figure 4.2.4- Percieved cognitive load- Task difficulty- Results

Median mental effort is 6.75 mean is 6.625 this means that on average users found the task to have high mental effort mainly due to the amount of information and lack of clarity as to what is important to focus on.

Median task difficulty is 4.6 mean is 5 this means that on average people saw the task as neither high nor low difficulty level. They found it easy to complete the steps however the organisation led it to be more difficult, specifically regarding the buttons and next button.

The Mental load is perceived to be higher than the task difficulty.

4.2.6 FINDINGS

METHOD:

- The information was put in the page by page cognitive walkthrough *see example in appendix D5*. the insights were gathered with the heuristic analysis insights and clustered into themes. *see example in appendix D6*

Since the mental load is perceived to be higher than the task difficulty this could indicate that the intrinsic load is not as high as the extraneous load. Although Ouwehand interprets mental effort as indicating germane cognitive load, the interpretation of the cause of the mental effort is the extraneous cognitive load.

The analysis resulted in three main themes.

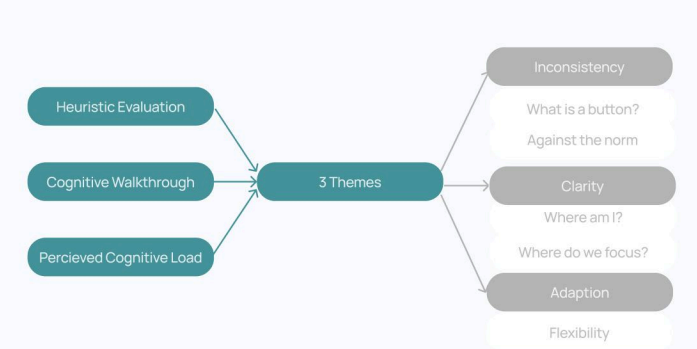


Figure 4.2.5- Main themes discovered from analysis

The main themes as shown in the figure above is inconsistency, clarity and adaptation. The following section will walk through these themes

Inconsistency:

The theme Inconsistency contains two subthemes, what is a button and against the norm.

What is a button as shown in figure 4.2.6, is created based on the frequent occurrence that participants had a hard time knowing which elements were clickable or not.

The mismatch between the user's knowledge and the UI elements created frustration in the participants since they did not understand the expected actions to take, and their actions did not receive the response they imagined.

Figure 4.2.6 shows some of the buttons or areas expected to be buttons.

One major frustration was adding facilitators, where all participants did not realize that the round teal circle was, in fact, a button.

In the simulation pages, the participants assumed that the boxes with rounded corners were clickable. Figure 4.2.7 shows the brief pages where the participants assumed the rounded boxes and some of the headings were clickable. Additionally, some of the icons were clickable, whereas others were not, creating more confusion.

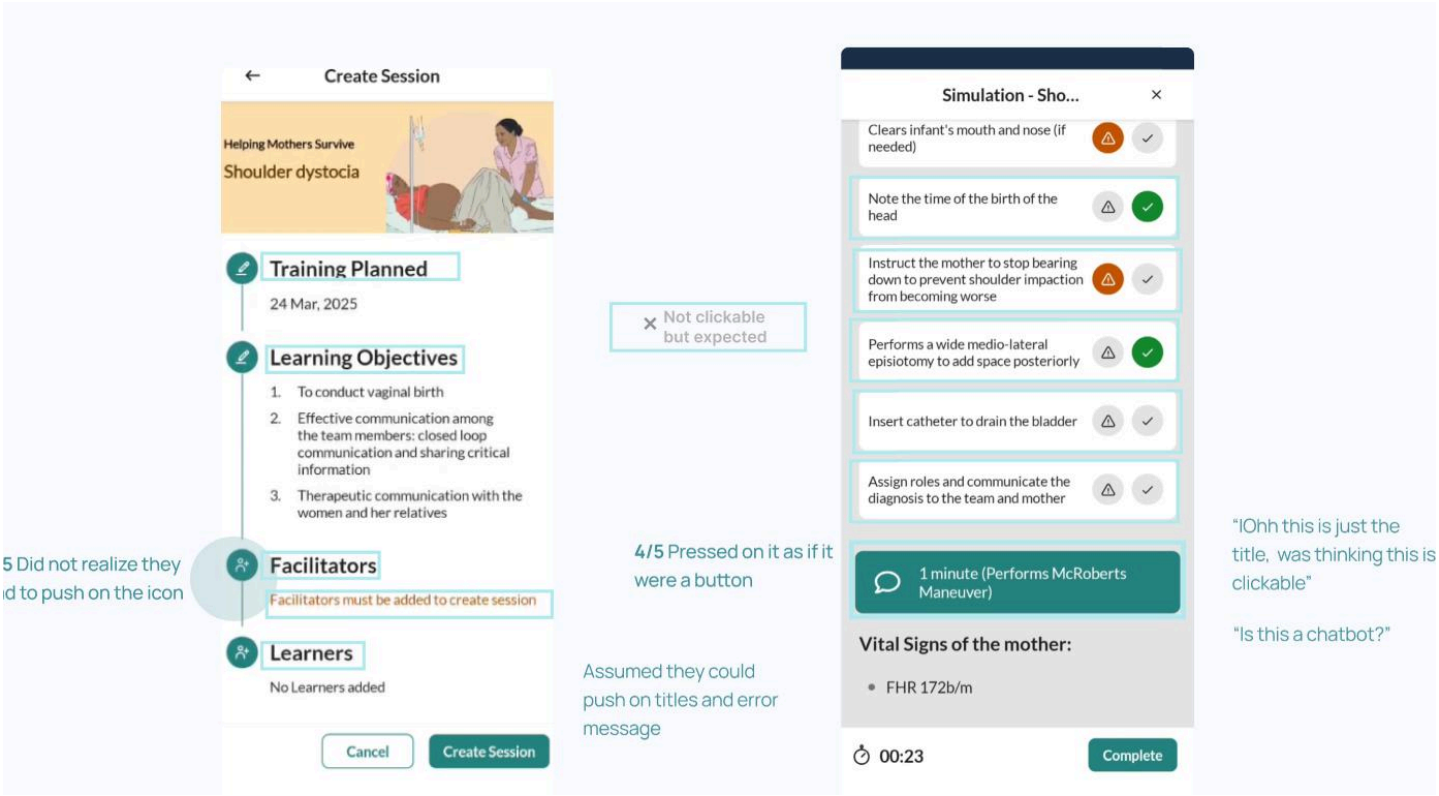


Figure 4.2.6- Theme 1 what is a button?

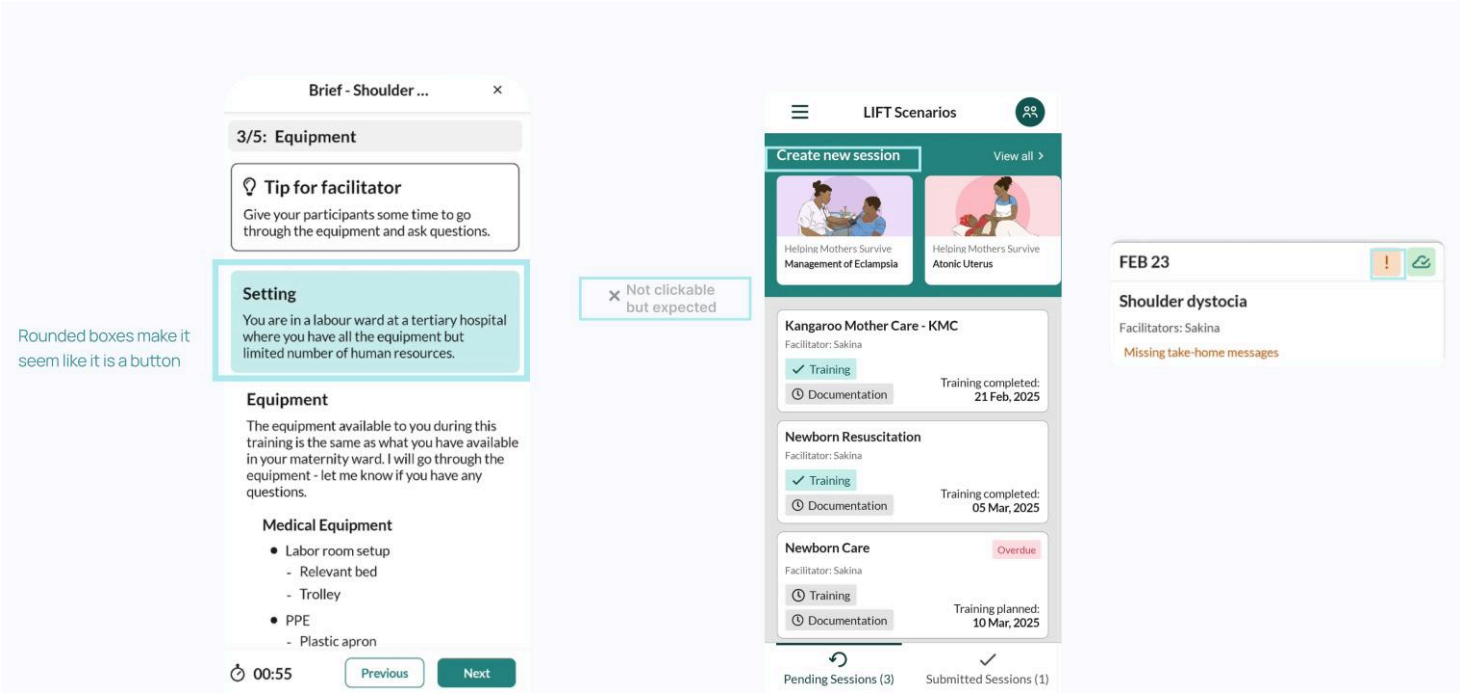


Figure 4.2.7- Theme 1- What is a button?

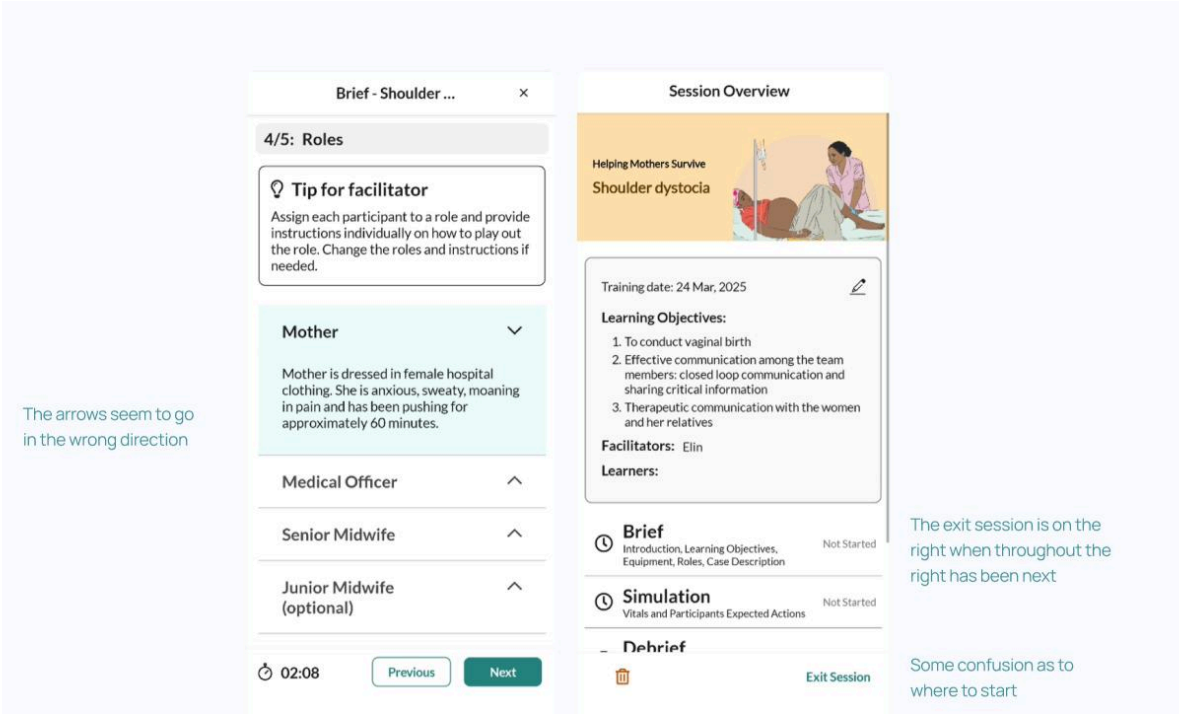


Figure 4.2.8- Theme 1- Against the norm

The second subcategory of inconsistency is against the norm. This category focuses on the mismatch between the internal and external standards, focusing on usability heuristic 4. This is evident in the roles where the arrow for opening the information about the roles points in the wrong direction, as well as the exit session in the session overview, at the exact location as the next on the other pages, therefore it seems like the logical next step. This mismatch causes some confusion for the user and makes them feel less confident when using the LIFT Scenarios.

The documentation with its uncommon format is confusing for some users. Additionally, the Learning objective text size does not match the rest of the App.

CLARITY:

The second theme that emerged was clarity, with the subthemes, Where am I? and Where should I focus?

The Where am I subtheme focuses mainly on usability heuristic 1, understanding where they are in the platform.

"I thought next would go to simulation not another part of the brief" - Quote from Participant.

The timeline is not enough of an indication as to where they are in the platform and what they can expect next.

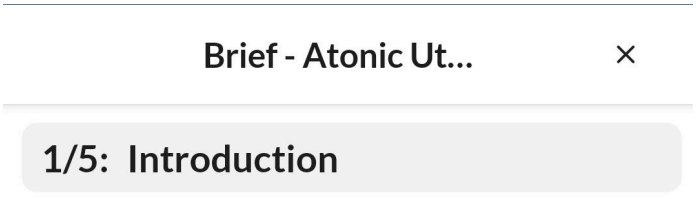


Figure 4.2.9- Timeline original

"Layers of layers of tasks I need to remember what step I am in now"- Quote from Participant The layers of the pages make it difficult to navigate easily for the participants, giving the feeling that they need to remember what part of the training they are in, causing extra effort on the working memory resources.

Where should I focus:

Where should I focus deals mainly with the visual hierarchy of the platform usability heuristic 8 of Aesthetic and minimalism.

In Figure 4.2.10, the visual layout does not have what participants consider to be a focal point; they see the light teal box and the tip for the facilitator to be competing for attention.

Additionally, the information in the blue box is similar to that in the tip for facilitator, causing redundancy in text, one of the cognitive load effects that increases cognitive load.

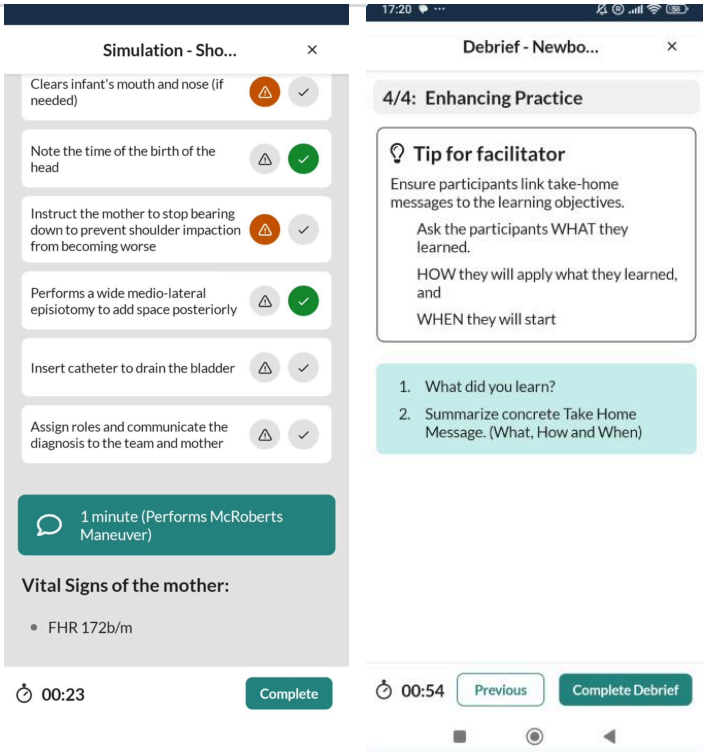


Figure 4.2.10- Green buttons

In the simulation page, see figure 4.2.10, the participants say, **"I am more attracted to the green buttons than the simulation."**

Overall, there is a mismatch between what is important to focus on and what the focal point of the LIFT Scenarios is.

ADAPTABILITY:

Lastly, adaptability is the third theme that emerged from the analysis, with the subtheme of flexibility in use.

Flexibility in use

addresses the areas of the application that may become repetitive over time, as well as parts that could be adjusted to fit various user behaviours.

This part focuses more on the potential adjustments and future proposals rather than critiquing the current app.

These include: an option to pause the session, pre-filled answers for documentation, a way to add more visuals, and an easy way to add and remove learners.

4.3. Testing - Behavior

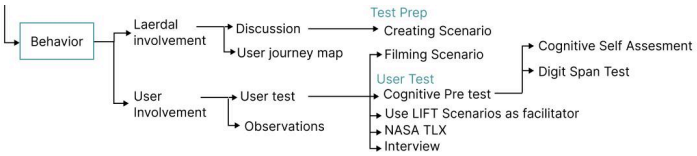


Figure 4.3.1- Understanding behaviour overview of activities

To better understand the current use of LIFT Scenarios, a user test was conducted using a restaurant scenario. This approach aimed to engage non-medical professionals, which represents a more accessible target group. Additionally, observations were made at a simulation centre to gather further insights about how LIFT scenarios is used in practice, as well as how simulation trainings are structured.

Discussions with Laerdal Global Health contributed to the development of a user journey map and the creation of an ideal scenario for user testing.

4.3.1 LAERDAL INVOLVEMENT

Laerdal helped in creating a user journey map as well as discussing potential options when creating a scenario to test with non-healthcare workers.

USER JOURNEY:

The user journey aimed to understand the experience of facilitators throughout the training stages, focusing on both novice and experienced facilitators. It was developed from insights gathered during user tests and discussions with Laerdal Global Health staff, who contributed to the section on routine facilitators. The aspects examined included mood, task difficulty, the use of LIFT scenarios, and time per task. See figure 4.3.2

Key insights from the user journey map include:

1. Simulation is the most challenging task: The primary difficulty lies in the simulation, as there is a lot for facilitators to observe. Since the format is a checklist, participants feel compelled to address every item, leading to an overwhelming amount of observation required. This phenomenon aligns with existing research on the challenges of observational tasks in simulation settings.

2. Debrief quality varies with experience: Debriefing is perceived as the most enjoyable aspect for experienced facilitators because it allows for meaningful discussion about the procedures and methods used. In contrast, new facilitators may find it challenging to guide the conversation during debriefs, which can be overwhelming.

3. Documentation is burdensome: Participants view documentation as a cumbersome task. Typically, routine facilitators fill it out collaboratively with some practitioners, while new facilitators usually complete it independently. In both cases, the depth of the debrief is not adequately captured in the documentation.

Creating the user journey provided a deeper understanding of the users and highlighted the distinction between novice and experienced facilitators. This understanding allows for a comparison of the cognitive load that can be is improved through more experience versus that which arises from the inherent difficulties of the task.

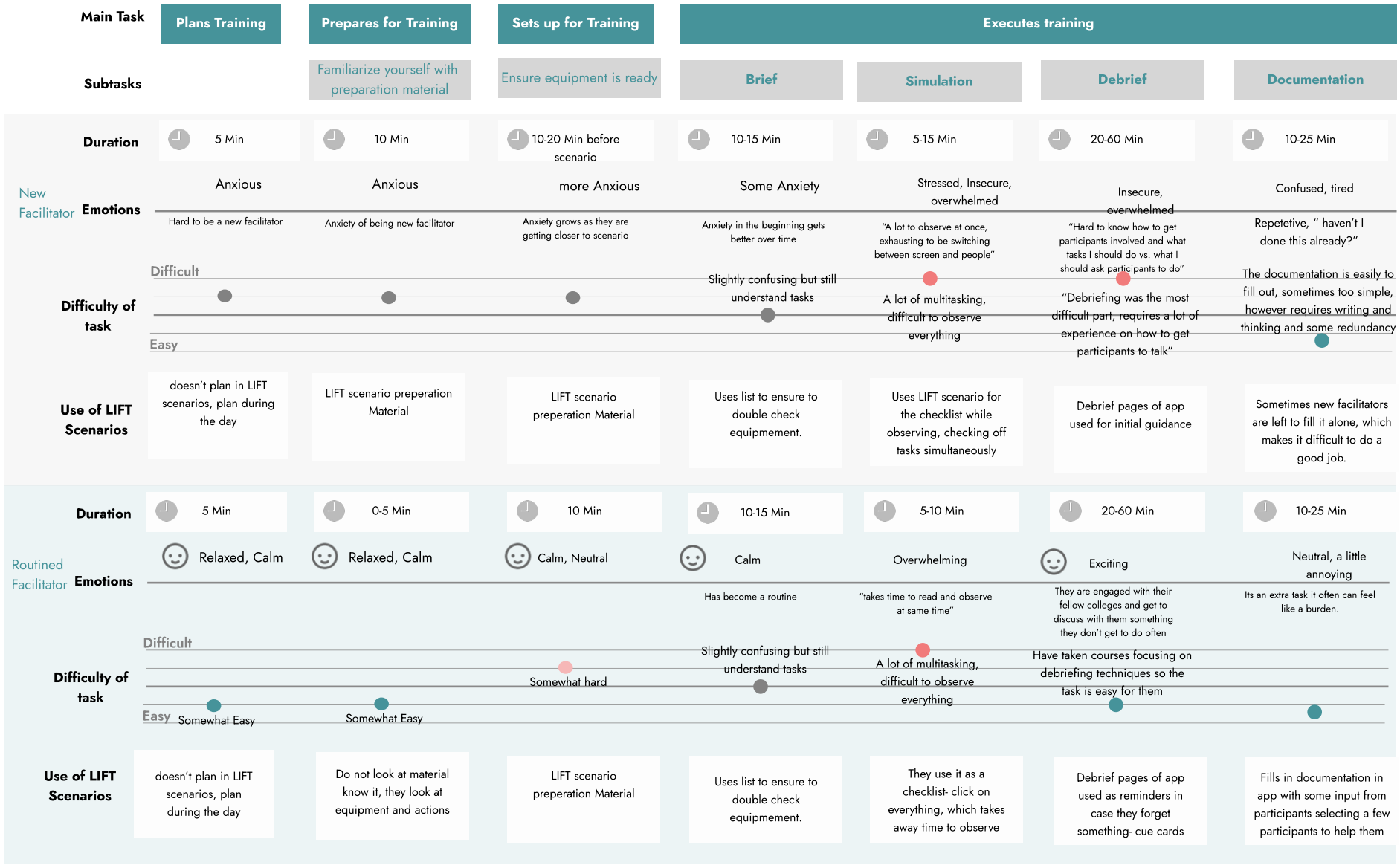


Figure 4.3.2- User Journey, Routined vs. New Facilitator

4.3.2 PREPARING FOR USER TEST

CREATING A SCENARIO:

To test with non-medical professionals, the scenarios had to be adjusted since they contain much medical jargon; the intrinsic load of understanding the task would be too high to represent the actual cognitive load accurately. The scenario must include group work, some decision-making, some inherent risk, communication, and guest management. Various scenarios were discussed; however, it was through discussion and conversation with Laerdal that we decided to have a scenario of a restaurant managing a gluten-free order.

This scenario involves risk management, teamwork in preparing a burger with various staff roles, and managing the guest.

While creating the scenario, some parts were complex:

1. Creating a scenario that is complex enough to be a fair comparison but easy enough for anyone to understand.
2. Creating realistic, achievable participant actions
3. Knowledge required to create a realistic scenario, knowledge of procedure, and what the actions should be and in what order.
4. Creating expected participant actions limits things to one way of doing things. Which, maybe, there is?

The participant's actions varied in observability. Some were very basic, whereas others required interpretation. An attempt at including this variability was made when creating the gluten-free scenario.

The scenario details were filled out in a form and sent to Laerdal Global Health to input into the LIFT Scenario developer version.

Figure 4.3.3- Handling a gluten free order- Scenario

FILMING THE SCENARIO:

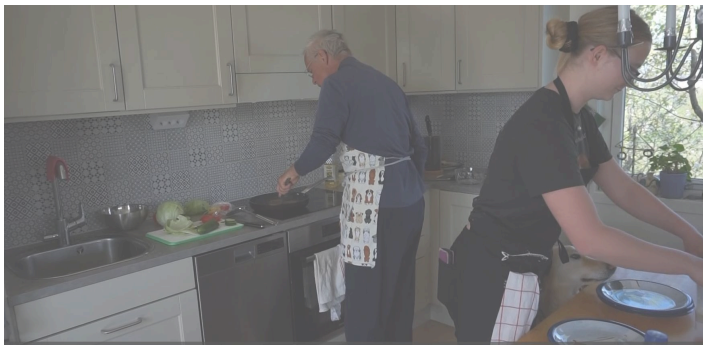


Figure 4.3.4- Screenshot of filmed Scenario

The created scenario was filmed for multiple reasons.

1. To ensure that the viewed scenario was consistent across all tests.
2. The focus during testing should be on the facilitator; therefore, filming the scenario allows the participant to act as a facilitator and observe the scenario without requiring a whole team for each test.
3. Ability to test with less participants

The actors performed their designated roles as outlined in the scenario. This arrangement required the filmmaker and director to take on the role of

facilitators, guiding the actors throughout the scenario and observing their performances. The scenario was filmed three times; one video was selected as the best and used during testing. Filming the scenario required becoming the facilitator for some time.

The video was filmed in a residential home kitchen, therefore does not replicate the restaurant environment, and was filmed with amateurs who have little to no restaurant experience, therefore make many mistakes.

Insights:

Initially, participants did not take the training seriously.

- Participants got shy acting as a staff member in a restaurant; therefore, they were not able to perform realistically; this effect disappeared after a few times.
- Participants were easily able to criticize others' behaviours; however, not their own.
- The three learning objectives helped structure the training leading to the participants actively reflecting on them.

4.3.3 USER TEST

PARTICIPANTS

In total 5 participants completed the test, including one pilot test. The participants were master students invited via WhatsApp.

STRUCTURE OF THE TEST:

The structure of the test *(see Appendix E1)* consisted of

Introduction and Consent *(see Appendix E2)*

- Initial cognitive readiness assessment & Digit span test *(see Appendix E3)*
- Brief
- Simulation with Video
- TLX assessment
- Debrief
- Documentation
- Initial reactions and Questions

The test took 1 hour to complete, including a 5-10-minute break.

The precognitive assessment aims to see the working memory capacity and attention resources to have a baseline, so that participants scores can be analysed and compared to each other.

The assessment consists of factors impacting attention. These include resources such as sleep, caffeine, and attention disorders *(Sharma et al., 2022; Massar et al., 2018)* and a manual digit span test, a way to test current working memory capacity *(Cambridge Cognition, 2023)*. After the initial test, the participants use LIFT Scenarios to guide the practitioner (the researcher) through the training. The participants have not received any training in simulation methodology or facilitation. In this way, we can see how well LIFT scenarios guide them.

During the observation section, the participants observe the video of the scenario while filling in the checklist. Participants then fill in a TLX form aimed at addressing the difficulty in observing the scenario and clicking the actions.

The participants continue to the debrief and documentation.

After going through the LIFT Scenarios, Interview questions are asked . The interview questions are based on parts of the usability test and the NASA- TLX form, asking them to expand on it, as well as observations made throughout their use of the app, such as taking notes, etc.

ANALYSIS:

The analysis was conducted based on the various sections of the app, as detailed in Appendix E4. It included a comparison of the NASA TLX form with both self-assessments and digit tests.

Insights from this analysis, along with discussions with the Laerdal design team and the user group, helped outline the user journey.

Participants found that the most challenging aspects were the Simulation and the debrief. While the debrief itself was not deemed difficult, it was challenging for participants to perform well without prior training.

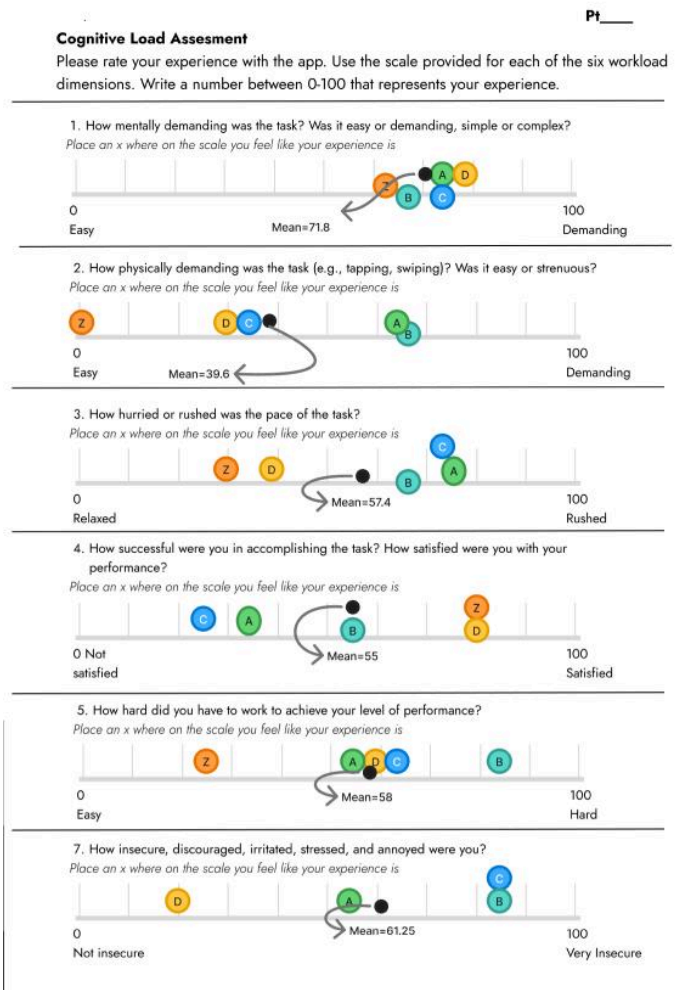


Figure 4.3.5- Cognitive Load Assessment Participant scores mapped

RESULTS OF THE NASA TLX FORM:

It included a comparison of the NASA TLX form with both self-assessments and digit tests.

The cognitive load assessment indicated that the majority found the task quite mentally demanding with a mean score of 71.8 / 100.

Additionally ´the task was considered physically demanding, because of the multiple things to focus on at a time. However it was not considered actually physically demanding because of the physical interactions with the app with a mean score of 39.6/100.

There was a wide variety in satisfaction of performance with a mean of 55.5/100. The participants who felt that the task was less rushed (Z-30/100)&D-40/100) also felt that they were more satisfied with their performance compared to others (Z&D- 80/100).

The majority (3/5) participants put that they had to work above average hard with the mean at 58, a little above average (50)

For the level of insecurity, the mean was a bit above average (61.25/100) indicating a high overall level of insecurity over their performance, which is to be expected from new facilitators.

INSIGHTS FROM SIMULATION:

- People interpret the simulation list differently, some are hesitant to put the warning sign because they feel it means exceptionally bad.
- Others feel like maybe they just didn't observe the behaviour, then they are unsure what to put.
- Other times they feel like there should be an in-between like the action is done but at an incorrect time.

BRIEF:

During the brief, participants knew what to do but were unsure of where they were in the platform. For example some were shocked that the brief consists of multiple pages.

4.34 OBSERVATIONS

Observations focused on addressing:

- Cognitive load of LIFT Scenarios
- Structure of testing
- Understanding the context of simulation training
- Observation of the training structure of other simulations, test and the overall training system.

OBSERVING COGNITIVE LOAD:

To prepare for observation research into how to spot cognitive load was done, this included findings, by Darejeh et al., 2024, such as:

- Facial expressions
- Longer pauses
- Use of complex languages
- Fixation on task

OBSERVATION SET UP:

Observations were conducted over the span of two days in a simulation facility in Norway. The simulations consisted of

- Three simulations using LIFT Scenarios
- Five skill workshop
- Two theory workshop
- Three simulations without LIFT Scenarios

After the observation, the facilitators were asked a few questions. The facilitators were also quite curious and liked providing feedback on the app.

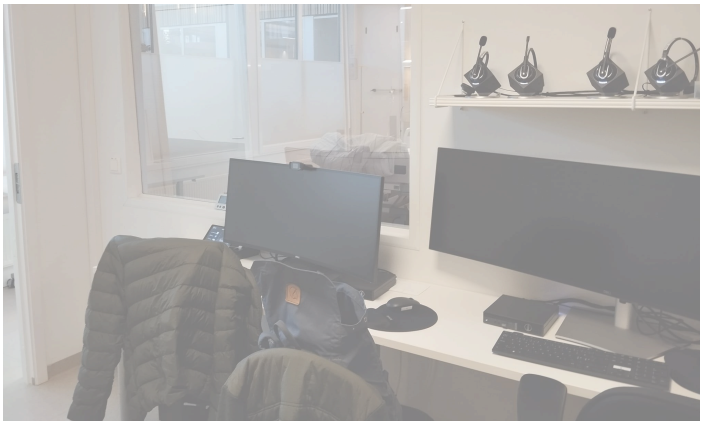


Figure 4.3.6- Observation Set Up

PRACTITIONERS AND SCENARIOS:

The simulations observed focused on emergency care practitioners. Therefore, the scenarios focused on emergency situations not neonatal situations that LIFT Scenarios focuses on.

The practitioners were consistent over the 2 days of simulations and workshops. The practitioners were skilled health care professionals who were doing their training as part of a mandatory skills update. However all of them are comfortable in emergency situations and have years of experience.

The scenarios and practitioners spoke in Norwegian , somewhat similar to Swedish (researchers native language). Due to the language differences some of the information was lost in translation.

Figure 4.3.7- Tools Used

FINDINGS:

While observing, a variety of things were noted, including the training structure, the behaviour of the facilitator, and the use of LIFT scenarios.

Training structure:

The simulation centre mixed skill workshops with theory and simulation. One skill workshop would build upon another and be addressed in the theory workshop as well.

Behaviour of the facilitator:

The most engaging facilitators told stories around the topic, following up with the procedure. When they commented on someone's behaviour, they would give an example of something bad that had happened, then what they should have done (the procedure). In this way, the practitioner is not as targeted. There was a lot of material the facilitators had to manage, the devices to control the vitals, and the checklist. The Sick patient was another facilitator familiar with the role, therefore all practitioners could focus on what they already knew.

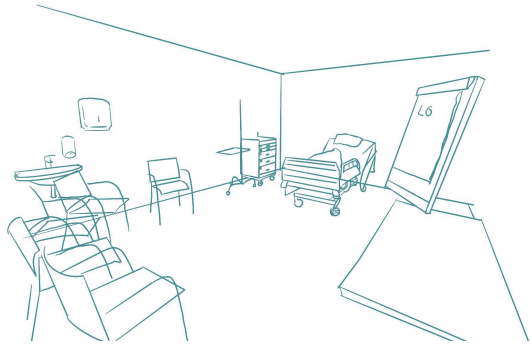


Figure 4.3.8- Simulation Room

The Simulation Rooms consist;

- Chairs to have brief and debrief
- Equipment for scenario bed, chest with supplies
- Flipchart to write down the Learning Objectives

LIFT Scenario:

The findings from the observations when facilitators were using LIFT scenario discuss the simulation checklist, the documentation and the tasks of the facilitator.

The simulation checklist was not considered overwhelming for any of the facilitators or users of it. They had neutral face expressions, spoke in a normal rythym, did not take any longer pauses. They were fixated on the task but apart from that had no signs of any of the observational ways to measure high cognitive load. Additionally when discussing afterwards they mentioned it was easy. However at times, it seemed physically difficult to manage the tablet and the material to control the equipment.

Furthermore, the documentation was not done. This may have been because the training seemed complete after the debrief was done.

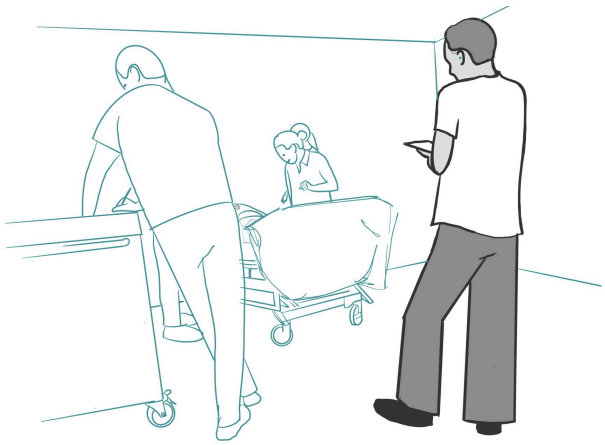


Figure 4.3.9- Facilitator 2 using LIFT Scenarios to observe

Facilitator two observed more closely and spent a lot of time reading the expected participant actions.

The facilitator is in charge of the material during the simulation, changing the vitals etc. which added to the intrinsic cognitive load. *For a complete findings of observations of LIFT scenarios see Appendix F*

Figure 4.3.10- Facilitator using LIFT Scenarios to observe

Facilitator one, spent time scanning the list and was a bit preoccupied with the equipment.

Figure 4.3.11- Facilitator 3

Facilitator three, gave the checklist to an observing participant, The observer found it easy to use.

One facilitator mentioned they would like to have some additional features:

1. Assign that an action is done but at the wrong time
2. A way for the simulation to progress or change based off the actions of the practitioners. Example if they don't do the right action the vitals become worse and they have to do different actions.

ANALYSIS:

Why was the simulation easy for the observed facilitators?

The simulation checklist was quite easy for the facilitators observed in the simulation centre compared to the user test and the user journey information. This phenomenon is likely because of a variety of reasons;

1. The expected participant actions are in their clinical language
2. The expected participant actions follow a procedure and an ABCDE structure therefore clearly have a specific order.
3. The observed facilitators are good at self-management of cognitive load; they utilize a lot of lists and checklists containing a lot of information, thereby improving their ability to manage the cognitive load.
4. Often, the practitioners would speak out loud; therefore, the facilitator could listen and check off some items. The different processors used to interpret the input increases the working memory capacity (The modality effect).
5. They were familiar with the expected actions.

4.4. What is the problem?

Problems

Cognitive load factors

What is the problem section focuses on issues when using LIFT Scenarios through a UI, behavioural, and systemic lens. The chapter then addresses the factors that affect the experienced cognitive load.

The problems were identified through analysis of the user tests, observations, interviews, and conversations with Laerdal Global Health. The main categories found are problems caused by UI, Behavioural, and Systemic problems. The identification of the main problems acts as a starting point for further analysis of those to get to the main problem.

4.4.1 UI PROBLEMS

The UI issues are a compilation of the identified problems from the Heuristic analysis, the flow chart, Cognitive walkthrough and the design system analysis.

The UI has the following issues that can lead to higher cognitive load.

- Redundancy in text
- Visual inconsistency
- Clarity
- Flexibility in use
- Order of the steps
- Ability to submit any session without filling in anything.

4.4.2 BEHAVIOUR PROBLEMS

Through understanding the UI problems, we can address how these may lead to behavioural problems. The behavioural problems that may increase cognitive load comes from insights from the user journey map, the observations and the user test.

The behavioural problems that can lead to higher cognitive load are the following.

- It is difficult to know which tasks are most important to focus on.
- The participant actions are sometimes not good or bad but in between.
- Facilitators use the buttons (good/warning) differently
- There is a lack of guidance in documentation
- The learning Objectives are not always related back to when creating the take home messages
- The documentation burden is high
- The facilitator knowledge and experience affect the session more than a memory aid.
- There is an expectation to tick all boxes in the simulation checklist.

4.4.3 SYSTEMIC PROBLEMS

Once we understand the behavioral and UI problems we can zoom out and address the structural and systemic problems. These problems affect the system as a whole including the facilitators experience.

The systemic problems were derived mainly from conversations with Laerdal. The following problems were noticed.

- Prioritising Quantity > Quality
- How to measure Quality?
- Not the same people are doing simulation training; it is hard to work on skill improvement as a group because the group members switch.
- How to improve quality holistically
- How to Ensure Take-Home Messages Are Applied.

4.4.4 FACTORS INFLUENCING COGNITIVE LOAD

Getting a holistic perspective of the factors that influence cognitive load, a fishtail diagram was made. This diagram was developed based on insights from cognitive load research, interpretation of user tests, and discussion with Laerdal.

The fishtail diagram emphasizes the parts and subparts that affect cognitive load, encompassing everything from the facilitator's current state to the training environment. This provides an overview of the factors affecting cognitive load and how we can begin to address one of its branches; Noticing, however, that we are unable to adjust everything that contributes to cognitive load.

This diagram does not distinguish the different types of cognitive load but includes aspects of each.

GERMANE COGNITIVE LOAD:

Factors that have an impact on germane cognitive load are current state, experience, and environment. Germane cognitive load is working memory capacity. The current state, emotional, stress, etc. Influences the cognitive capacity. When someone is stressed, they have less working memory capacity, therefore affecting germane cognitive load.

Experience affects germane cognitive load in many ways. Age influences cognitive resources available. As well as experience helps recognition and

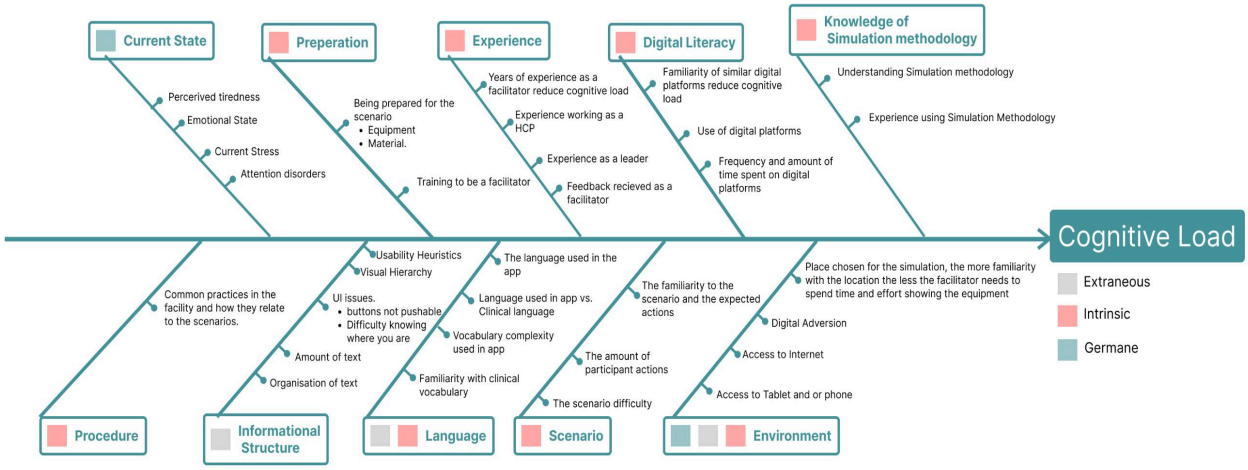


Figure 4.4.1 Fishtail diagram of factors influencing cognitive load the facilitator experiences when using LIFT Scenarios

creating chunks, therefore requiring less germane cognitive load. The environment influences germane load through the amount of stimuli; the more stimuli, the more likely to have distractions, therefore decreasing the amount of available cognitive resources while making it difficult to stay attentive.

INTRINSIC COGNITIVE LOAD:

Factors that impact intrinsic cognitive load include preparation, experience, digital literacy, language, scenario, and environment.

The intrinsic cognitive factors deal with the difficulty of the task, and the competence of the facilitator. These categories go hand in hand. A more skilled facilitator will experience less intrinsic load on the same task than a novice facilitator.

Preparing the material beforehand increases recognition, which aids in scanning the material and completing the task. Consequently, it reduces intrinsic cognitive load.

Experience has a similar effect; the more experience on the topic, the less cognitive load because of recognition.

Digital literacy affects the comfort and the difficulty of the task of using a digital platform such as LIFT scenarios. Low digital literacy may result in high intrinsic cognitive load, which may lead to rejection of the platform.

The language used affects task difficulty if the clinical language is different than the language used on the platform. The phrases and procedures may differ; therefore, the expected participant actions as well as instructions require more interpretation, requiring more cognitive resources, since they have to go through the training and simultaneously translate all the material.

The familiarity of the scenario impacts the task difficulty. A more familiar scenario is easier to recall since it has been experienced recently. This helps predict the expected participant actions.

The environment affects the task difficulty. A familiar environment makes it easier to organise material and for the facilitator to feel comfortable. Making it easier to express themselves.

EXTRANEOUS COGNITIVE LOAD:

Factors that affect the extraneous cognitive load are the environment, the language, and the informational structure. Extraneous cognitive load is how information is being presented. The environment impacts how information is presented. A lot of similarly shown information in the environment makes it easier to process the information in LIFT Scenarios.

INSIGHTS:

The majority of the factors affecting load are intrinsic cognitive load.

4.5. Analysing the Problems

Root Cause Analysis | Personas | Storyboard

Analysing the found problems helps gain a deeper understanding of the issues, making it easier to redesign the product by addressing the underlying problems. Root cause analysis, Personas, and a storyboard with the ideal situation are used to analyse the problems.

4.5.1 ROOT CAUSE ANALYSIS

Root cause analysis aided in gaining insight into certain behavioural issues, and help identify the underlying problems. This involved repeatedly asking "why" to delve deeper into the issues. Likewise, during the debrief, it is essential to pinpoint the root belief that led to the problem, rather than merely focusing on the incorrect action taken. The results of the root cause analysis helped define the main problems.

The root causes were based off of assumptions and conversations with Laerdal Global Health team. They acted as a way to visualize conversations.

One of the behavioural problems was addressed in the root cause analysis "The expectation to tick all boxes in the simulation" see figure 4.5.1. After analysing the problem through a Root Cause Analysis the underlying causes of the expectation to tick all the boxes is assumed to be;

1. The actions do not exist in a vacuum, one action impacts the other. Therefore one action has to be completed before another
2. Lack of training
3. Inherent task difficulty
4. Limited time for prioritisation so a reduction in cognitive load
5. Familiarity and way of using a checklist

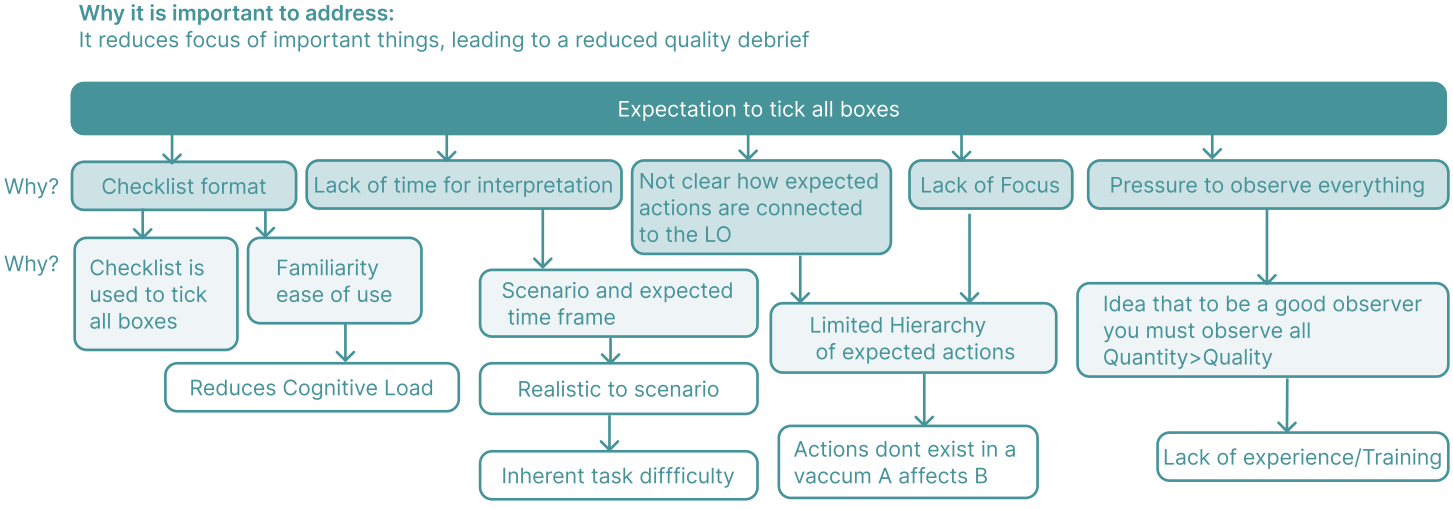


Figure 4.5.1 Root Cause Analysis- Expectation to tick all the boxes

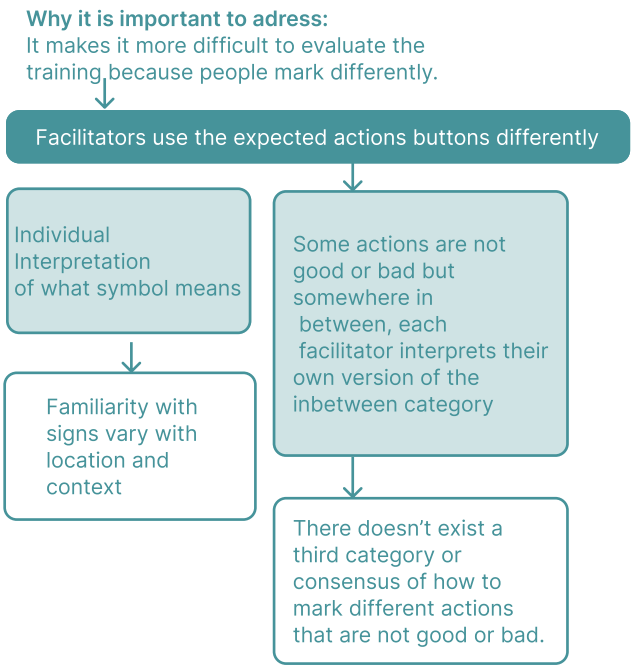


Figure 4.5.2 Root Cause Analysis- Facilitators use the buttons differently

The different use of expected actions buttons due to;

1. Familiarity with signs and icons vary from person to person.
2. No third category for in between good or bad.

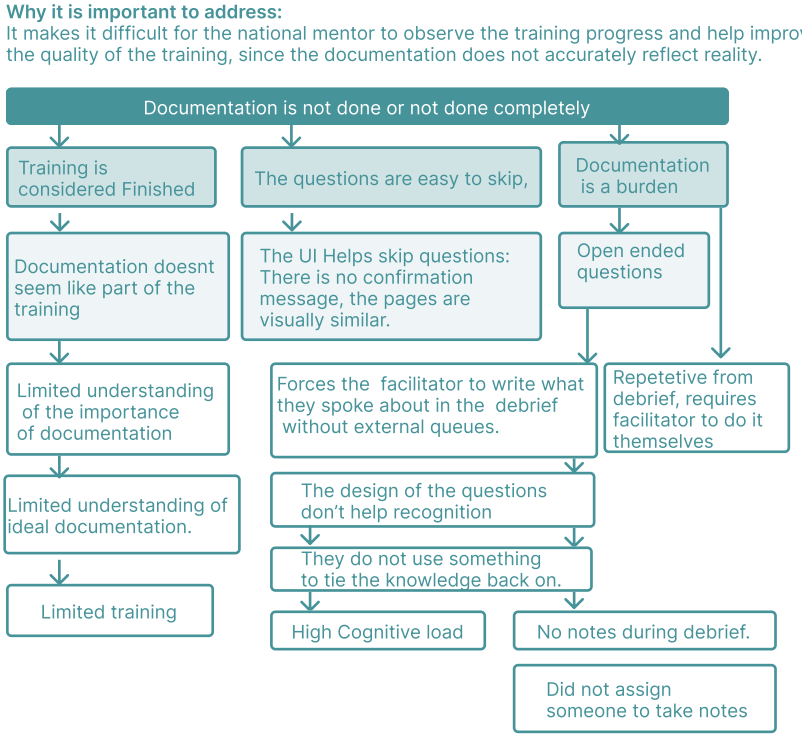


Figure 4.5.3- Root Cause Analysis- Documentation not done

The Documentation is not done for multiple reasons,

1. The documentation is a burden due to the requirement to recall the discussion during the debrief.
2. The training is often considered finished
3. Repetitive from debrief

4.5.2 PERSONAS

Personas are used to gain an understanding of the types of people who might use the LIFT Scenarios. The personas are developed based on conversations with Laerdal, simulation research, and observations.

Three types of facilitators were highlighted and their needs fleshed out. This aids in designing for a variety of facilitators and ensures the needs of the various types are understood and are designed for.

When designing, not everything will suit everyone; it is, however, important to understand who we are unable to design for.

LIFT Scenarios currently focuses on the Novice facilitator, who requires more guidance and structure than the routine or tech novice.

The routine facilitator uses LIFT scenarios as a touchpoint rather than a strict programme to follow, requiring more flexibility in use. (UH7). Whereas the tech novice is easily overwhelmed with the platform and requires a minimalistic design (UH8) and a strong connection to other apps (UH5).

NEW FACILITATOR

"Being a facilitator is fun but a little bit anxiety inducing I want something that can help guide me through the training"

Needs

- Reminded of the structure of the training and what they are expected to do throughout.
- Tips and tricks to make them more effective facilitators.
- Preparation documents
- Deal with anxiety of being a new facilitator

ROUTINED FACILITATOR

"I like having something that can help me observe and I can use when I need extra help remembering the structure"

Needs

- Simplistic and flexible platform
- How to go the extra mile when being a facilitator. not basics but extra
- Accelerators
- Memory aid functionality for observations.

TECHNOVICE FACILITATOR

"I like new products but don't feel like we get enough training on how to use it, I am sceptical of new devices"

Needs

- Needs enough training with platform before use
- Not cluttered platform minimal text, organised in easy way.
- Actions that don't require a lot of interpretation
- Minimalistic yet functional
- See the Value in the System

Figure 4.5.4- Three facilitator types and their respective needs when using LIFT Scenarios

4.5.3 STORYBOARD

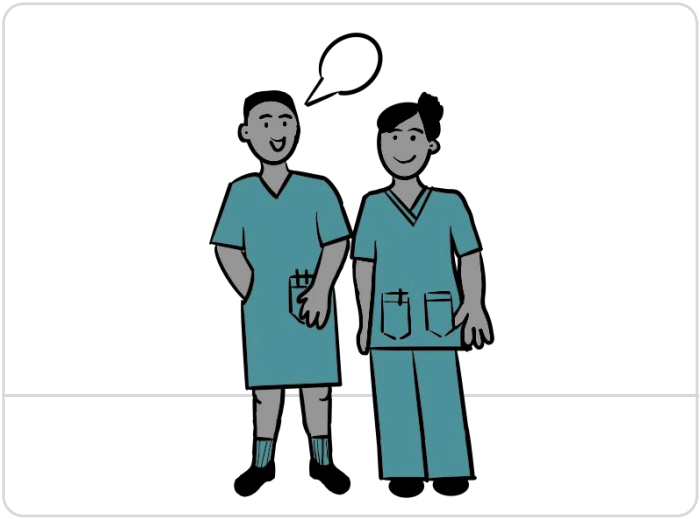
Creating a storyboard helps show the ideal situation and can act as a way to compare to the current situation, which can help create an initial point for brainstorming.

1 INFORM TRAINING

The first step is informing the participants of the training. This ideally happens in advance, so participants know what to expect and the facilitator has sufficient time to prepare, including informing participants of the case to work on during the session, as well as the time allocated. Having standard times to work on the simulation training helps create structure.

2 PREPARE FOR TRAINING USING LIFT

The second step is preparing for the training. Here, the facilitator ideally goes through the case, writes the Learning objectives on a board, and gathers and places the equipment in the right place.



3 PARTICIPANTS GATHER

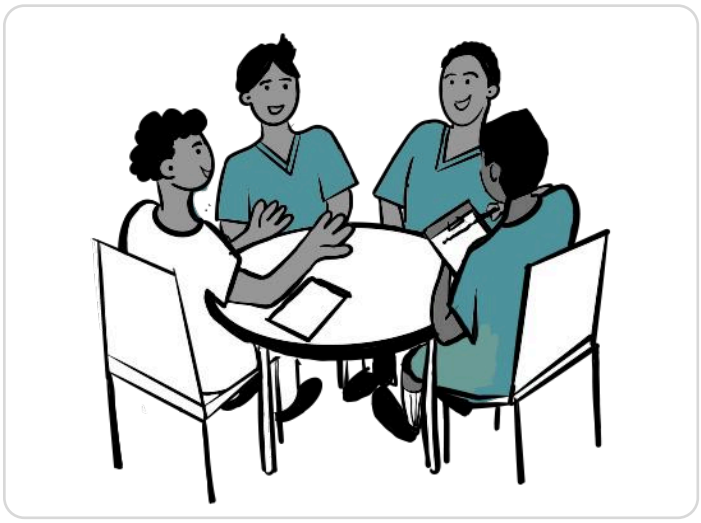
The third step is participants gathering in the right place at the right time. Here, the facilitator can register who the learners are.

4 BRIEF USING LIFT

The fourth step is using LIFT scenarios to have a brief. The brief is intended to be a conversation as well as a source of information regarding what to expect during the training and simulation, including the roles of practitioners.

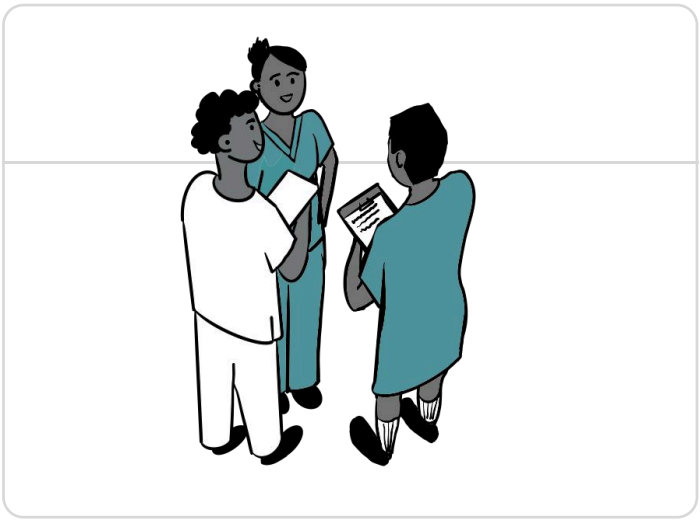
5 SIMULATION USING LIFT

The fifth step is going through the simulation. The facilitator uses LIFT Scenarios to check off actions that participants do well or have not done well, to help with the debrief.



6 DEBRIEF USING LIFT

The sixth step is the debrief, which should be more of a discussion of performance. The debrief compares the ideal to what happened with a focusing on outlining procedures. The facilitator ensures everyone gets a chance to speak. Additionally, one practitioner takes notes so that the facilitator can focus on speaking.



7 DOCUMENTATION USING LIFT

The seventh step is filling in the documentation, which focuses on creating the main takeaways that hopefully lead to training sessions where these aspects are emphasized. The documentation is completed in collaboration with the note taker, the facilitator, and another practitioner to ensure the training is accurately represented.

4.54 COMPARING IDEAL VS. ACTUAL

The comparison between the ideal situation and the real situation starts by addressing more systemic areas that need improvement, as well as some behavioral guidance to help.

4.6. Identifying main problems

From the testing and evaluation and analysis of the problems we finally reach the main problems.

4.6.1 LACK OF FLEXIBILITY IN USE

One of the main problems found is the lack of flexibility in use. This problem comes from the personas and various ways of using the platform, as seen in the behavioural problems. This signifies the need to take into account this diversity of approaches and needs. Various types of facilitators require various needs of the LIFT Scenarios. How do we ensure that the varying needs are met?

4.6.2 NOISE

Another main problem is the amount of Noise in the UI of the app. Noise is the excess amount of visual elements that do not serve any function to the participant. The UI of the platform causes much Noise due to its redundancy, excessive amount of text, and the number of steps required to guide users through the platform and perform the expected participant actions.

The Noise is created by:

- The platform is not adjusted to the expertise of the learner or their needs; therefore, some functionality becomes Noise instead of signals.
- The redundancy in text created more cognitive load since it requires the user to process similar information twice.

4.6.3 PROPER TRAINING

The third and final main issue is derived from the root cause analysis and the user tests: the importance of proper training.

Training both simulation facilitation skills such as good debriefing skills as well as how to use the platform.

Many of the platform's problems can be avoided with proper training on its use; however, this requires logistical support.

4.6. Conclusion

- How does LIFT Scenarios perform now?
- What does good performance look like?
- Q3. What does the Ideal simulation Scenario look like?
- Q. 4 What does the facilitator /Observer do to prepare?
- What is done well?
- What is the problem?
-

This chapter aimed to answer the questions above in green and two of the main questions (Q3 & 4), through systematically testing elements of the app, observations, user tests, heuristic analysis, interview and user journey to understand how LIFT Scenarios performs now.

Good performance and the ideal simulation scenario is shown in the storyboard, it focuses on a good brief and debrief, through using the resources available including the practitioners to offload some of the tasks.

The facilitators preperation beforehand is discussed in the user journey map as well as in chapter 3 about the facilitator. Preperation is divided into before training and before conducting trainings.

Before a training; includes reviewing the material and case before hand and gathering the equipment.

Before conducting a training; a SIMbegin course focusing on learning good breif and debrief techniques.

What is the problem? Is analysed through the user tests as well as the root cause analysis, the fishtail diagram, and the comparison between the actual and ideal scenarios. Three main themes were identified; the lack of flexibility in use, the noise of the platform and the need for proper training.

4.7. Discussion

OPEN EXPLORATION CREATES LESS DEPTH:

Finding, identifying, analysing, main problems to find a conclusion is a difficult task that varies greatly depending on the perspective followed. Since I wanted to keep the exploration relatively open, I considered a variety of solutions within different scopes. A wide variety of problem exploration was conducted to gain an in-depth overview of all the problems. In this way, I can target the right areas for a redesign. However, aiming to go in-depth on all the topics is not possible. It may have been a better approach to stick to one area.

RESEARCH FOCUS LIMITS SOLUTION SPACE:

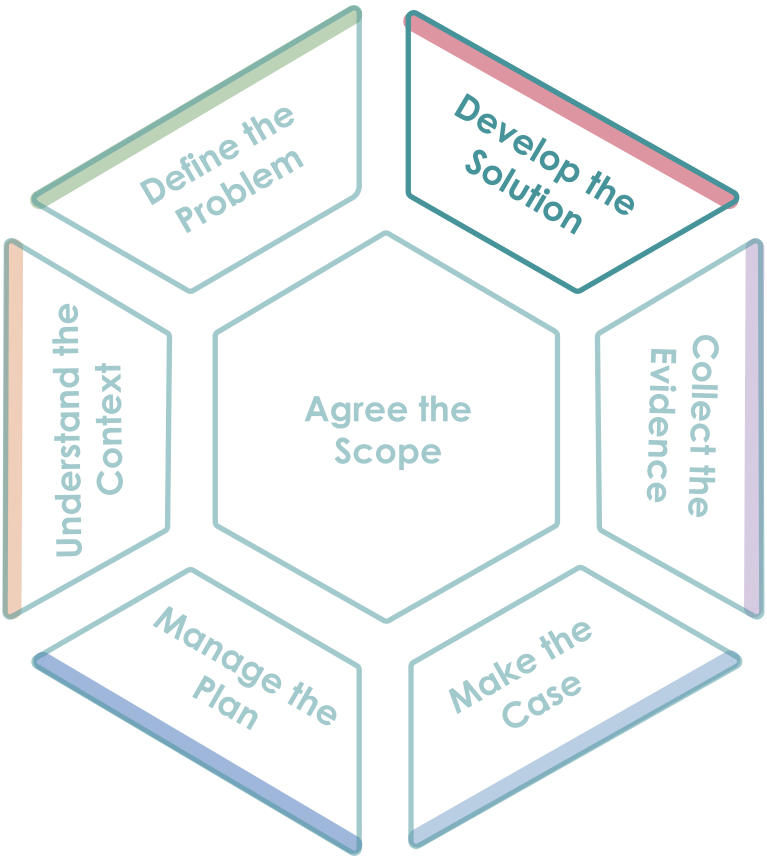
Although the biggest impact may be in prior training of the facilitator, this was not possible to implement interventions on. Additionally the thesis focused primarily on understanding and exploring the problems of the product, not providing sufficient time for prototype generation or evaluation.

MORE STRUCTURED COLLABORATION:

A lot of the problem definition was done as a activity with only the researcher when in reality it would have been more accurate if it was done in collaboration with Laerdal. Exercises such as the story board and the root cause analysis could have been easily accomplished in meetings and would be a good way to have a cohesive view of the product and system around it.

USER TEST BIAS RESULTS:

Some of the main problems such as lack of training are a result of analysing the results from the user test with first time facilitators of LIFT Scenarios, that have not received any training. These results and concept direction may have differed when using facilitators who received training and who are used to facilitating.



CHAPTER 5

Developing the Solution

Developing the Solution 5

Developing the solution focuses on brainstorming ideas for the problems and needs of the facilitators mentioned in chapter four.

Answering the questions.

- How can we improve LIFT Scenarios?
- How can the user needs be met?

These questions are part of the Improving Improvement model.

This chapter focuses on three main sections, the initial concept directions, the development of the prototypes and creating the flow of the prototypes so they can be tested.

5.1. Concept Directions

The main insights, led to three main concept directions that aim to answer the question How can we improve? These concept directions broadly examine the improvement potential in LIFT Scenarios. Systemically, behaviourally and through UI improvements.

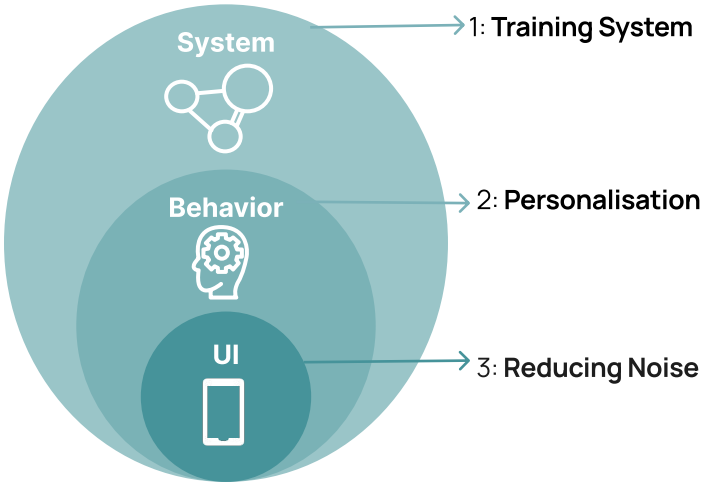


Figure 5.1.1 Concept directions

5.1.1 TRAINING SYSTEM

Concept Direction 1, focuses on addressing the key insight that most of the cognitive load reduction comes from the knowledge of the facilitator (part of the intrinsic cognitive load). Viewing LIFT scenarios from a systems view concept 1 aims to rethink the training to increase variety and create more learning opportunities and time to work on practical skills. Focusing on what type of trainings are being conducted and how facilitators are trained.

FOCUS AREAS:

- Variability improves Learning
- Peer Feedback
- Tech Novice
- How Key Take Aways are applied
- Focuses on improving intrinsic cognitive load

POTENTIAL QUESTIONS TO ANSWER:

- How can we increase variety in how LIFT Scenarios is used to increase learning?
- How can peer feedback be included in facilitator training to increase confidence?
- How do we ensure key take aways are applied in practice to improve the quality holistically?

5.1.2 PERSONALISATION

Concept Direction 2 focuses on the key of personalisation and flexibility of use. So that every type of facilitator can gain something and see the value in using the platform.

FOCUS AREAS:

- Adaptability,
- Flexibility in Use,
- Expert vs. Novice user
- Focuses on the Intrinsic and extraneous cognitive load

POTENTIAL QUESTIONS TO ANSWER:

- How can LIFT Scenarios be adapted to novice and expert users?
- What parts of LIFT Scenarios are essential to use?
- How do we enhance discoverability of accelerators in LIFT Scenario?

5.1.3 REDUCING NOISE

Concept Direction 3 focuses on reducing extraneous load through the usability heuristics, consistency and standards (#4) and aesthetic and minimalism(#8).

FOCUS AREAS:

- Visual consistency
- Reducing Text
- Page Hierarchy
- Usability Heuristics
- Focuses on Extraneous cognitive load

POTENTIAL QUESTIONS TO ANSWER:

- How can we reduce information while still being accurate?
- How can we increase scanability?

5.1.4 CHOSEN DIRECTION

Each of the concepts had an initial brainstorming session, *see Appendix G1*. From the brainstorming, a direction was chosen based on feasibility and adherence to the scope. The chosen direction aims to reduce extraneous cognitive load for novice users of LIFT scenarios. This strategy integrates elements from concepts 2 and 3. To tackle extraneous cognitive load, usability heuristics are utilized, combining insights from heuristic evaluations with behavioural factors that influence the user interface (UI). This approach will consider the system as a whole, from information architecture to the design system, with a primary emphasis on aesthetics and minimalism *(Babich, 2020)*.

5.2. Developing the Final prototypes

To develop the final prototypes the initial starting point was addressing how to reduce extraneous cognitive load of the platform. Focusing primarily on novice users, two main needs emerged from previous research.

1. Increasing Simplicity
2. Improving Guidance

Simplicity aims to reduce extraneous load and Guidance aim to reduce the intrinsic load.

How can we _____? brainstorming *(see Appendix G2)*, taking inspiration from other fields, as well as prototyping was done to develop ideas. Features of each of the prototypes were first fleshed out then a flow for each of the prototypes was created.

5.2.1 INCREASING SIMPLICITY

Increasing simplicity aims to remove unnecessary information or graphics that does not directly contribute to the aim of the page. Increasing simplicity correlates with UH8 (Aesthetic and Minimalism), 7 (Flexibility in Use) and 4 (Design Standards) and extraneous cognitive load. Increasing simplicity is approached through reducing noise and increasing flexibility.

REDUCING NOISE:

One method of increasing simplicity is to reduce the noise. Reducing noise is an essential part of adhering to the Aesthetic and Minimalism (UH8) heuristic. Any app should have a good signal-to-noise ratio *(Nielsen,2024)*. The signal-to-noise ratio is dependent on the user and their capabilities. The user's expertise and ability to self-manage the cognitive load affect what is considered signal and noise.

Joe Natoli from Give good UX created a 4-step guide to improve the signal-to-noise ratio *(Signal Vs. Noise: Removing Visual Clutter in the UI | Joe Natoli :: UX Consultant, Speaker and Author,)*¨Including

1. Increasing white space
2. Removing borders
3. Clear visual hierarchy
4. Clear headings.

Reducing Noise was done strategically by addressing one point at a time, changing one feature, and reflecting on the outcome of that change, then changing more parts.

Figure 5.2.1 shows an example of removing some of the border around the tip for facilitator, organising the information in the tip for facilitator with one action per bullet point. Adjusting the colour on the boxes to highlight the words instead of the colour, thereby adjusting the visual hierarchy

Figure 5.2.2 tackles the second point in Joe Natoli's guide to removing noise, which focuses on removing borders. Figure 5.2.2 The screen to the right deletes the boxes using white space to separate the information visually; however, this causes a lack of division between the Tip for facilitator and the other information. This reduction of division removes some of the guidance.

Joe Natoli also addresses the distinction between different types of headers, removing the visual similarity through color or style. Here is an attempt at switching the subpart of the brief (Introduction) to an all-caps introduction.

However, again, this part generally lacks guidance and is therefore further addressed in the guidance pages.

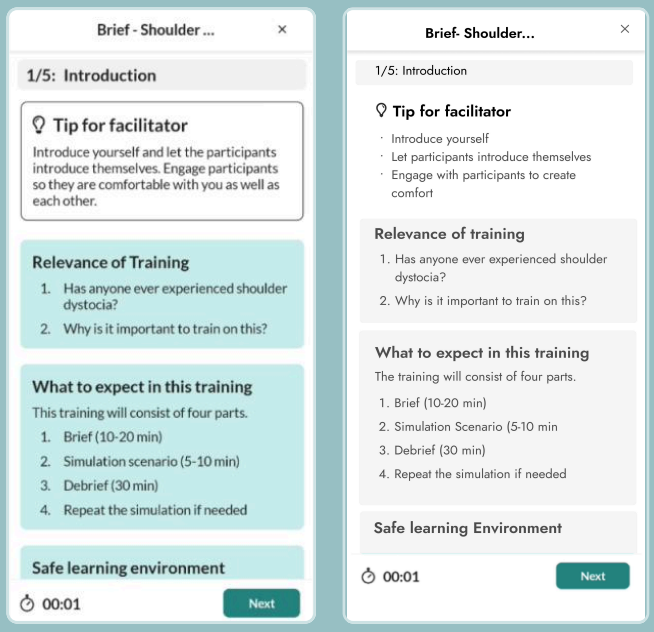


Figure 5.2.1 Removing color and border | Brief

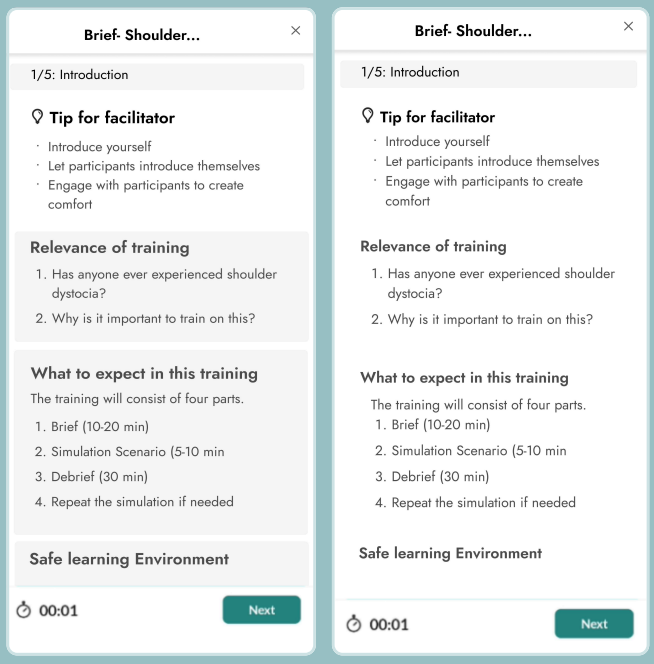


Figure 5.2.2- Removing the Borders | Brief

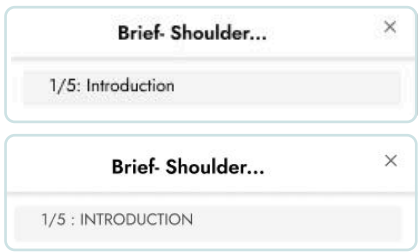


Figure 5.2.3- Sub heading distinction

Part of reducing noise and increasing simplicity is addressing the visual hierarchy. Visual hierarchy is addressed in the simulation pages as well as in the session overview. Figure 5.2.4, as compared to the original design, removes a lot of the visual elements, focusing solely on the key factors.

Compared to the original design, 5.2.4 does not encourage flexibility in use, since it does not make it evident that all subcategories of the training are clickable. However, it guides them to take the next step in the training. The simple navigation removes some of the clutter on the page, eliminating information that is often not read anyway, and reducing the noise on the page to align better with heuristic 8: Aesthetic and Minimalism.

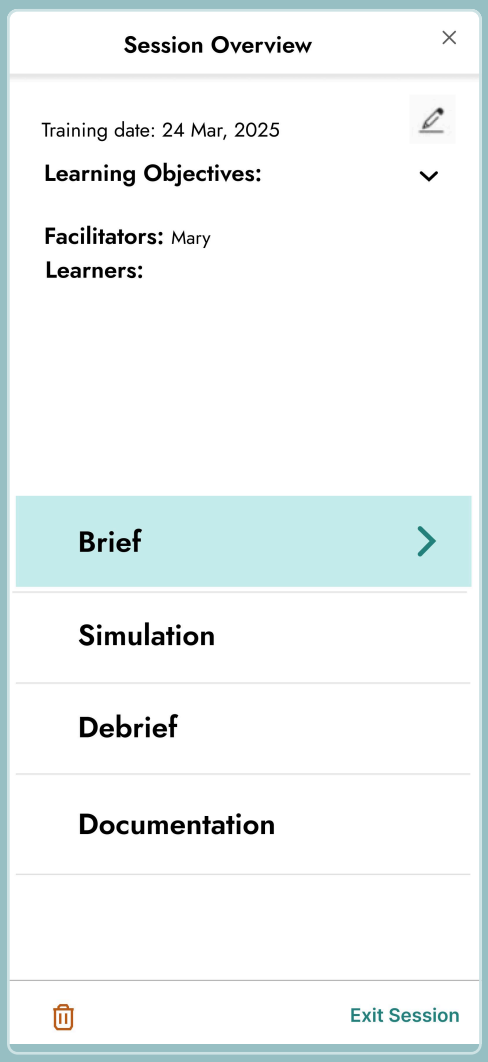


Figure 5.2.4- Reducing Noise pages- Clear direction

Thereby, guiding the facilitator through a clearer visual hierarchy and a more precise focal point.

The session overview aims to provide an overview of what the session has to offer. The original version gives all the information, whereas the reduced noise version provides only the information about each section. These could be combined where the information from the highlighted section is visible, but not from all the sections.

To further reduce noise, a focus is placed on enhancing the visual hierarchy, particularly within the simulation pages. During user testing and the cognitive walkthrough, participants expressed confusion regarding the teal boxes. These boxes became the focal point due to their colour saturation and the established convention in the app, where blue teal boxes indicate buttons and call-to-action elements that are considered very important.

Furthermore, the clock in the lower left-hand corner was not addressed, despite its relevance to the text within the blue boxes. Therefore, it would be beneficial to create more coherence between the stopwatch and the time displayed, as both elements are related to the concept of time. We suggest removing the rounded corners from the teal box, changing its colour to Gray, and replacing the current symbol with that of a stopwatch, as illustrated in Figure 5.2.5 on the next page.

INCREASING FLEXIBILITY:

Apart from reducing noise, improving flexibility in use is another important aspect of simplicity (UH7). Enhancing flexibility benefits a broader range of participants by making the experience more user-friendly.

One effective way to increase flexibility is by implementing accordions. Accordions minimize the amount of information displayed on the screen, allowing users to choose whether they want to see more details. This approach enables users to process information step by step and easily skip over sections that seem redundant.

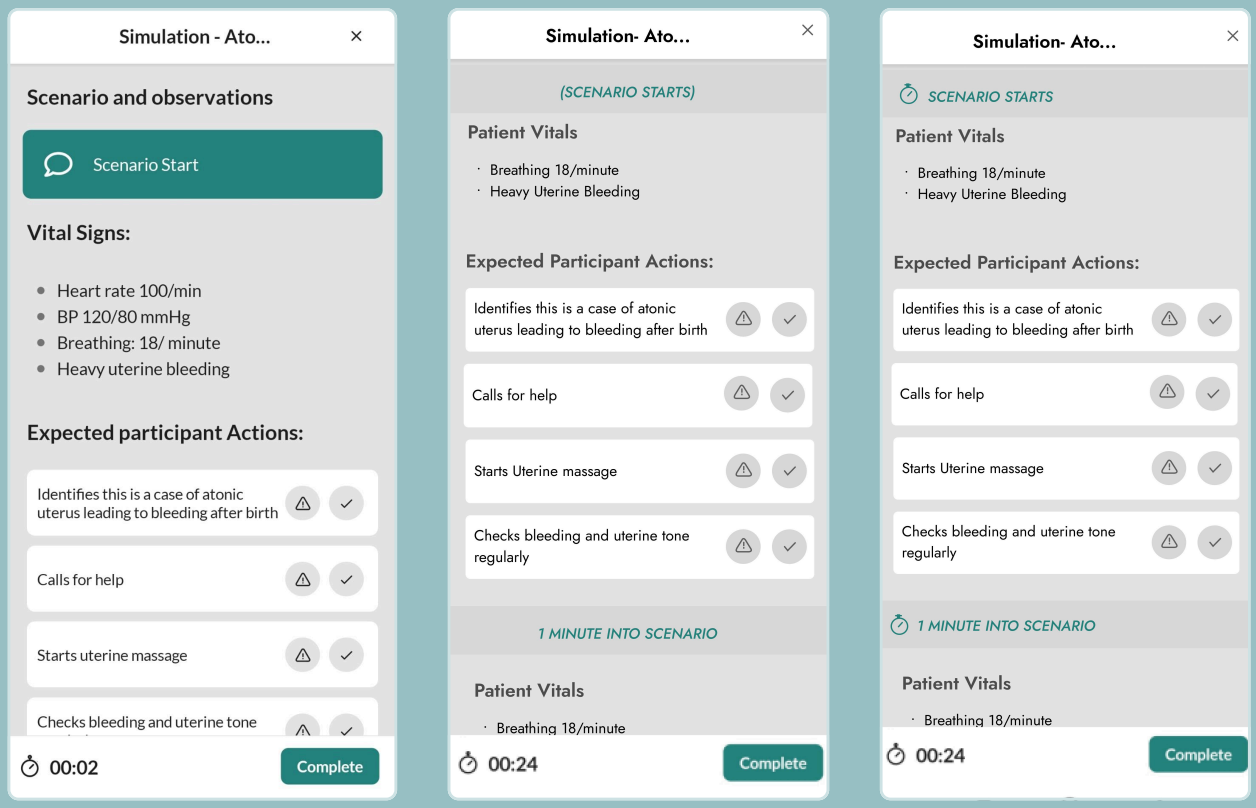


Figure 5.2.5 Adjusting Hierarchy to Expected actions | Simulation Pages

According to (Budiu, 2023), accordions are particularly suitable for mobile screens, where a lot of information needs to be displayed. However, they may not be beneficial in contexts where users will always need to open the accordion.

Therefore, some sections should be pre-expanded, reducing the need for users to open multiple accordions. Additionally, if an accordion opens to reveal only a small amount of information, such as just a single sentence, it can become redundant.

Overall, accordions provide a quick overview of the page, reducing the need to scroll. This was a discovery for some participants during the cognitive walkthrough and user testing, as many were surprised to learn there was much more information available. Furthermore, the use of accordions aligns with the style of other elements in the roles, thereby enhancing coherence throughout the app.

Cons:

- Requires interaction, may be difficult with cracked screens or a different mental model.

Figure 5.2.6 (next page) shows an example of accordions implemented in the screens as an attempt to reduce extraneous load. The facilitator can decide if they want to see all the information. They can choose to close one tab at a time.

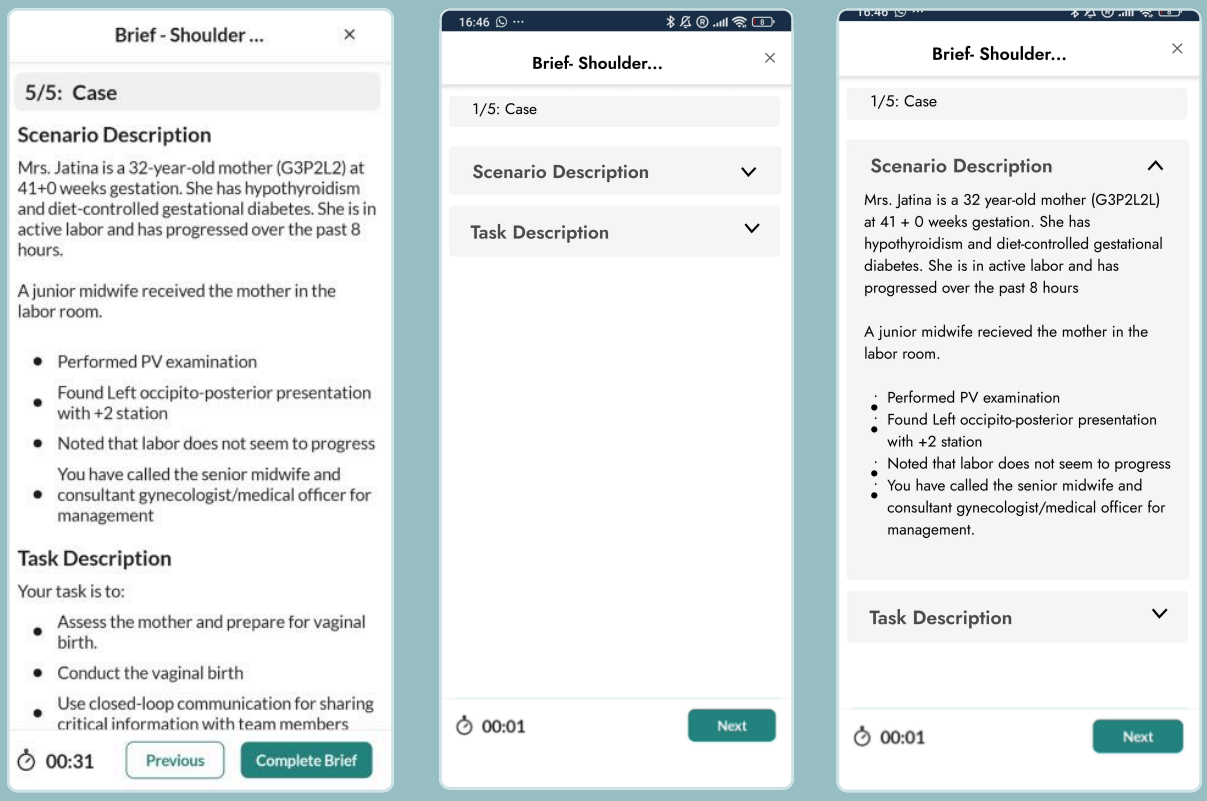


Figure 5.2.6 Implementing Accordions | Brief

5.2.2 INCREASING GUIDANCE

The second part of improving the experience and reducing the cognitive load of the facilitator is by increasing the guidance on the platform. Currently the guidance is in form of the tip for facilitator, the layout of the platform, and the training structure.

During the Heuristic analysis and initial user test it was found that some parts of the platform are difficult to interpret on the mobile version including clarity and current state Design Heuristic 1, making it difficult for facilitators to feel guided through the process. Increasing the guidance was approached by addressing the timeline, the visual hierarchy, the focal point and adding action prompts.

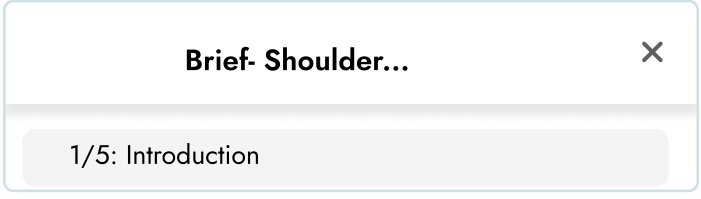


Figure 5.2.7 Original Timeline LIFT Scenarios- Mobile version

5.2.2.1 ADDRESSING THE TIMELINE:

The timeline was addressed through attempting to create variations to indicate progression in the subsections of the training. There are a variety of ways to indicate progression, however since the line with circles is used in the tablet version a simplified version of this is attempted in the mobile version.

Out of the timelines Timeline D was implemented since it shows the amount of steps with the circles and is not as busy as the ones that show everything. Additionally brief was highlighted in the teal to show a connection between the brief and the timeline the main section and the subsection.

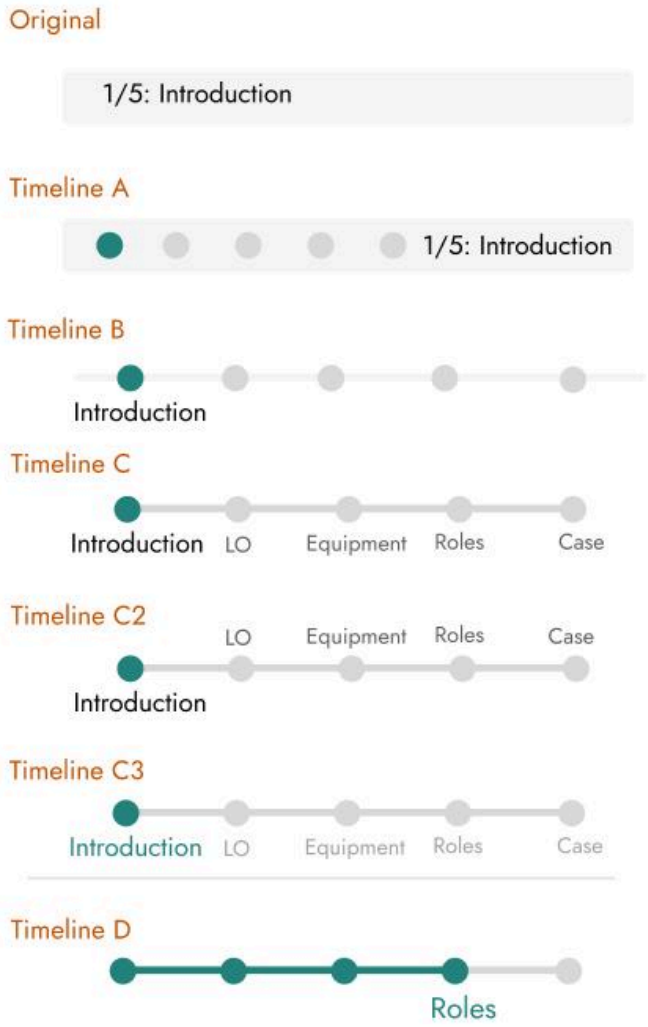


Figure 5.2.8 Variations of timelines

Figure 5.2.9 Chosen timeline and header

Figure 5.2.10 shows the original timeline compared to the new timeline applied to the brief pages.

There are a few shortcomings to this prototype

- Interaction is difficult due to size
- The interaction that the tablet version has cannot be applied to the mobile version due to the small size.
- Colour highlights the feature, bringing unnecessary attention.

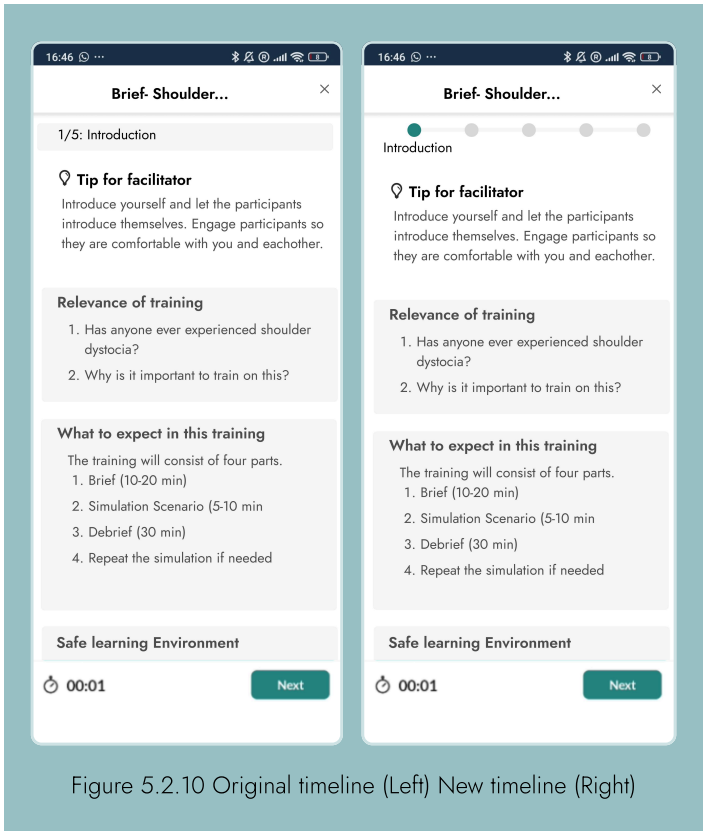


Figure 5.2.10 Original timeline (Left) New timeline (Right)

- The colour used highlights the feature which may cause more noise to the overall design rather than be a helpful indication of progress, it becomes noise rather than a signal.

The timeline although one element of increasing the overall guidance of LIFT Scenarios, is not the only feature that can be enhanced through more guidance.

5.2.2.2 INCREASING VISUAL HIERARCHY:

Increasing visual hierarchy goes hand in hand with increasing guidance. A good visual hierarchy aims to guide the user's attention to key elements on the page and indicate the following action.

During the user test and initial heuristic evaluation, some pages were more challenging to understand how to use, including the session overview page. The initial page on figure 5.2.11 does not have a call-to-action button that is typically used throughout the app. Furthermore, the location of the following button, which is typically placed on

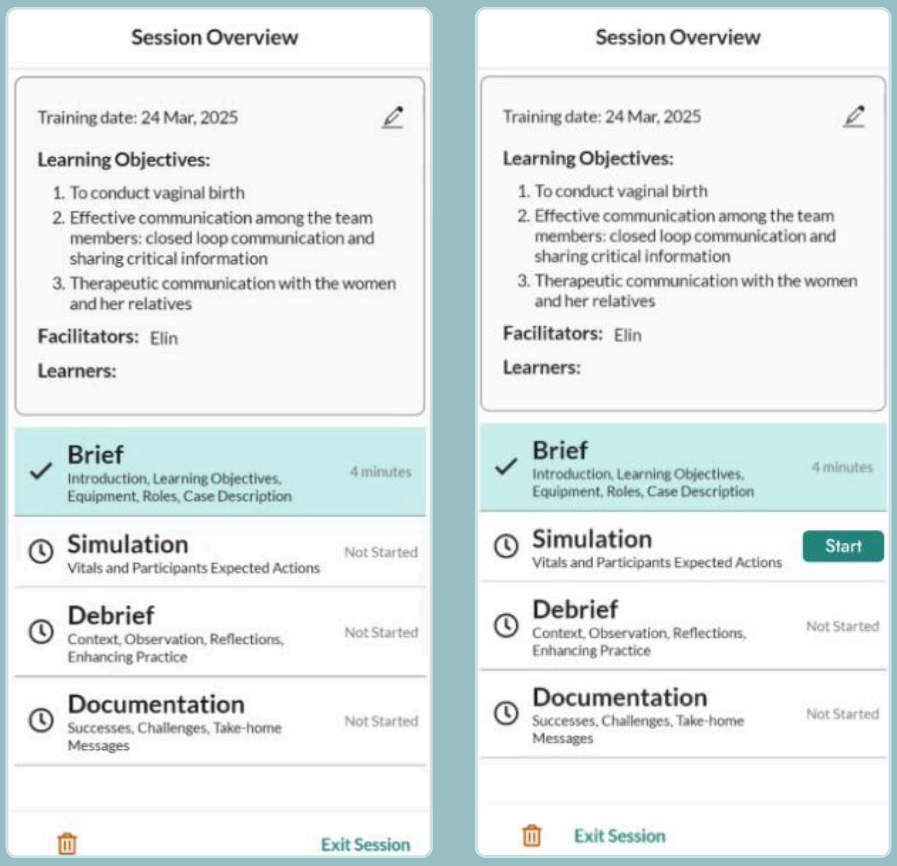


Figure 5.2.11: Guidance pages- Clear direction

the bottom right, replaced with "exit the session". Making it easy for a slip (error from inattention) to happen.

The page to the left of figure 5.2.11 lacks visual hierarchy; the user is unaware of the correct next step. Therefore, the typical button used as the primary call to action is added beside the next part of the training. In this example, the simulation.

Addressing The Focal Point:

The guidance prototype manipulates the focal point to ensure that the user focuses on the correct areas. To address this, the simulation pages were adjusted to ensure that the areas that the user should look at (expected participant actions) are highlighted. Figure 5.2.12 shows how the expected participant actions are slowly bolded, then colour is added so that the focal point becomes the expected participant actions.

Figure 5.2.13 blurs the prototypes to see the focal points and enhance the guidance of using the platform. The focal point aims to highlight the most important information so that the user will see it first. Therefore, it should serve as a guiding point.

Other ways of testing the focal point include code charts, where a picture is shown on a screen for a short period of time, then numbers are shown.

Generally, the spotted number is the place that brought the most attention. After the numbers appear, a box appears to input the spotted number. The focal point generally aligns with the number people put in the box. The test is programmed by Isak Wahlqvist and sent to people via WhatsApp group chats.

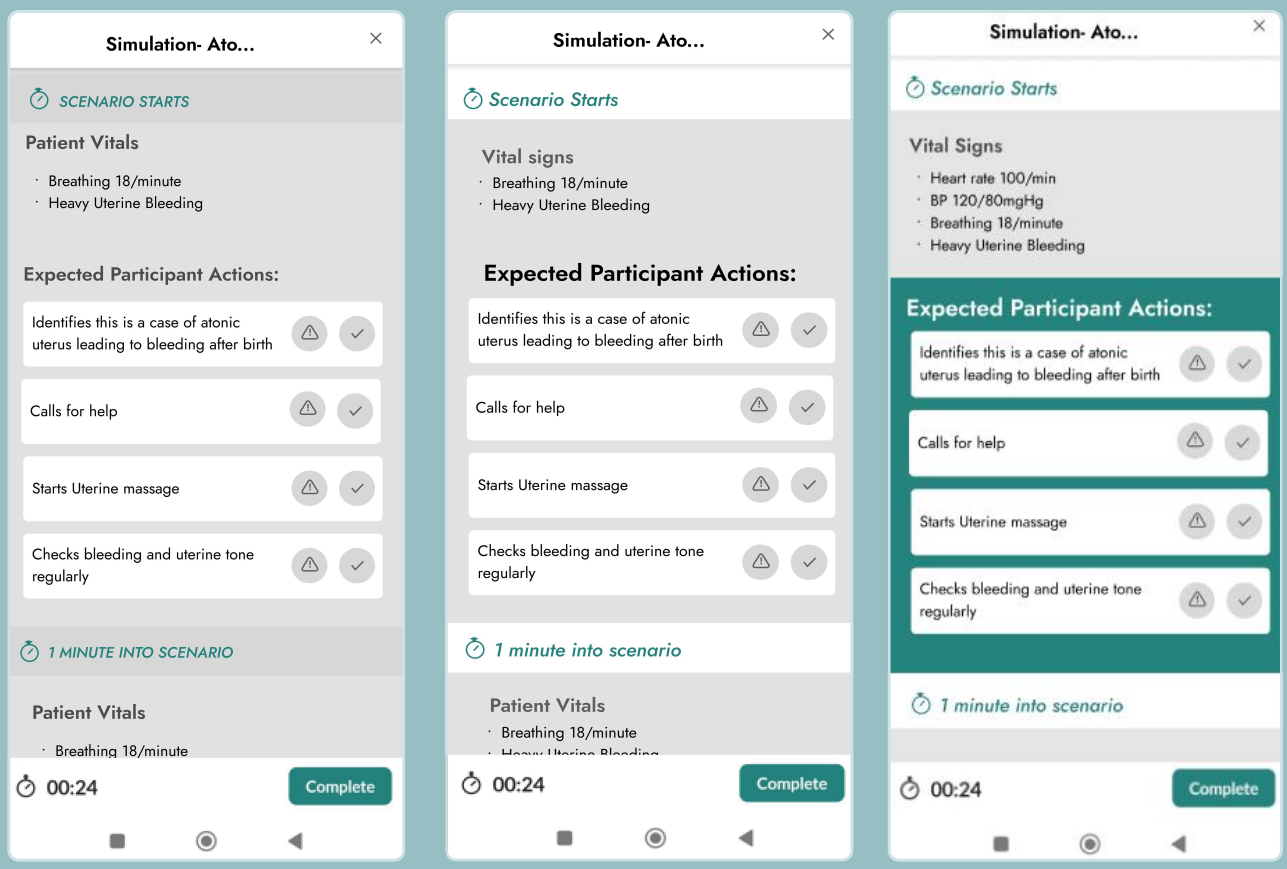


Figure 5.2.12- Increasing contrast to create new focal point

In total 23 people filled in the code charts test, heat maps from each of the tested pages, including session overview and simulation pages of guidance, reducing noise and original. For more information about the test, refer to Appendix H. The following sections show the heat map of the pages.

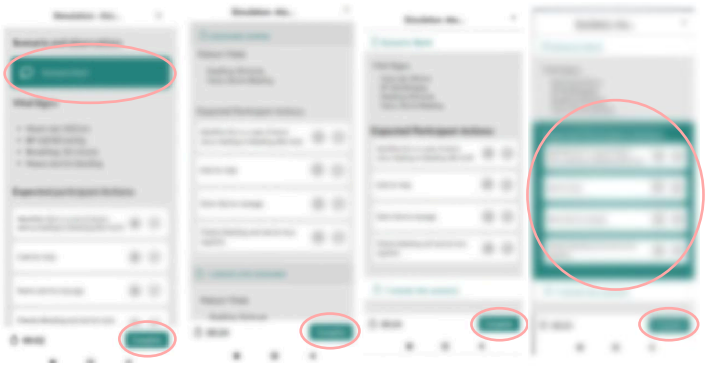


Figure 5.2.13- Blur test to identify focal points

Figure 5.2.14 shows heat maps of the simulation and session overview pages. The stronger the red box, the more people saw that box. This serves as a test

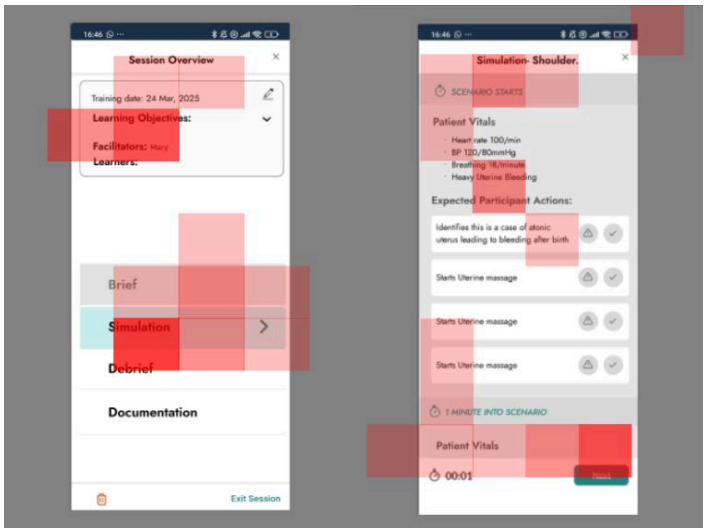


Figure 5.2.14- Code Charts - Focal Area Example

to see the initial focal point. It was able to be used in conjunction with the blur test to understand the focal point of each of the pages.

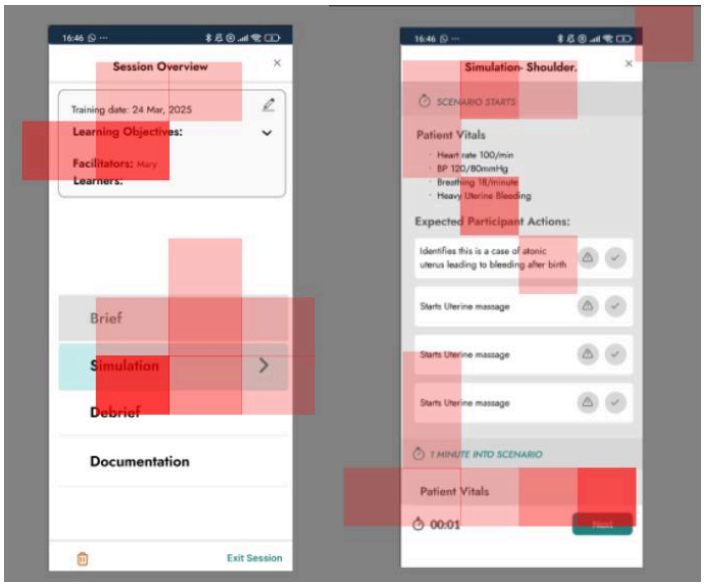


Figure 5.2.15- Reducing Noise- Heat map

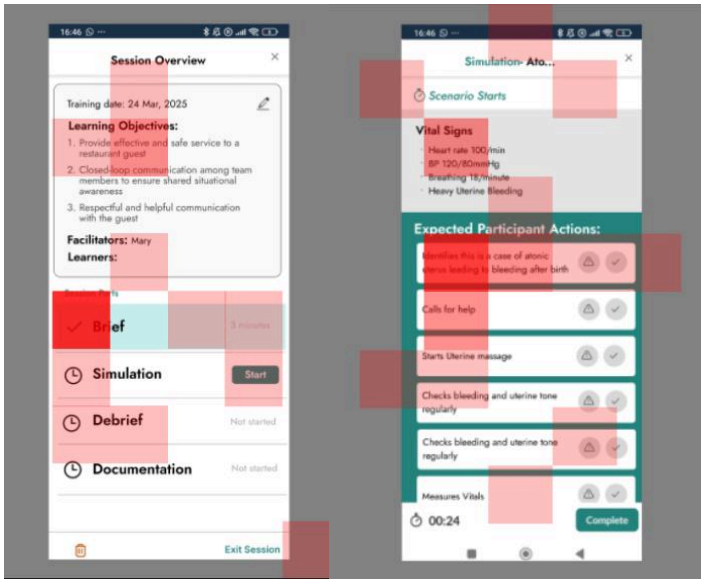


Figure 5.2.16- Increasing Guidance heat map

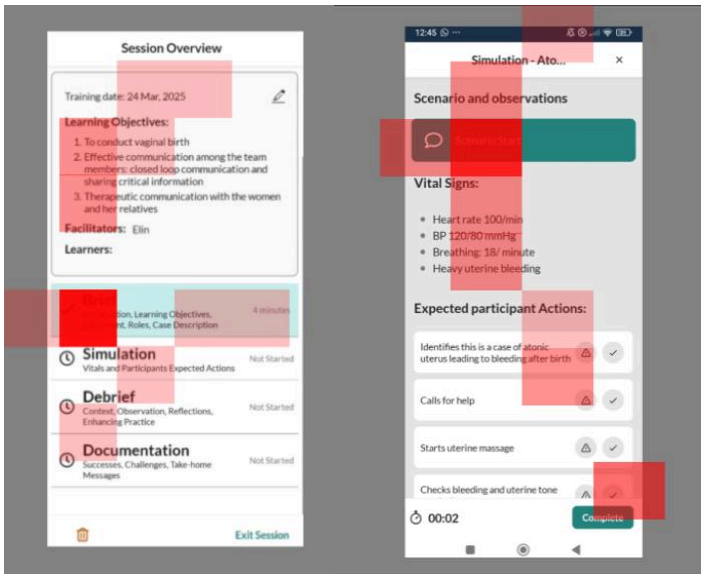


Figure 5.2.17- Original Heat Map

Focal points for the pages

Reducing Noise,

the session overview has two clear focal points:

1. The learning objectives
2. Simulation turquoise box.

The simulation page lacks a clear focal point. There is some focus on the simulation heading and the Next button, but overall, it lacks a focal point.

Increasing guidance: The session overview has one clear focal point varying from the expected results, the brief checkbox is a clear focal point, which was assumed to have been the start button. On the simulation page, the first expected participant action was the focal point, which is desirable.

Original prototypes: The session overview similarly to the guidance prototype had the focal point on the brief check box. The simulation page had a clear focus on the scenario start teal text box.

Insights from Code charts

- Colour generally creates focal points as seen in the boxes.
- The symbol on the side of the brief generally creates a focal point. When comparing the original and increasing Guidance vs. the Reducing Noise session overview that does not have a symbol. the focal point was brought to the text and there was more people looking at the learning objectives as well.
- No focal point =Lack of guidance, without a clear focal point people looked everywhere on the page.

Conducting a code charts test and getting a heat map from the test created greater awareness of more active areas of the prototype and inactive areas. This brought the insight of strategic colour use to guide the user.

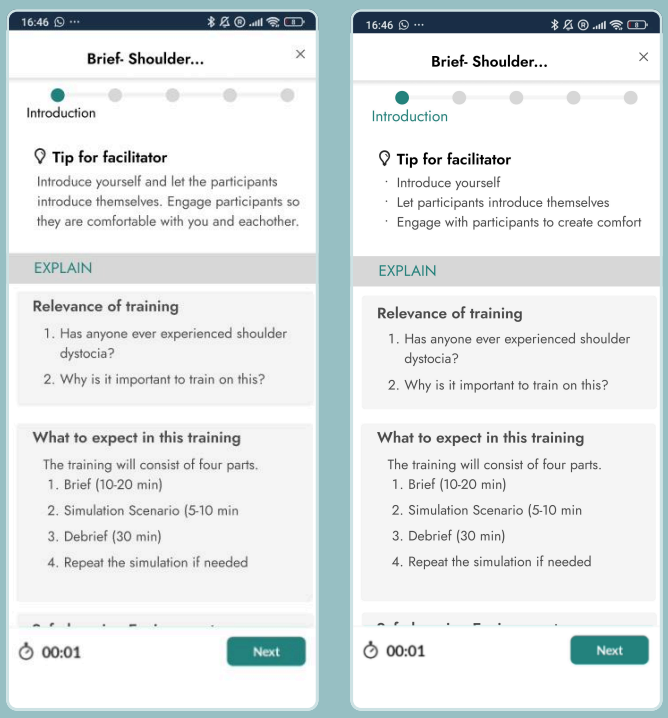


Figure 5.2.18- Guidance pages- Adding Prompts

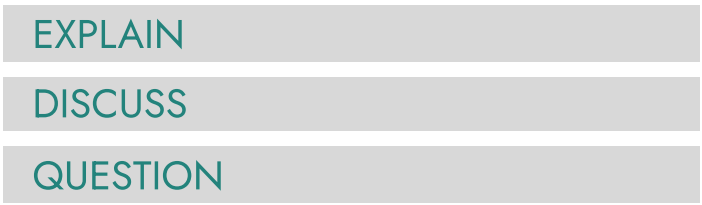


Figure 5.2.19- Action Prompts for Guidance

5.2.2.3 ADDING ACTION PROMPTS:

One of the main insights from the user testing was the limited ability of the novice facilitators to understand what to do with the information on the screen. They first had to read the information, then interpret how they should communicate that information, whether it is in the form of a question to ask, something to discuss, or something merely to explain. Drawing inspiration from screenplays that feature visual cues to distinguish between scripted actions and direction, a similar approach can be applied within the platform.

Therefore, this is addressed through the application of the action prompts, guiding the facilitators to the correct action and reducing the need to interpret the intended way for the information to be addressed. The action prompts come in three main categories: discuss, explain, and question, all of which relate to how the facilitator should interpret the text.

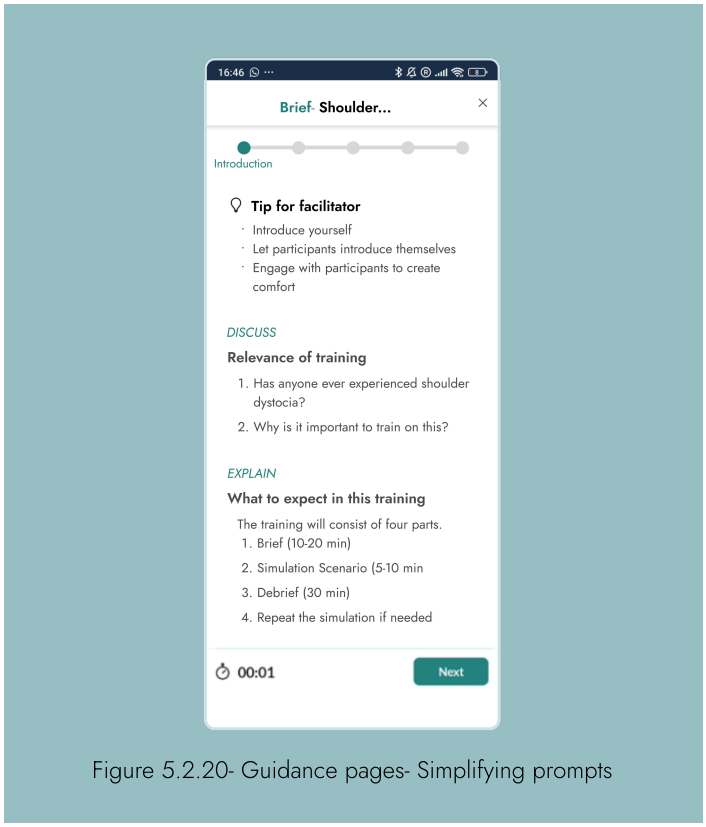


Figure 5.2.20- Guidance pages- Simplifying prompts

The example above illustrates the 'Discuss and Explain' approach, where the use of green is intended to guide the facilitator through the training. Starting with the introduction, then discuss, then explain, then next, the green visually guides the user, as seen in the heat map, color can guide the user.

These action prompts are intended to be cohesive with the new visually minimalistic version of the simulation pages so that there is more visual coherence throughout the app.

Cons

- The Simulation pages use this feature as a 'speak out loud' feature, rather than an action.

5.2.3 COMBINING THE PROTOTYPES

As an effort to combine the prototypes to see what would happen if the main features of each the

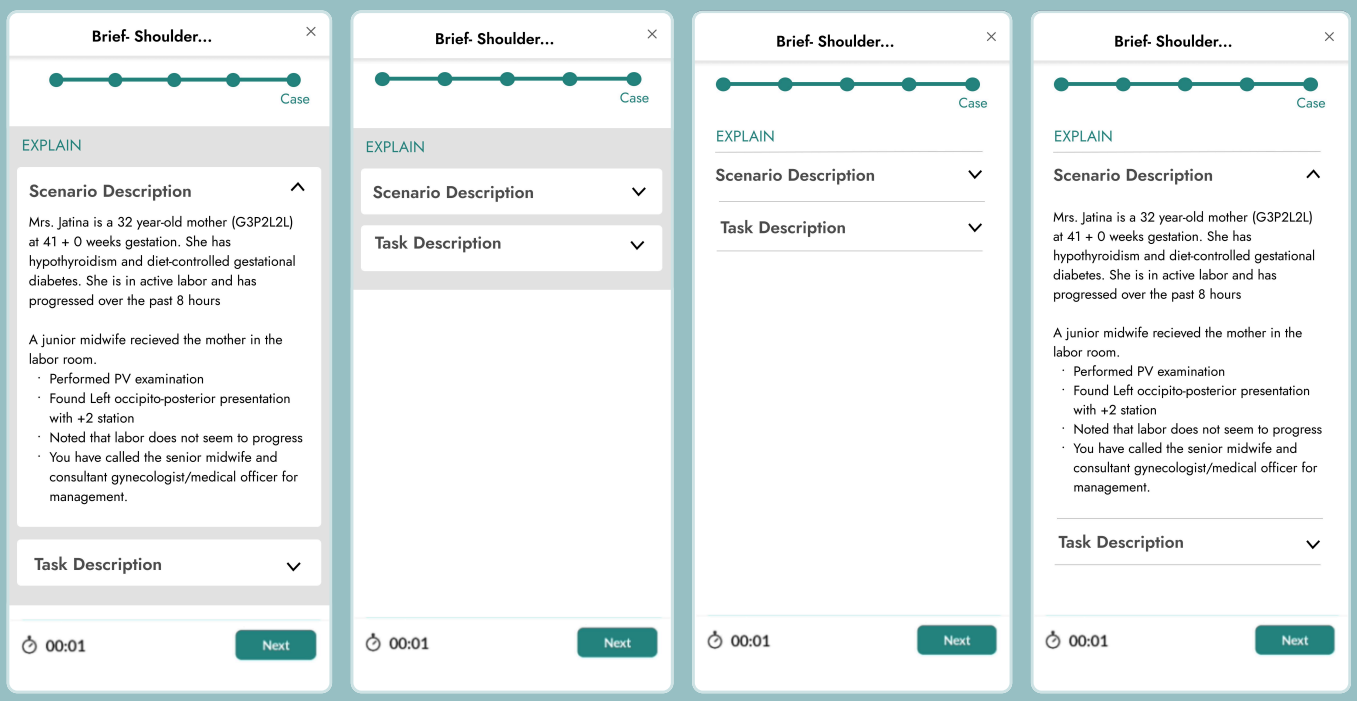


Figure 5.2.21- Implementing accordions and Guidance prompts

accordion and the action prompts were applied.

The accordion and action prompts were combined to visualize how the action prompts and accordions can aid in further understanding. Combining Reducing Noise and increasing guidance.

Cons:

- if touch screen doesnt work well it becomes another issue since they may not be able to click the button to open it.
- Scenario description is already open since most will open this feature anyway

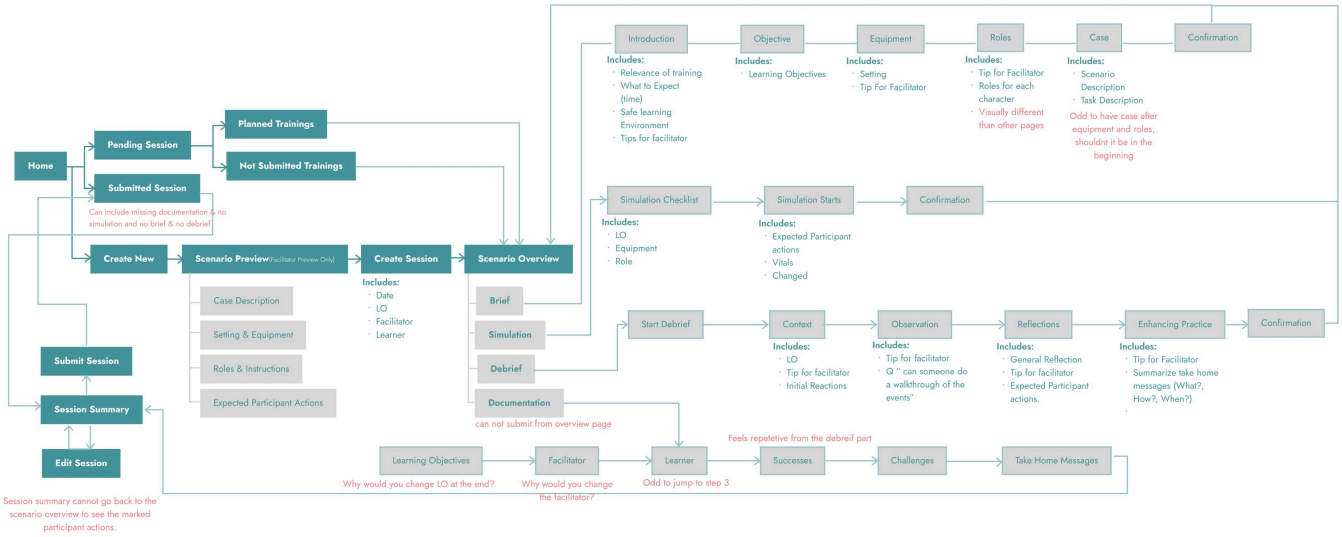


Figure 5.2.22- Original Flow chart

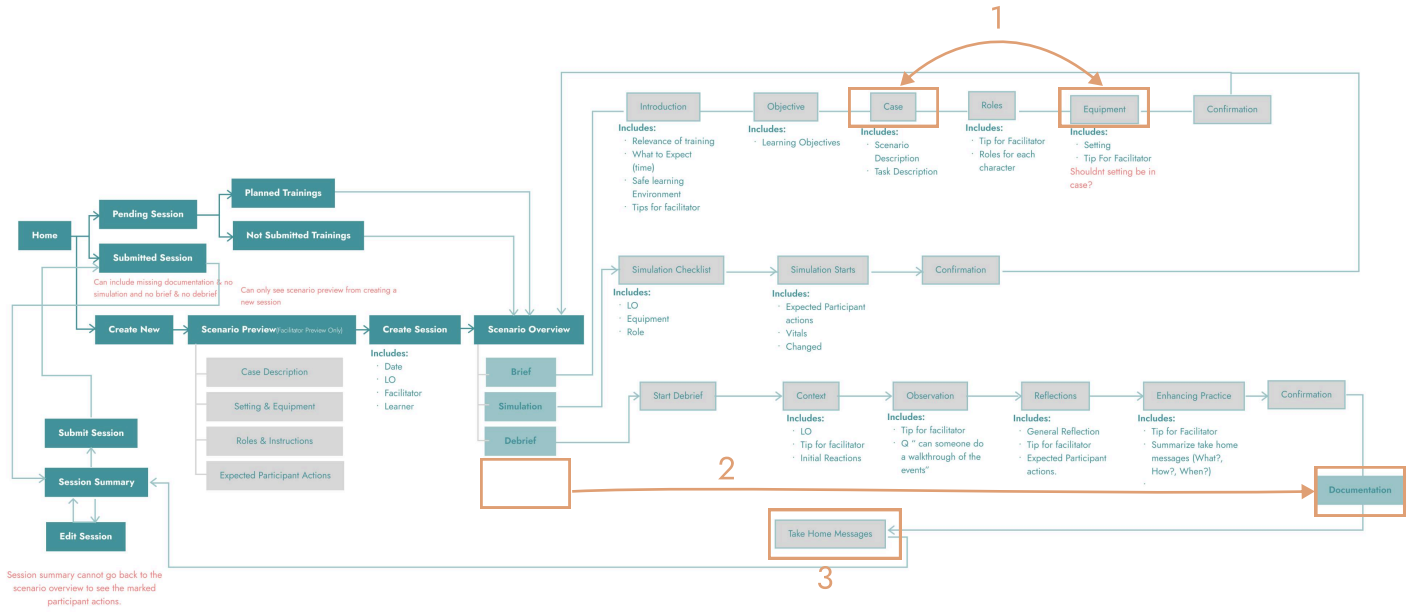


Figure 5.2.23- New flow chart addressing the documentation

5.2.4 ADJUSTING THE FLOW:

The flow was something that came up multiple times, indicating a lack of clarity and redundancy. These are tackled through:

1. Moving the case from the 5th page in the brief to the 3rd page. Throughout testing and observation, the case was the most important aspect for the facilitators to understand before assuming roles or using equipment.

2. Documentation that starts directly after the debrief to remove the step required to start the documentation.

3. The documentation would focus only on the Take-Home messages instead of having to input the learner and what went well, and what can be improved. Therefore, all the energy that is left is focused on how they will apply what they learned from the training.

5.3. Creating the prototype flow

To test the Guidance and Reducing Noise prototypes, the components that characterise each concept were put together in a flow. This allowed the concepts to be tested in their entirety in the context of the other pages and how they shape each other's experiences. Merely testing them one page at a time removes them from the effect of the pages before.

Additionally, addressing the pages as a flow, the concepts were elaborated on and understood across a variety of pages.

5.3.1 REDUCING NOISE:

The reducing noise prototype primarily focused on UH8, minimalism and aesthetics, while also addressing flexibility in use (UH7). When elaborating upon the concept, focus was primarily put on the necessary details of the prototype, to remove any unnecessary parts.

Session Overview page see figure 5.3.1
Developing the session overview page for reducing noise, the minimum required for this page to serve its purpose was reflected upon, which is

- The steps of the training
- The order of the steps
- Signify the next step
- The learning objectives
- Exit strategy

Focusing on the simplest way to achieve these parts of the training, adding arrows to signify the next part of the training, as well as gray to signify a finished part, done opposite to the current design system, see page 33.

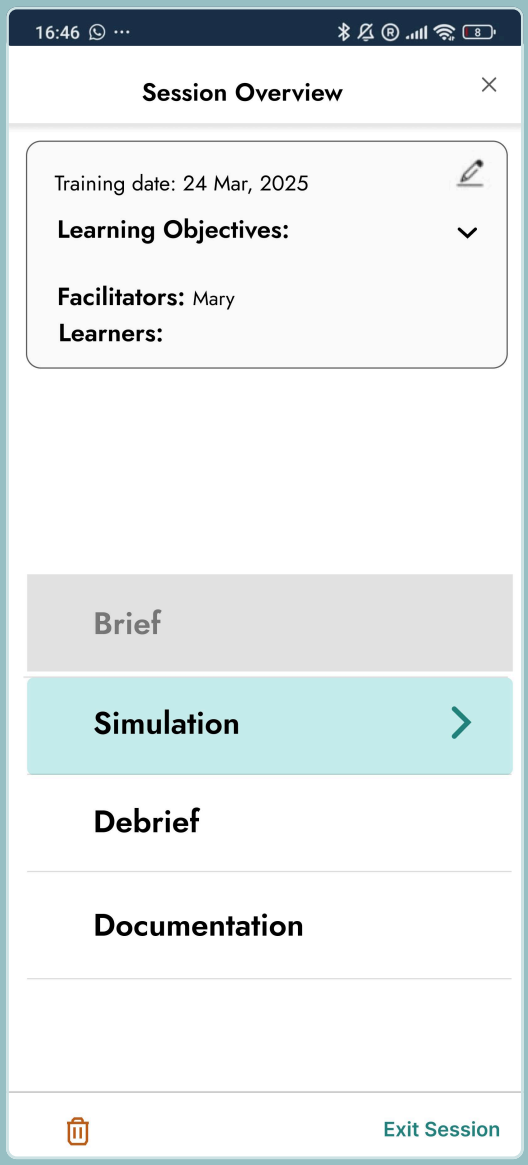


Figure 5.3.1 Session overview- Reducing Noise

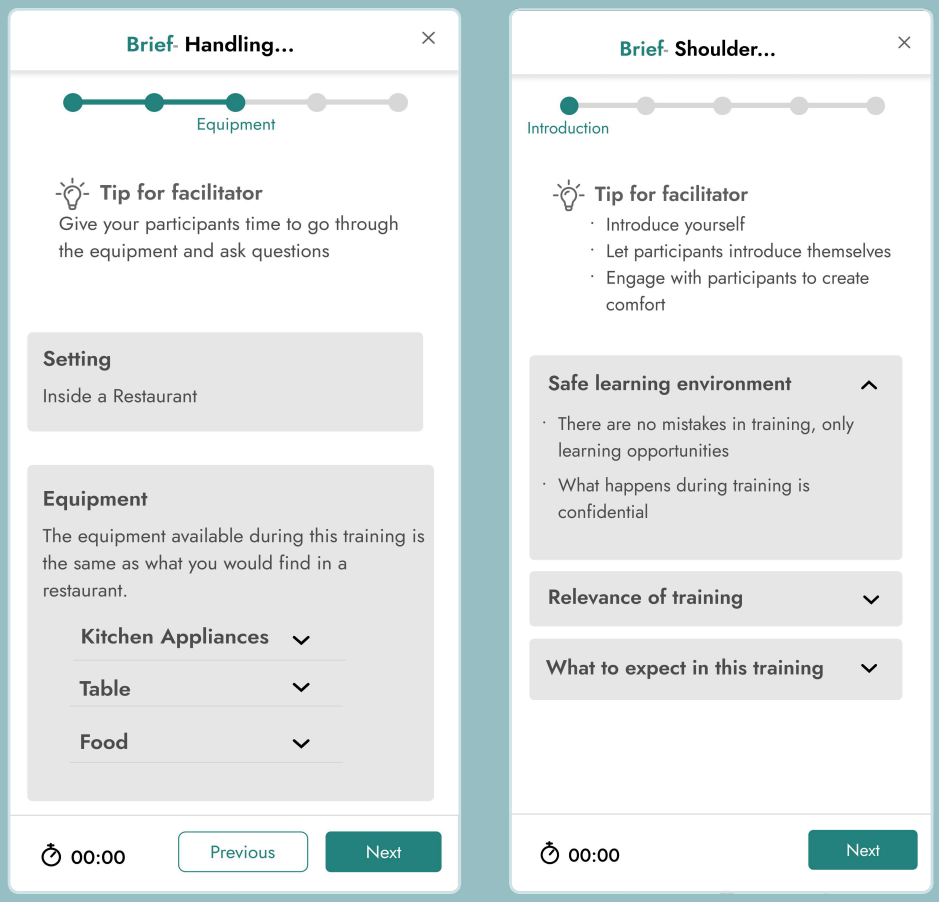


Figure 5.3.2- Brief pages- Reducing Noise

BRIEF PAGES:

In figure 5.3.2, we can see how the brief and debrief pages are similar to each other in reducing noise. Therefore, this section focuses mainly on the brief pages that highlight the main addition to reducing noise, the tabs.

In these pages, some information is not placed in tabs due to its short length. For example, in the screen to the left of Figure 5.3.2, the brief includes the kitchen example, where the setting is not in a tab. At the same time, the equipment has sections with multiple tabs.

The Tip for the facilitator does not have a box as a way to reduce the noise, according to Joe Natoli.

However, the subsections of the page have boxes as a way to visually separate the information.

SIMULATION PAGE:

Figure 5.3.3 shows the Simulation page. It was not a focus of these redesigns. The header (1 minute into scenario) is in all caps to visually distinguish itself from the other headers. Overall, there is not a clear focal point in the reducing noise prototype.

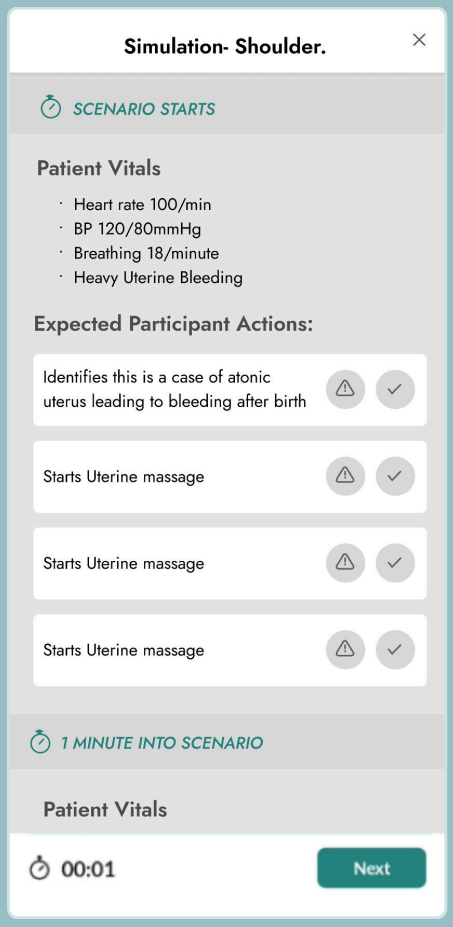


Figure 5.3.3- Simulation page- Reducing Noise

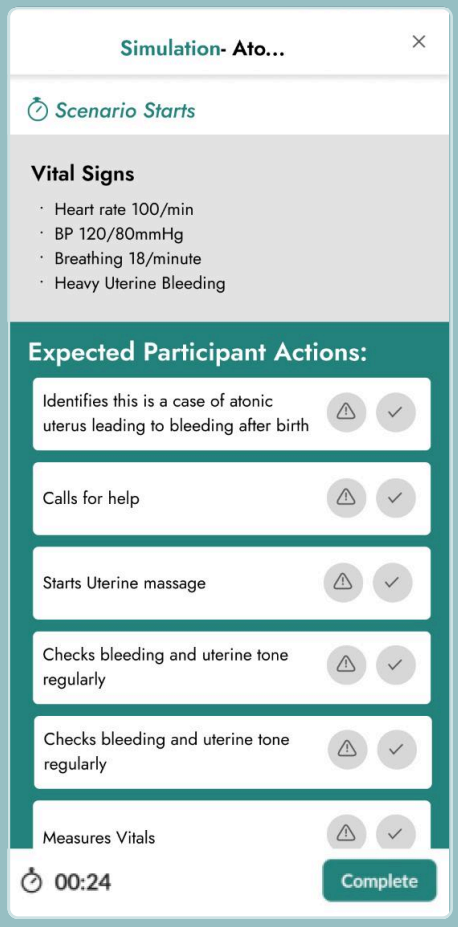


Figure 5.3.4- Simulation page- Guidance

5.3.2 INCREASING GUIDANCE

Creating the flow and integrating the overall appearance and functionality of the guidance prototype into the pages was done similarly to reducing noise. The two prototypes were created simultaneously, back and forth; therefore, they impacted each other. Some components of the noise reduction made their way to the guidance and vice versa.

Figure 5.3.4 shows the Simulation page. It was not considered in the focus of these redesigns. The main difference in the simulation page is the colour and the adjusted header with the speech bubble icon removed, and the colour adjusted.

In the guidance prototype of the simulation pages, an attempt at explaining the definition of the actions was made after clicking the buttons with the following text: see figure 5.3.5

Figure 5.3.5- Simulation page- Guidance- Button animation

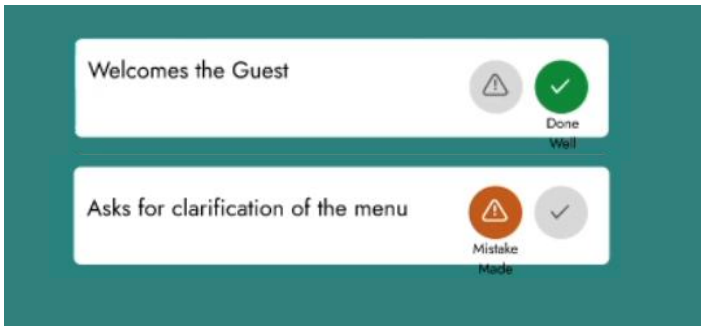


Figure 5.3.6- Simulation page- Guidance- Button Description

See figure 5.3.6 for the Description of the buttons in the UI.

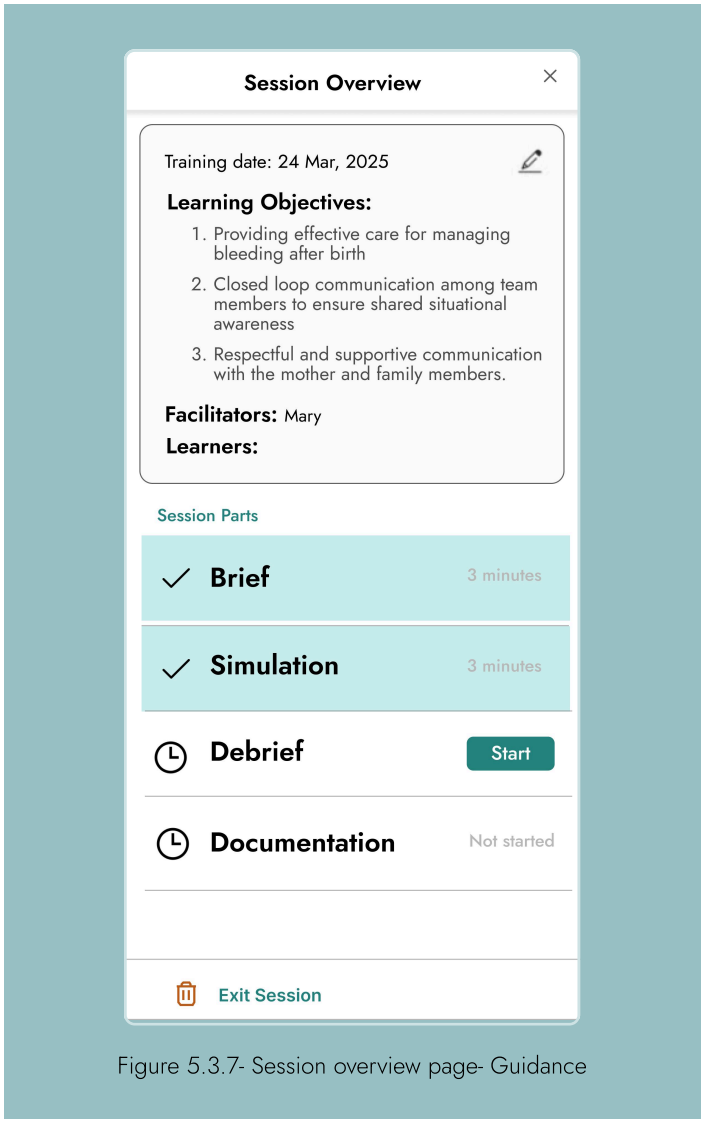


Figure 5.3.7- Session overview page- Guidance

SESSION OVERVIEW PAGE:

The session overview page (see figure 5.3.7) is more similar to the original; it keeps the symbol of done with a check and the colour according to the design system, see page 33. However, it removes the steps of each of the training parts. Like the reducing noise prototype, it also implements a starting location with the call to action green from the design system.

BRIEF/ DEBRIEF PAGE:

The layout for the brief and debrief pages is similar; therefore, only the brief page is shown here (see figure 5.3.8).

The tip for the facilitator is in a box to separate the information from the content visually; however, it is in a light grey box rather than black, so the focus is on the content rather than the box itself.

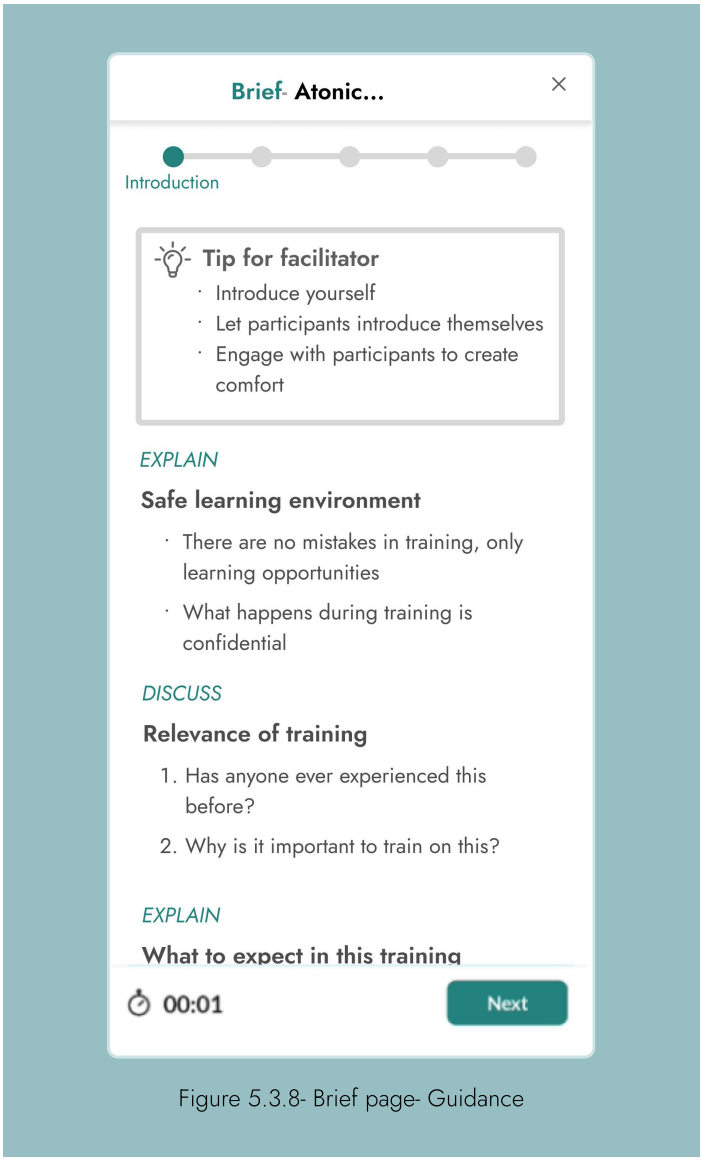
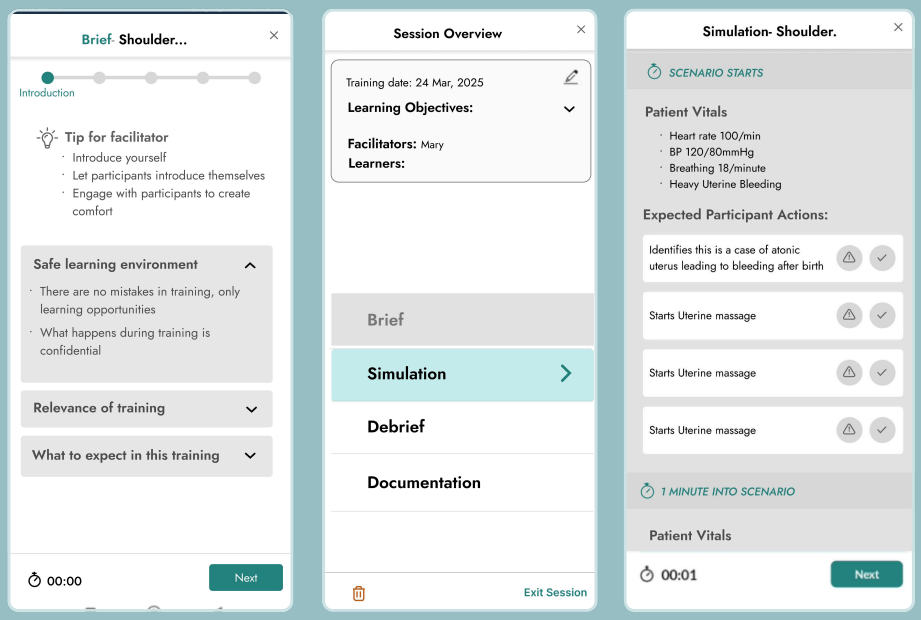


Figure 5.3.8- Brief page- Guidance

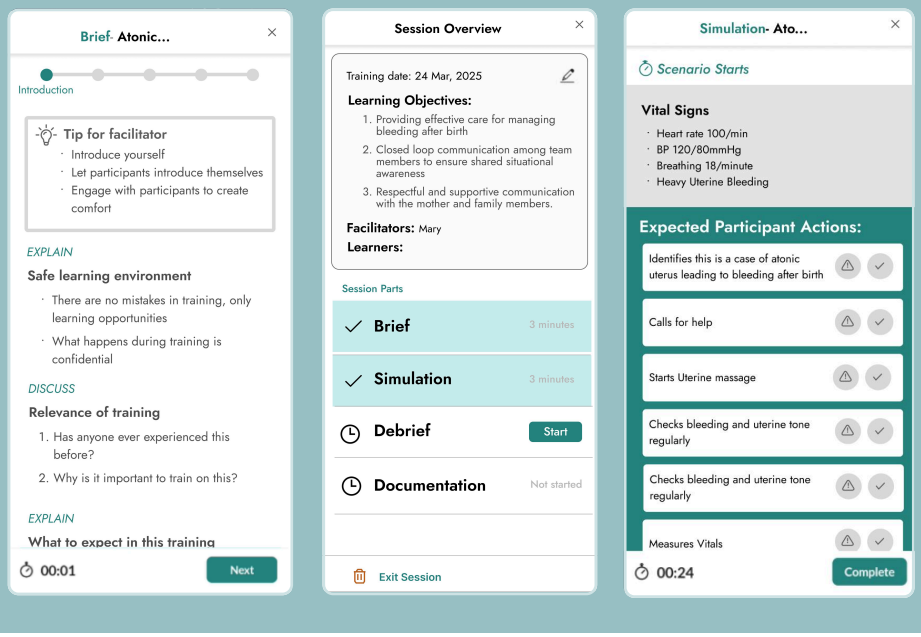
The central part of the guidance prototype is the set of prompts that divide the information on how to approach it. This serves as a way to reduce interpretation for new facilitators.

The guidance and reducing noise pages were developed into a flow to aid in testing the prototypes; however, only minor changes in the prototype are being tested, therefore, the prototypes themselves are similar, and some of the pages have not been fully addressed.

REDUCING NOISE



GUIDANCE



5.4 Conclusion

- How can we improve LIFT Scenarios?
- How can the user needs be met?

This chapter aimed to answer the questions above, through brainstorming potential redesigns of the app, prototyping, inspiration from competitors, and How can we ____ ?brainstorming.

We can improve LIFT scenarios by implementing guidance and simplifying the app. There are many ways to implement these aspects into the app.

This chapter focuses on implementing guidance aspects through prompts, visual hierarchy, and a clear timeline.

Prompts help understand how to approach the text, reducing the need for interpretation. A visual hierarchy tested with the blur test and a code chart test creates a clear focal point that serves as an initial guidance point. A clear timeline removes the ambiguity of how many steps to expect in ach part of the training. The guidance aspects resulted in the Guidance Prototype.

This chapter focuses on implementing Simplicity aspects through reducing noise and Tabs.

Reducing noise removes unnecessary visual stimuli, allowing for a focus on the most important aspect and minimizing extraneous cognitive load.

Tabs help structure the information, allowing the user to decide what they want to focus on at a given time. The simplicity aspects developed into the prototype, Reducing Noise.

The guidance and reducing noise prototype were developed into flows to be able to test the added parts.

5.5 Discussion

HEURISTICS TRADE-OFF

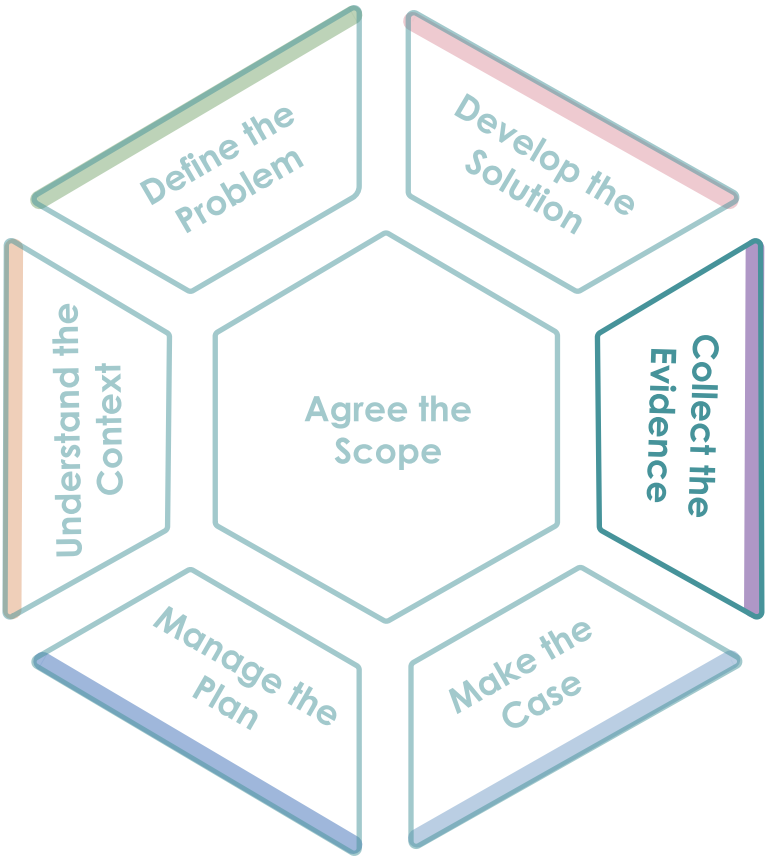
Through creating prototypes, it became evident that strictly following one heuristic can counteract another heuristic. For example, reducing Noise and following simplicity (UH8) impacts the Visibility of the system (UH1). Adding every step in the timeline helps understand the consequence of the user's actions; however, it clutters the page, and depending on who is actually using the platform, it varies in importance. It is important to strike a balance between informing and overwhelming. Similar to Signal vs. Noise.

THOROUGH APPLICATION OF PROTOTYPE ELEMENTS

While creating the two versions of the prototype, the prototypes were created without properly dissecting the key elements and what applying those key elements to all the pages actually entailed. The similarity between the two designs made them comparable in terms of cognitive load. The designs should have initially been more out of the box to develop stronger more cohesive concepts.

FLOW NOT ADJUSTED IN PROTOTYPE FLOW:

The adjusted flow of the pages was not added to the prototype flow. Since the prototypes were already testing a few concepts I didn't want to add more. However therefore the page flow is never tested and evaluated.



CHAPTER 6

Collect the Evidence

Collect the evidence 6

Collecting the evidence takes us back to the original research question this thesis aims to answer.

"How does the application of Usability Heuristics affect experienced cognitive load of the observer's using LIFT Scenarios during medical simulation scenarios?"

This section sees how the new prototypes, developed through usability heuristics, influence the cognitive load.

Answering the questions:

- What should we measure?
- How does the system perform?
- How well are the needs met?

These questions are part of the Improving Improvement model.

6.1 What should we measure

Evaluating the prototypes, this chapter focuses mainly on the main research question, evaluating the cognitive load of the new prototypes. Through Quantitative and qualitative measures, understanding the cognitive load and experience of the new prototypes and their components.

6.1.1 STRUCTURE OF TEST

A test was created to assess the cognitive load of the Guidance prototype (G), the Reducting Noise prototype (RN), and the Original (O), allowing for a comparison between them. A repeated measures design accomplishes this. The Independent variable is the type of prototype (O/G/RN), and the dependent variable is the experienced cognitive load(NASA-TLX).

Each prototype shows the section's brief to debrief; the documentation is not shown since limited interventions focused on this part.

Each prototype uses the scenario "Handling a gluten-free order at a restaurant". This scenario enables participants to utilize the simulation checklist without being a medical professional.

Thereby isolating the effect of the design interventions.

The simulation focuses only on the first 2 minutes of expected participant actions to reduce the test time. During the simulation, a video of the scenario is displayed for the participants to observe. The video changes with the scenario, but it remains constant in the part of the test.

The test is a repeated measures test with the format in the figure below;

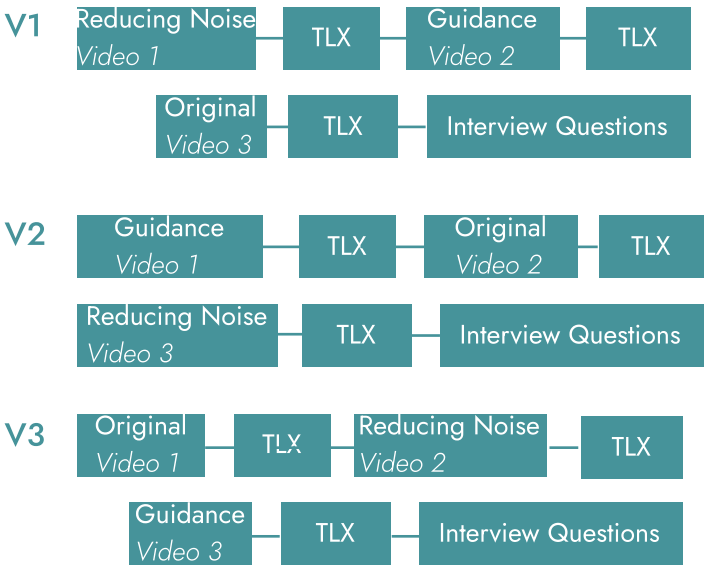


Figure 6.1.1-Repeated measures, randomisation of order of prototypes

The structure of the test and order of the prototypes vary to reduce the effects of fatigue and learning. Although there are six ways the prototypes can be ordered differently, only three versions are utilized in this testing; the limited variation is due to the limited number of participants a total of 8 participants. Each prototype is tested in each of the three potential positions. See the three variations of order in the figure above.

This evaluation employs the NASA-TLX (Task Load Index) subjective rating scale, as it offers a non-intrusive method for assessing cognitive load and due to Its widespread application in cognitive load assessment. Analysis of TLX scored used the ANOVA test, which compares the P-values of three or more groups. During the evaluation, participants watch three different videos featuring actors in varied roles. The audio of the videos was edited using Premiere Pro, subtitles were added, and background noise was reduced through Adobe Podcast AI.

PARTICIPANTS:

The participants are contacted through WhatsApp Master student groups at TU Delft. In total Eight Master students partook in the evaluation. Four male, four female. The limited number of participants were due to the use of qualitative data and its heavy data analysis, as well as the length of the test.

6.1.2 CONDUCTING THE TEST

Each participant is tasked with becoming a facilitator and facilitating the researcher through the training focusing on the sections brief to debrief, since these were the areas that most changes were made.

During the test a script was followed *(see appendix I1)* each participant was given a consent sheet *(see appendix I2)*. Each participant also filled in an initial quiz asking about their experience at a restaurant and facilitating, things that could affect their intrinsic cognitive load. *(See appendix I3)*

The tests took roughly 60 minutes.

6.13 ANALYSIS METHOD

Audio Recording

NASA TLX

The test input consists of TLX scores for two prototypes and the original version, gathered from all participants. In addition, each participant was audio recorded, and the interview sections were transcribed.

THE TLX SCORE is designed to compare the different aspects of cognitive load associated with the prototypes to understand their differences. The scores provide a numerical value ranging from 0 to 100, which allows for statistical analysis.

The six aspects of cognitive load evaluated through the TLX are as follows:

- Mental Demand
- Physical Demand
- Temporal Demand (Time Pressure)
- Performance
- Effort
- Frustration Level

A low score on the 6 aspects indicates a low overall cognitive load. The performance in the form intended for the participant to rank the higher value, the easier it is to achieve a good level of performance. However, the numbers were reversed for the performance aspect to make it easier to graph, so that for all aspects, a lower value is better.

The objective is to determine the statistical significance of the results, using the ANOVA single-factor test for analysis. This method was applied to each factor of the TLX form to compare the prototypes. Additionally, comparisons were made based on the order of prototypes to assess if that had a greater impact than the prototype itself.
The analysis was conducted using an Excel plugin.

To visualize the data and identify potential patterns, the TLX scores were graphed, which facilitated a straightforward comparison of the mean scores for the prototypes.

The interviews were transcribed, and statement cards were created. These cards were classified using thematic analysis, with a particular focus on gathering positive and negative opinions regarding the additional features and the overall user experience.

6.2 How well does the system perform?

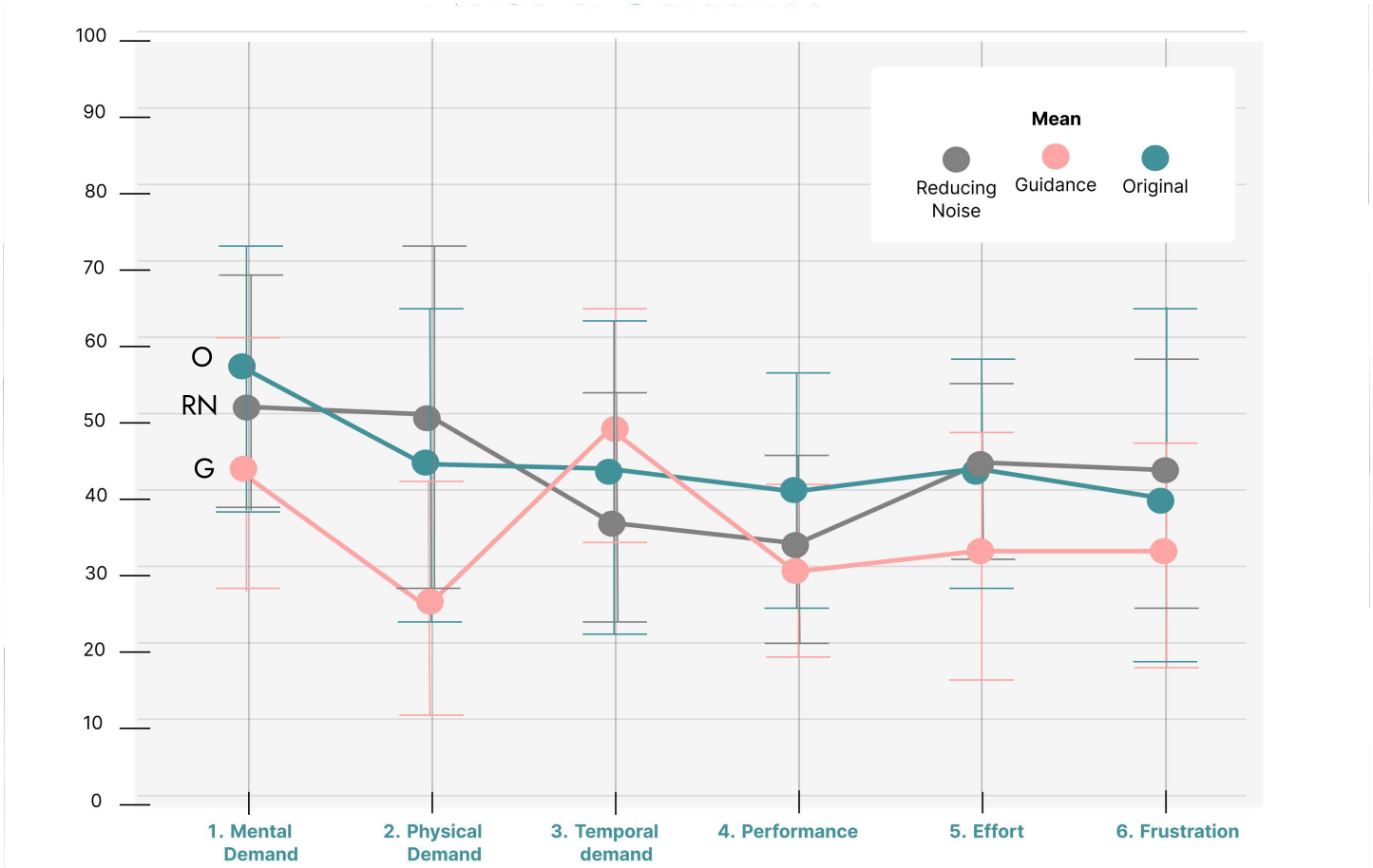


Figure 6.2.1 Mean TLX scores

Evaluating a systems performance this chapter aims to showcase the results and the conclusion from the results. The various graphs and connection between quantitative and qualitative analysis.

6.2.1 NASA-TLX

The TLX six indexes and the prototypes mean scores as well as error bars are shown in figure 6.2.1 A low score indicates that the prototype has lower cognitive load. Therefore a low scoring prototype is ideal. The error bars indicate there is a 95 % probability that if other participants were to rank the prototypes the scores would be in that range. It addresses the certainty of the data. A wider range of the error bar suggests less certainty. *For an overview of the error range for the prototypes refer to appendix I4.*

All three prototypes have a mean below 60 on all six indexes. With mental demand generally highest, then physical demand is considered relatively high, then temporal demand is lower in Original and Reducing Noise however in guidance it peaks on temporal demand. The performance level generally all prototypes find lower than other indexes then effort causes a slight increase and frustration is similar to effort.

Guidance has a mean below reducing noise and original for 5/6 indexes indicating that it is the prototype with lowest cognitive load.

6.2.2 SIGNIFICANCE

Analysing the data through the ANOVA single-factor test showed there is no significant difference in cognitive load between the various prototypes. Overall, the prototype that scored the best was

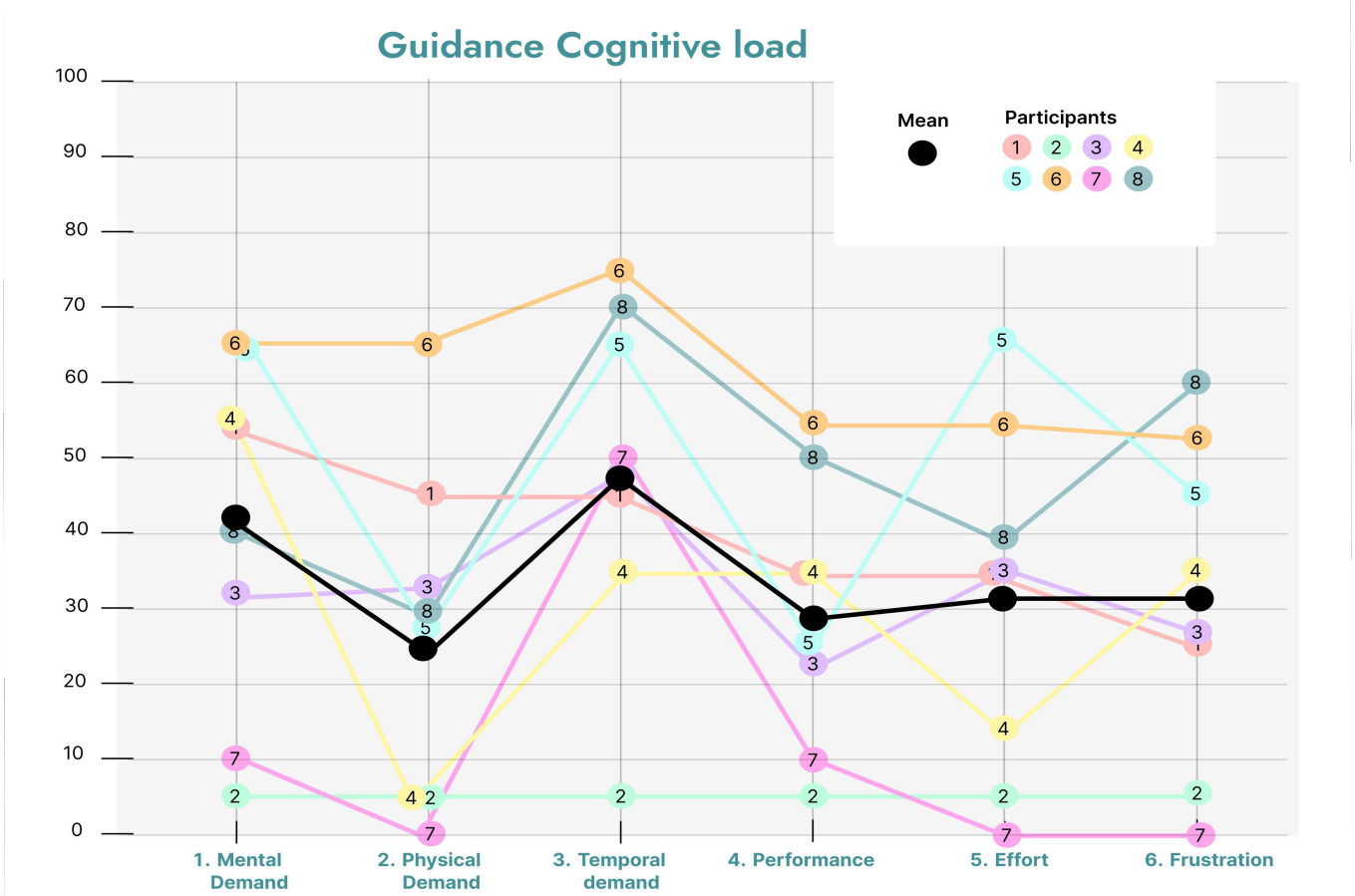


Figure 6.2.2 Guidance TLX scores -Participants and Mean

Guidance; however, the difference was not significant. The p-value ranges from 0.24 to 0.68, which is significantly higher than the 0.05 significance level—Indicating that the results can be due to random chance as the results are not statistically significant.

6.2.3 TLX - GUIDANCE

OVERALL:

The participants answered the ratings quite differently all of the six indexes have a range from 5- 55 with the lowest score 0 and highest 75. Although the general pattern of the participants scores are similar.

MENTAL DEMAND:

The Mental workload varied a lot with half of the participant ranking it below 50 and half above 50.

PHYSICAL DEMAND:

The physical demand is lower than the mental effort where 7 out of 8 participants rank it lower than 50.

TEMPORAL DEMAND:

Temporal demand is the one ranked most difficult, generally most participants ranked temporal demand as one of their highest.

PERFORMANCE:

Performance level was varied throughout the participants. However, still relatively low between 5-55.

EFFORT:

Effort was divisive with half the participants ranking it above 50 and half below, however the majority ranking above 35.

FRUSTRATION:

The frustration ranking is quite divisive ranging from 60 to 0.

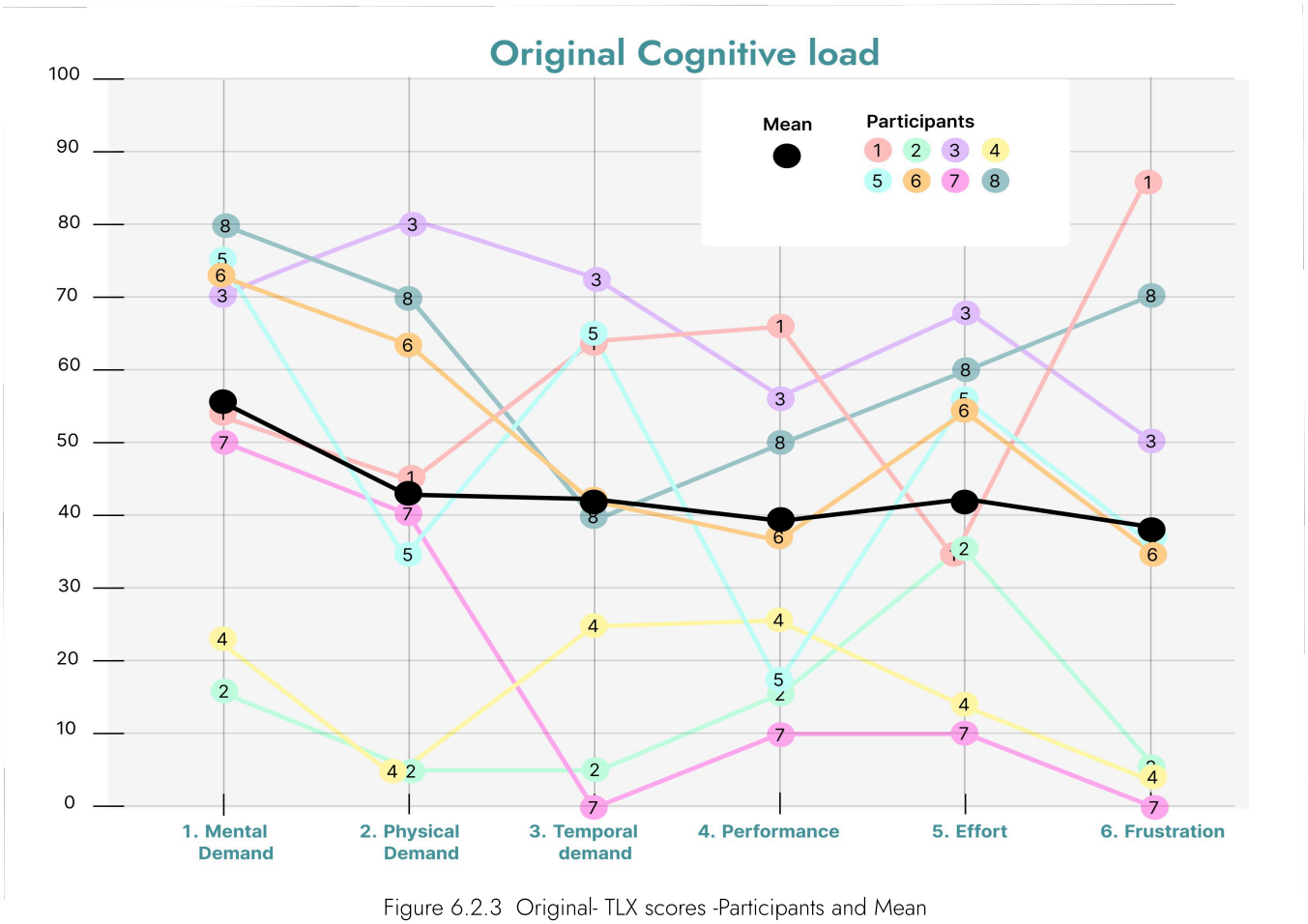


Figure 6.2.3 Original- TLX scores -Participants and Mean

6.2.4 TLX - ORIGINAL

OVERALL:

Comparing the scores from guidance we can see similar answers to the original where the physical demand is lower than the mental demand. Compared to the Guidance prototype the temporal demand did not result in as high peak rather seems generally lower than the physical demand. The data varies from 0-85 a wider range than the guidance prototype. Compared to the other two prototypes the original does not seem to have a peak where the cognitive load is more difficult.

MENTAL DEMAND:

Mental workload was considered high with the majority of participants voting above 50

PHYSICAL DEMAND:

The physical demand is lower than the mental effort there seems to be three categories of votes high physical demand (63-80) Medium low (35-45) low (5)

TEMPORAL DEMAND:

Temporal demand has a wide range of dispersion (0-72) with 50% of participants ranking the demand below 50 and 50% above 50.

PERFORMANCE:

Performance level was varied throughout the participants.

EFFORT:

Effort was divisive with half the participants ranking it above 50 and half below, however the majority ranking above 35.

FRUSTRATION:

Performance ranking is quite divisive ranging from 85 to 0.

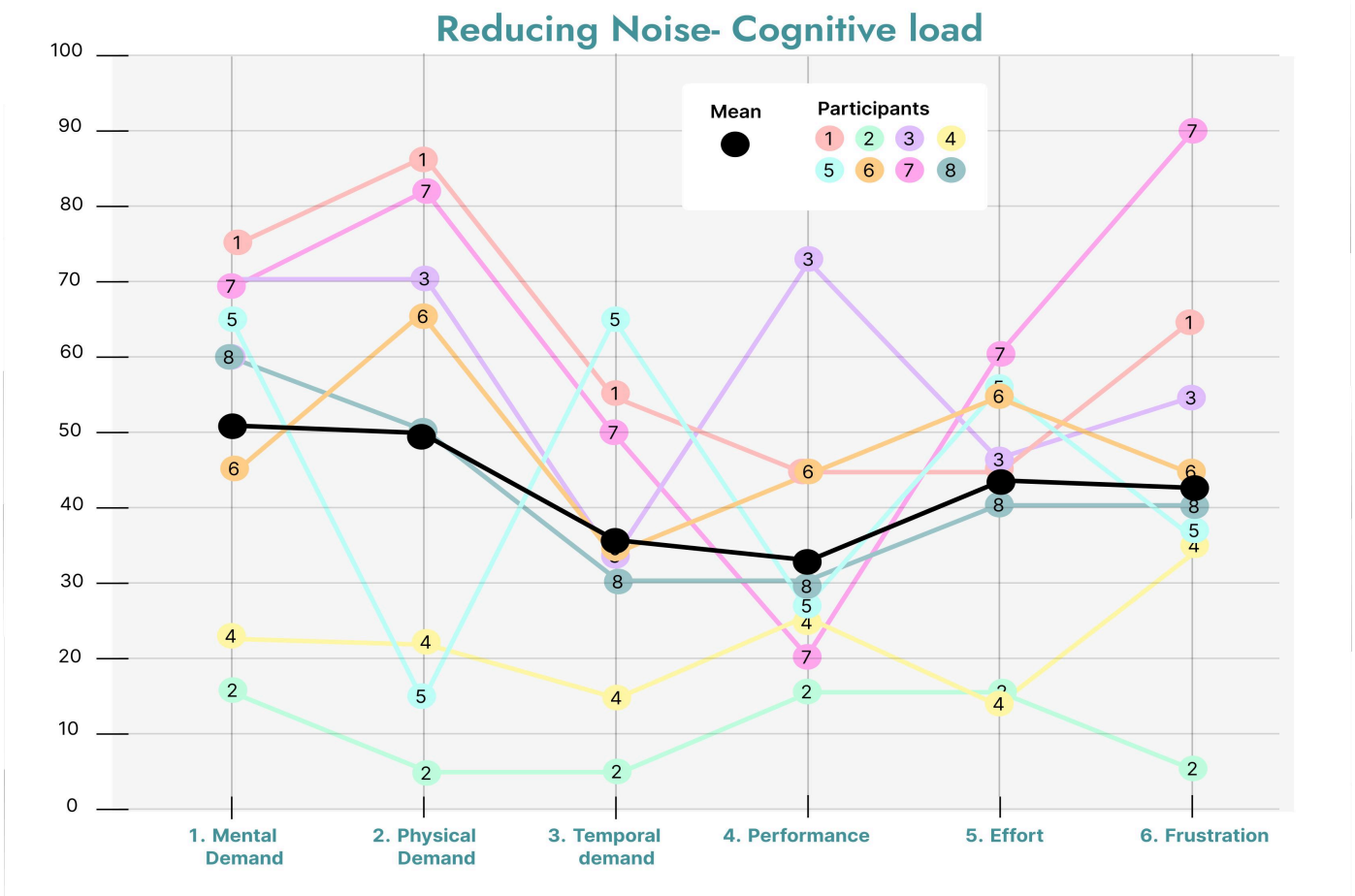


Figure 6.2.4- Reducing Noise- TLX scores -Participants and Mean

6.2.5 TLX - REDUCING NOISE

OVERALL:

Overall mental demand and physical demand seem to be the highest in the reducing noise prototype. Frustration level is generally higher than the temporal demand. There is quite a wide range of answers in this prototype as well from 5 - 90. Therefore indicating that there was a wide variety in opinions. However throughout the prototypes 2 and 4 scored generally lower values

MENTAL DEMAND:

Mental workload was considered high with the majority of participants voting above 40.

PHYSICAL DEMAND:

Physical Demand 5 out of 8 voted higher than 50 Procent. There is quite a variation in scores of the physical demand relating to the information shared in interviews where each participant had quite a different experience when it came to if they liked the tabs or not.

TEMPORAL DEMAND:

Temporal demand was not as united with the answers however the range of numbers is not as large as other measures. (5-65)

PERFORMANCE:

Mental workload was considered high with the majority of participants voting above 40.

EFFORT:

Effort yielded relatively cohesive responses with the majority from the range 40-60 a relatively small range when compared to the other measures.

FRUSTRATION LEVEL:

Frustration level most participants (6/8) rated from 33-65 indicating a medium level of frustration.

6.26 THEMATIC ANALYSIS

OVERALL:

The thematic analysis dealt with analysing the qualitative data, focused on the opinions and behaviours of the participants, understanding why they prefer certain elements. From interviews and observations, statement cards were created that were divided by the prototype they related to, as well as general knowledge.

GUIDANCE PROTOTYPE:

"I preferred prototype G, since it seemed easier to follow had less visual clutter and it was clearer what to do."

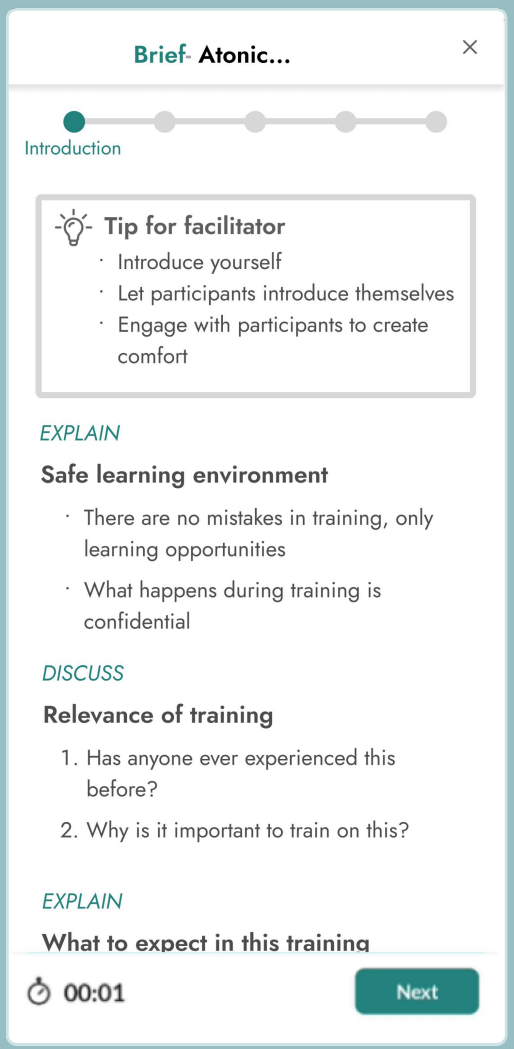


Figure 6.2.5- Guidance Prompts Example

The Guidance prototype focused on two main features that were discussed within the test.

1. The Guidance Prompts
2. Button Description expected participant action

Guidance Prompts Positive:

- Adds structure and helps navigate through the training
- Does not read the prompt but it helps structure the information.
- Did not spend time reading the information rather just scanning therefore the prompts were not visible.

Guidance Prompts Negative:

- Since they didnt see them they didnt see the purpose of having them
- The text seemed self explanatory not necessary with interpretation help.
- The Guidance prompts only really seem helpful to beginners it may be too much when you are routined facilitator.

Guidance Prompts- Redesign

- Add all explain parts under same explain prompt.
- Implement colour to guide the user through the page.
- Implement the guidance prompt in the title.

Figure 6.2.6- Simulation page- Guidance- Button Description

Figure 6.2.7- Simulation page- Guidance- Button Description

Button Description Positive

- Nothing positive

Button Description Negative:

- Since they didn't see them they didn't see the purpose of having them
- The buttons were self-explanatory
- The text is too small to see
- There is already a lot to focus on in the page

Button Description- Redesign

- Do not use idea
- Implement how to interpret buttons in training.

REDUCING NOISE:

The Reducing Noise prototype focused on one main feature that were discussed within the test.

1. The tabs

"Dropdown menus are good, I dont have everything at once if it is a real scenario then I want the participants to think I am prepared, one look and I know what is coming instead of having to scroll."

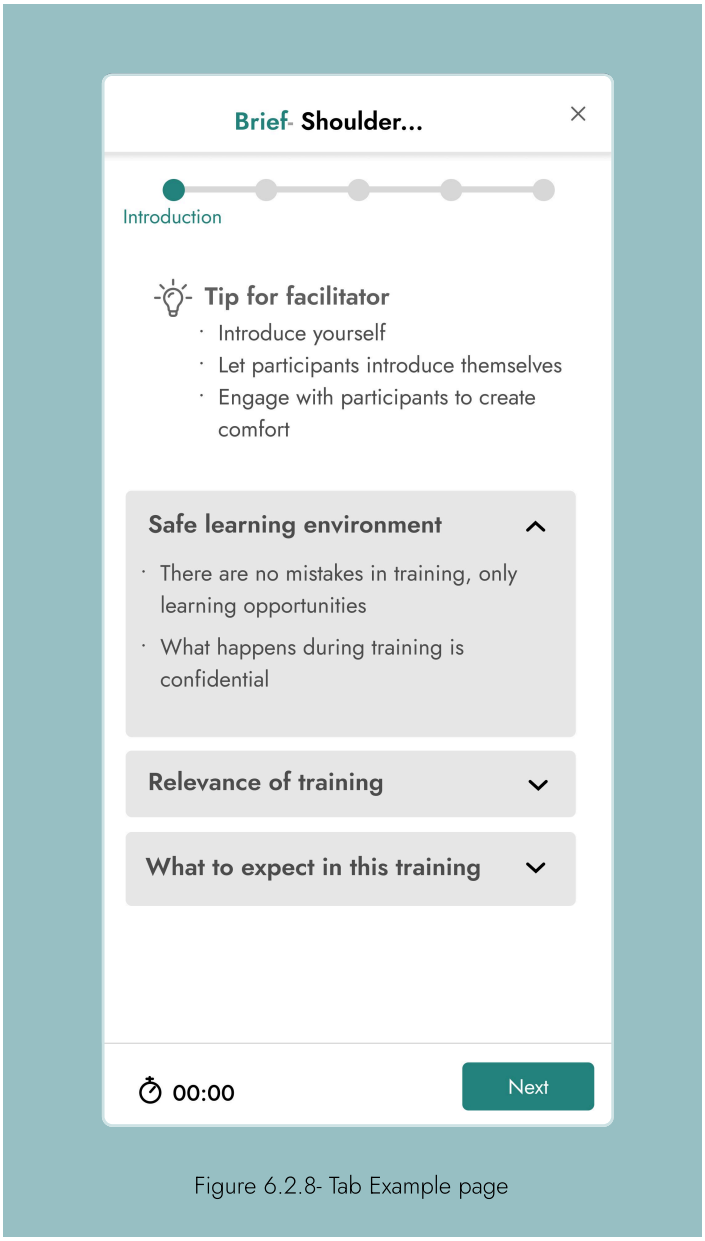


Figure 6.2.8- Tab Example page

Tab Positive

- Add structure to the training
- Reduce overwhelm caused by a lot of text
- Help control one thing at a time
- Overview of what to expect without scrolling
- Easier to scan, reduces the likelihood of getting stuck reading

Tab Negative

- Opening tabs becomes overwhelming- adds more work on facilitator
- Expectation to open all the tabs as not to miss anything
- Some text amount seems unnecessary to put in tab- tabs are expected to have a certain amount of information.

Tab - Redesign

- Ensuring the tabs are relevant for the page
- Auto setting to have the first tab open
- The text should be long enough to justify having a tab

TIMELINE:

The new timeline focused more on the process rather than the step the users were in. The current step was more challenging to see, but it was easier to see the progress; therefore, it was easier to see how the pages connected. The old timeline is read as more of a heading, whereas the new one is seen as a progress bar, most likely due to its visual nature compared to the textual nature of the old timeline.

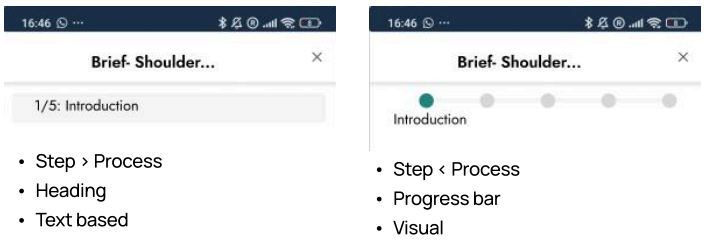


Figure 6.2.8- Timeline Comparison

Having a timeline focusing more on the progress highlights that the current step is not an isolated part, but rather a part of the overall subpart.

IMPORTANT ASPECTS:

The Participants highlighted three important aspects

1. The importance of proper training and knowing what to expect
2. The importance of simplicity over complexity (As shown in the preference for guidance prototype)
3. The training platform should allow them to become a good facilitator

There were many qualities that arose from the tests about being a good facilitator, see figure 6.2.9

Above all they wanted LIFT Scenarios to support them in being what they consider a good facilitator.

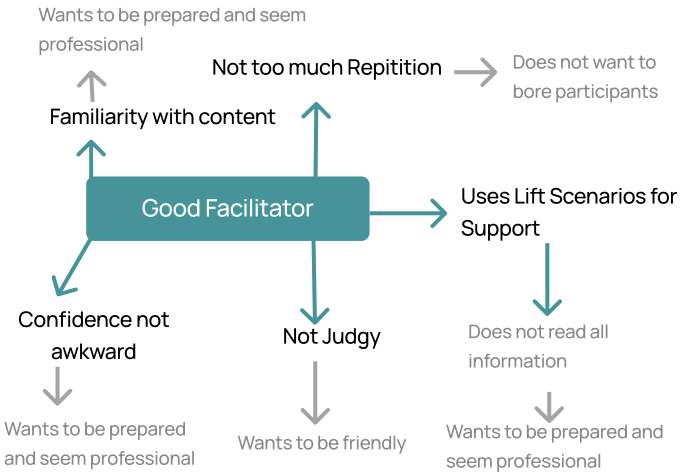


Figure 6.2.9- Participants opinion-Qualities of a good facilitator

GENERAL:

- Mandatory things increase burden.
- External motivation influenced the scores.
- Reducing Noise and Guidance prototypes were very similar therefore received somewhat similar scores.
- Technical issues affected scores given; Opening tabs was quite burdensome due to slow figma prototype.
- Reading the material while talking seemed like a poor facilitator.

Connecting Quantitative And Qualitative Data:

This section focuses on comparing quantitative and qualitative data. Testing with both qualitative and quantitative data helps interpret performance from many lenses.

When looking at the NASA TLX Forms;

Overall there is a higher temporal demand which indicates a time stress, similar to what is experienced throughout the test and what participants mentioned in the interviews **" I don't have enough time to look through all the steps and observe"**- Quote from participant

Additionally the level of frustration was the highest in the reducing noise prototype similar to what was said in the interviews where the prototype technical difficulties added to the frustration and effort.

Frustration level and effort may have been impacted by the order of the prototype since many participants mentioned and visibly got more tired and less motivated towards the end due to its repetitive nature.

Although the Guidance prototype was the lowest scored in the TLX Form. The participants preference varied when discussing their preferred prototypes. Figure 6.2.10 shows the participants with the prototype they preferred. Some of the participants ranked two of the prototypes the same therefore their number is in multiple sections.

Figure 6.2.10- Participants prototype preference

The ranking of the cognitive load in the TLX Quantitative form does not always align with the participants preference in the interviews.

Participant 2 and 3 preferred the prototype Reducing Noise but voted lower cognitive load for Guidance

Participant 6 liked Guidance and Original but voted lower cognitive load for Reducing Noise.

6.3 Conclusion

This chapter focused on answering the questions

- What should we measure?
- How does the system perform?
- How well are the needs met?

We measured cognitive load as well as the perception of different additions to the prototypes. The cognitive load was measured using the task load index, and the perception of prototype elements was tested through interviews and observations during a user test.

The system showed that the prototypes are generally similar; therefore, it is difficult to have a clear prototype that is preferred. In general, however, the guidance prototype scored lower on 5/6 indexes; therefore, it is the one with the lowest workload.

Figuring out how well the needs are met is more complex in general, as the reduction in cognitive load is not significant according to the Anova single factor test; therefore, it may require more effort to reduce the actual cognitive load.

6.4 Discussion

The results of the testing indicate the problems similar to chapter 5, that the prototypes are very similar therefore the ability to differentiate the scores is difficult.

The testing format has a lot of limitations, making it difficult to generalize the findings.

SMALL SAMPLE SIZE:
The small sample size was used since the data analysis focused on qualitative and quantitative analysis, having a large number of participants, although making the data more reliable, makes it very difficult to analyse all the raw data. Qualitative analysis is very time-consuming, and the more participants, the more time required.

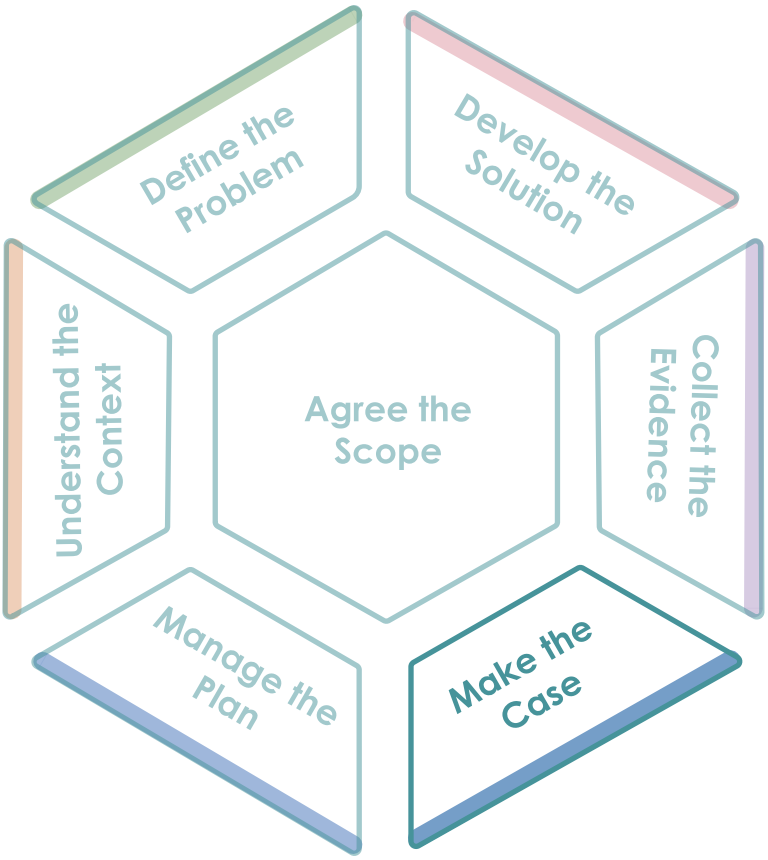
TESTING A SMALL PORTION OF THE TEST:
Testing a small portion of the test is another limitation; the observation length of the scenario was shortened from ~7 minutes to ~2.5 minutes as a way to shorten the time spent on each prototype. This, however, means that the prototypes were tested on a shorter version and cannot be assumed to be used the same way as when the scenario is longer.

NO PREPARATION BEFOREHAND:
Apart from the typical scenario where facilitators have time to look at the facilitation material beforehand, the facilitators were not given any material; therefore, the role of the facilitator may have been at times more difficult or perceptively simpler.

REPETITION OF THE TEST:
The repetitive nature of the test resulted in many participants losing motivation towards the end, where they were less encouraged to go into the role of a facilitator. A lot of them felt exhausted by the last prototype.

NASA TLX FORM:
The better scores (lower cognitive load) are lower values. Although this was mentioned to the participants initially, this may have been confusing for some of the participants since usually to a high rank ranking is considered better.

QUALITATIVE & QUALITATIVE:
A mixed methods approach to this Evaluation helps interpret the data from many viewpoints. Looking at the data and recognizing a pattern, then going to the qualitative data and finding why that pattern exists. Furthermore the questionnaire acts as a forced ranking helping participants easier compare the prototypes.



CHAPTER 7

Final Redesign & Test Plan

7.1 Developing the Final Redesign

The final redesign and test plan considers the limitations of the prototypes, increasing guidance, and reducing noise by addressing the simulation page. The final prototype focused on the simulation pages, which had previously been avoided since they are primarily dependent on the difficulty of the simulation, which was challenging to replicate and test. However, the simulation is the most challenging part of the training, therefore deserving of attention.

This final part looks at categorizing the simulation pages in the following ways;

- Simplifying the expected participant actions.
- Increasing visual hierarchy
- Chunking the sections of the training, attempting to increase the ability to scan the text.

7.1.1 SIMPLIFYING EXPECTED PARTICIPANT ACTIONS

To simplify the expected participant actions, an analysis of the current actions was done.

ACTIONS THAT REQUIRE INTERPRETATION TAKE LONGER TO OBSERVE.

Example 1- High level of interpretation

"Comforts the mother"

This example illustrates an action that requires interpretation and an understanding of good non-technical skills, such as comforting. This action, although deceptively simple, requires a lot from the facilitator /observer of the scenario.

Example 2- Low level of interpretation

"Measures vitals"

Unlike the example above, measuring vitals does not require the same level of interpretation. "Measuring is a Quantitative measurement." It is done or not done. It does not require as many non-technical skills.

Example 3- Medium interpretation

"Assign roles and communicate the diagnoses to the team and mother"

This example requires some level of interpretation and knowledge of good non-technical skills, including who should be doing what, how to assign roles correctly, and how to communicate with the mother respectfully.

ACTIONS THAT REQUIRE EXPECTED FACILITATOR KNOWLEDGE, MAY CAUSE MORE COGNITIVE LOAD.

Example 1- Required knowledge is medium

"Looks for effective sucking signs and swallowing sounds"

This example requires the skillset and experience to know the effective sucking and swallowing signs. However, it does not look at non-technical skills.

Example 2 - required knowledge is high

"Performs antenatal assessment"

This example requires a certain skill level and knowledge of the antenatal assessment, therefore requiring the facilitator/observer to know the steps of the procedure. This can cause an extra cognitive load, as the facilitator must recall the steps of the procedure.

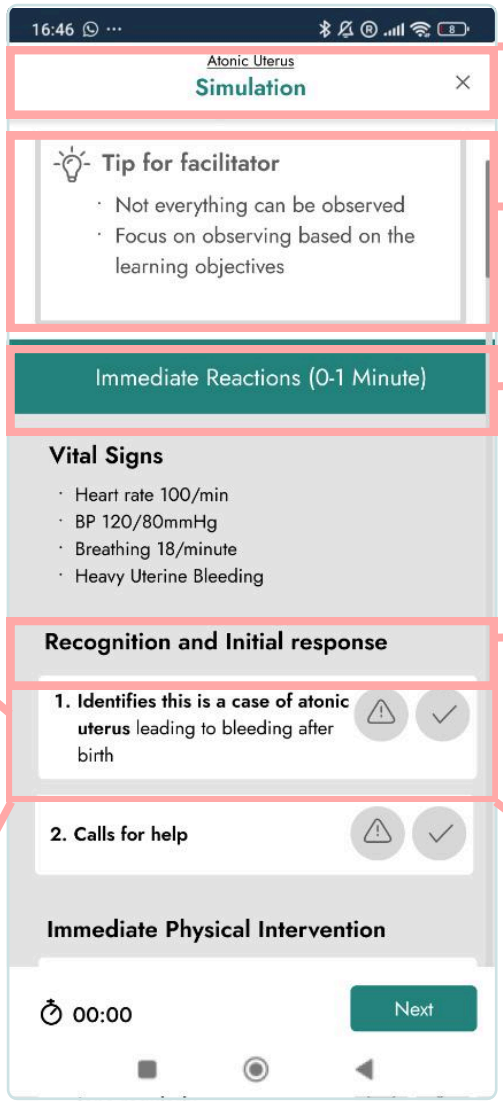
DIFFICULTY OF EXPECTED PARTICIPANT ACTIONS

The difficulty of the expected participant actions is therefore categorized into;

- The difficulty is related to the required previous knowledge necessary to understand the action
- The amount of information to recall
- The level of interpretation
- The length of the action

This is not meant as a way to remove more difficult actions since it is often the harder to observe actions, generally non-technical skills that may need more work and require training. This is only an explanation to better understand the inherent difficulty of the expected participant actions.

7.1.2 FINAL REDESIGN



Title on Top
The name of the training is on top so that the information is always available for the facilitator

Tip for Facilitator
The Simulation is the most difficult part therefore adding tips to this part to add reassurance.

Larger subsection
The subsections have expected part of the training not only time, this way they help the facilitator structure the training. It also makes it easier to implement tabs.

Smaller Subsections
The smaller subsections help divide the expected participant actions into chunks, they can then be processed as a chunk instead of multiple individual actions.

Larger Buttons
Larger buttons to make it more accessible for phone.

Numbering
Numbers act as a way to remember the expected participant action and make it easier to take notes.

Heirarchy
Adding Heirarchy to Expected Participant actions.

Figure 7.1.1 Final Redesign Simulation Page

The final redesign focuses on small interventions that can have a significant impact, including chunking and visual hierarchy, addressed in sections 7.13 and 7.14. The following text focuses on the minor details that have been changed that influence the experience.

TITLE ON TOP:

The title at the top addresses the Visibility of the system (UH1), where the user can see the step they are in. During user tests, participants noted the difficulty in seeing only part of the title, which caused them to forget the scenario they were working with momentarily. Additionally, they mentioned the cut-off title as distracting.

TIP FOR FACILITATOR:

The tip for facilitators is added to the simulation pages as well to guide novice facilitators and increase consistency within the app (UH4).

NUMBERING:

Adding numbers to the expected participant actions serves as a way to take manual notes during the simulation so that it is easier to refer back to which expected participant action it relates to.

Larger buttons, small and large subsections, as well as hierarchy are all addressed in the following sections.

7.1.3 INCREASING VISUAL HIERARCHY

Is there anything we can do to make the actions easier to interpret and scan?

This section focuses on increasing the ability to scan the page, thereby enhancing the speed of reading the information in an attempt to reduce the cognitive load of the list of actions.

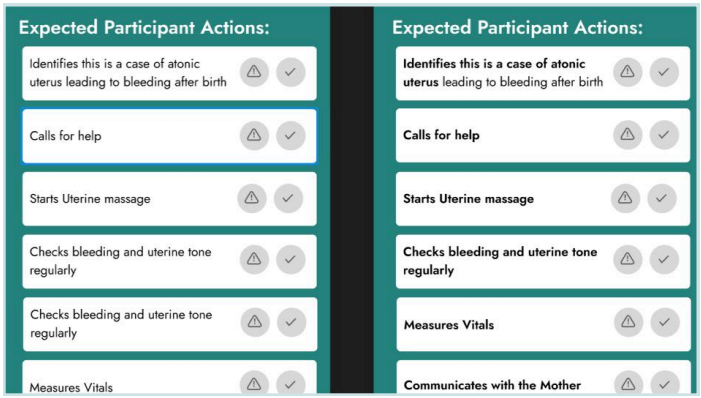


Figure 7.1.2 Increasing Visual Hierarchy

Increasing the visual hierarchy makes certain parts of the actions bold, so that they visually draw attention. Creating a hierarchy within the expected participant action reduces the amount of text required to read without removing the content.

Putting the most important information in bold and supporting information in regular font. This makes it easier for a facilitator to scan the expected participant actions.

See figures 7.1.3 and 7.1.4 for examples of how the hierarchy is applied to the expected participant actions. In 7.1.3 there is an addition of bullet points since the action is relatively low and contains many subparts. In 7.1.4 the non bolded text serves as supporting text to the main action.

Formatted as;

Main action-Bold

supporting information- Regular text

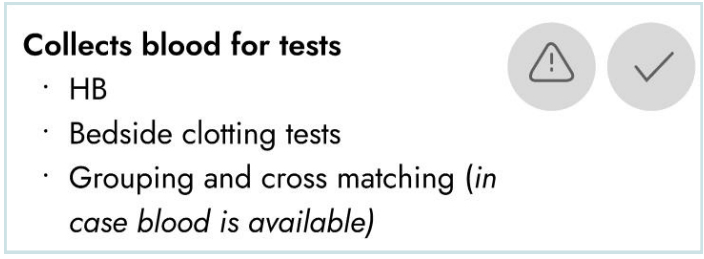


Figure 7.1.3 Expected participant actions- sub steps

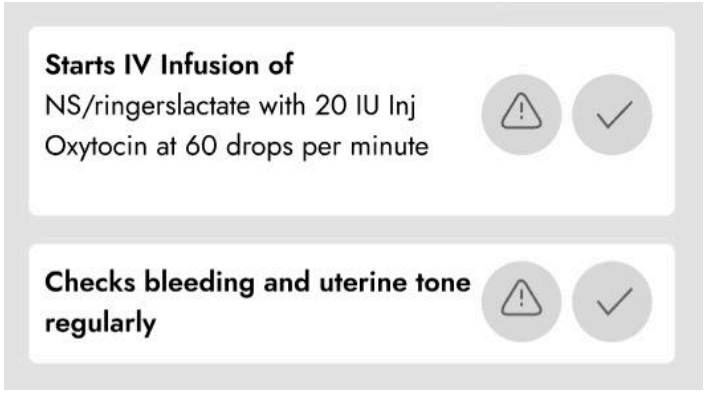


Figure 7.1.4 Larger button size for expected participant action

LARGER BUTTONS:

Increasing button size for mobile screens to improve accessibility. See figure 7.1.4 The smaller buttons were addressed as a pain point during evaluation of the prototypes.

7.1.4 CHUNKING SECTIONS

"Concepts and procedures that consisted of multiple elements can, with increases in expertise, be stored in long-term memory as a single element that is transferred to working memory for use in appropriate environments" *(Sweller m. fl., 2019, p. 277)*

To reduce cognitive load experience, chunking items so that they are processed as a singular unit is attempted.

ADDING NUMBERS:

To facilitate writing notes on the expected participant actions a simple intervention such as adding numbering can be explored. See figure 7.1.5

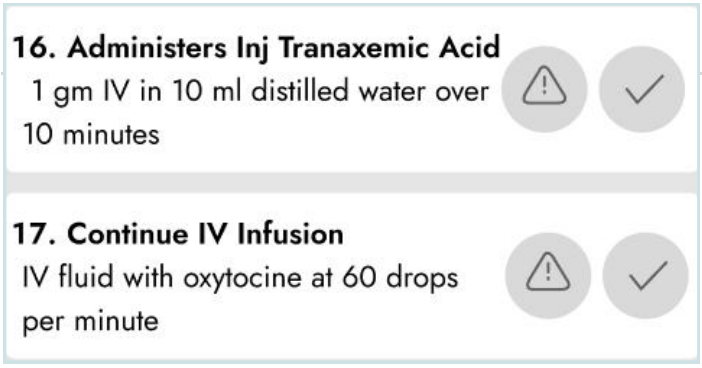


Figure 7.1.5- Adding numbers to expected participant actions

Additionally, to facilitate scanning the expected participant actions, the actions that are currently broken down into time-based sub-sections can be divided into;

- primary,
- secondary,
- and ongoing actions

as well as subsections such as:

- physical administration,
- fluid management,
- drug administration,
- communication,
- and monitoring.

In this way, it is easier to tackle one subsection of actions at a time and address the sections systematically, reviewing the actions within them.

These subsections also serve as a basis for drop-down menu expected actions.

Dividing the expected participant actions into chunks removes some of the necessary working memory resources since chunking can help categorize multiple pieces of information and help it be processed as one singular chunk, thereby requiring less cognitive resources.

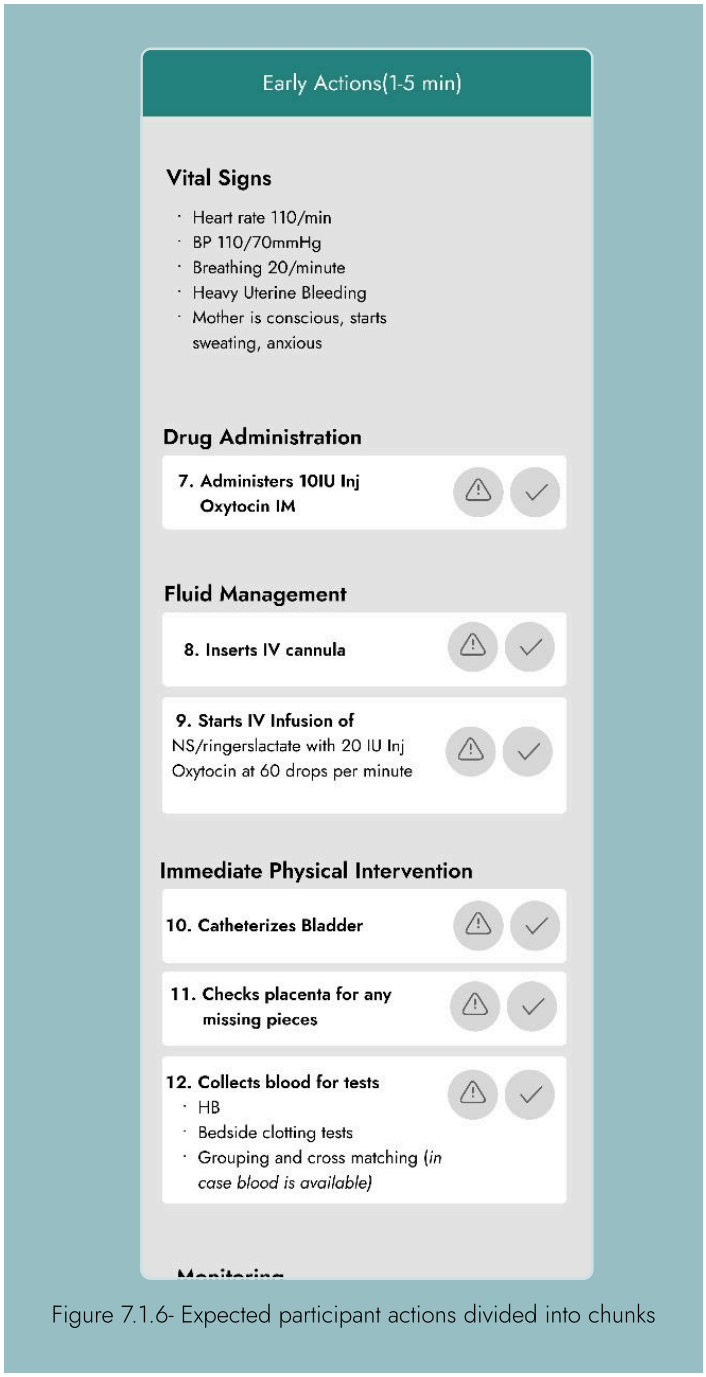


Figure 7.1.6- Expected participant actions divided into chunks

and help interpret the cognitive load. Therefore as part of the final deliverable a poster on how to test cognitive load of an app is developed. This can be further developed as a way to test other training platforms.

Note: All the test formats have their own limitations that are caused by not being able to test the real scenario or how it was developed.

7.2 Developing the Final Test

Although this thesis aimed to improve the cognitive load of the LIFT scenarios it has simultaneously explored a wide variety of user tests to expand on

Adapted from the Master Thesis;

Exploring cognitive load in simulation-based training- A case study of a medical training platform

HOW TO TEST THE Cognitive Load of an application

Prepare

App

1. What application do you want to test the cognitive load of?
2. Where is the app used ? What users and conditions are necessary during testing?
3. Why do you want to test the cognitive load of this app?

Task

1. Decide on the task you want to test
2. How much previous experience is required for this task?
3. How difficult is this task?

User

1. Decide the User you want to test with. Novice vs. Expert users?
2. Recruit participants to test with
3. Inform participants what to expect during testing

Aim for a minimum of 7 participants

Test

1 Background & Consent

Inform the participant about the research's aim, their role, and the test's structure. Let them know about the data collection methods.

2 Cognitive Pre-test

To address the initial cognitive load and see what potential cognitive load may influence the user, ask the participant to fill in a cognitive pre-test.

3 Task

- While the participant is performing the task, film the task to check for facial expressions, longer pauses or task fixation (signs of high cognitive load)
- Have an observation checklist. Observe the participant and write notes or comments to ask in the interview

4 TLX- Form

Explain the NASA-TLX Form and how to complete it.
2. Let participants fill in a NASA- TLX form

5 Interview

Ask follow-up questions about the TLX form:
- Ask Participants to explain the reasoning behind their ratings.
- Ask them the questions from observations
- Ask them prepared questions about the app

Analyse

Quantitative

- Visualize the data
- Interpret the data, find mean scores, statistical analysis, compare dispersion.
- Compare data to qualtitative findings

Qualitative

Process raw data:
- Transcribe the interview, look through the videos
- Notice any themes
- Cluster quotes or facial expressions into themes.

This poster gives an overview of a potential method of looking at cognitive load when analysing the cognitive load of a task within an app. This poster was created as part of the Master's Thesis "Exploring cognitive load in simulation-based training- A case study of a medical training platform".
**All user tests have to be adjusted to the context and the users. This is just a general starting point

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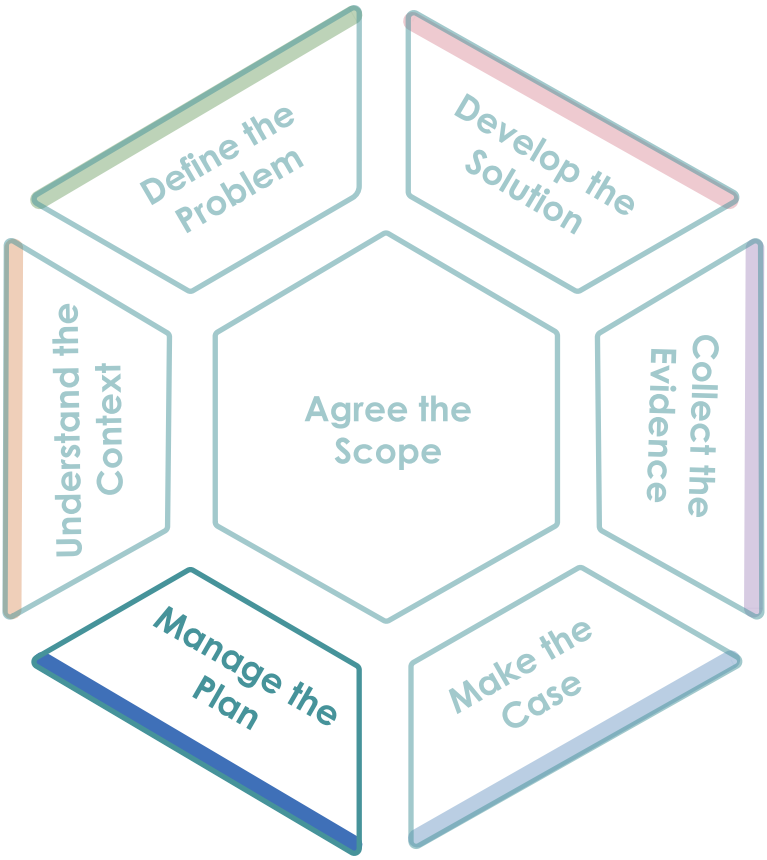
7.2.1 EXPLAINING THE POSTER

The poster aims to provide a general approach for measuring cognitive load in various applications. In this way, it can be used for contexts outside of LIFT Scenarios. The methods demonstrated in this poster aim to be low threshold, not requiring an advanced skillset or tools, so that they can be used by more researchers and be less time-consuming.



CHAPTER 8

Conclusion & Reflection

Conclusion & Reflection 8

The final chapter of this report aims to evaluate the process taken in this report as a whole. Each chapter has its own conclusion and discussion that emphasizes the decisions taken in that specific part of the design and research process. This section instead focuses on how the parts connect to each other and the overall methods, conclusion and reflection on the entire process.

8.1 Conclusion

8.1.1 ANSWERING THE MAIN RESERACH QUESTION

This research aimed to identify:

the extent to which usability heuristics aid in reducing cognitive load experienced by the observers while using LIFT scenarios during medical simulation training.

This question is answered in two parts: first, by examining how usability heuristics reduce cognitive load, and second, by evaluating the extent to which this reduction is possible.

This thesis shows that applying usability heuristics has only a small effect on perceived cognitive load. Eight participants completed the NASA-TLX questionnaire for both redesigned and original prototypes. While some differences appeared, ANOVA tests confirmed they were not statistically significant (all p-values > 0.05).

Usability heuristics and cognitive load factors are interrelated. Some heuristics directly target cognitive load—for example, Recognition over recall (UH6) reduces memory demands—while others act indirectly. Aesthetics and minimalism (UH8) reduce extraneous load by minimizing noise, aligning with the redundancy effect. Similarly, the split attention effect relates to Consistency and standards (UH4) and Match between system and real world (UH2), as inconsistent or unfamiliar designs increase divided attention. Flexibility in use also reduces both intrinsic and extraneous load by accommodating varying user skills.

Aesthetics and minimalism (UH8) reduce extraneous cognitive load through reducing the noise of the platform, which aligns with the redundancy effect, where redundancy is noise.

Additionally, the implementation of flexibility in use reduces the intrinsic load as well as the extraneous load for a variety of different user skill sets. This addresses the differences in the experienced usability and cognitive load between users.

When increasing the usability of a platform, it is essential to address extraneous cognitive load. When a product has good usability, it generally has low extraneous cognitive load. The difficulty in using a platform and understanding the system should not detract from the primary function.

To evaluate the extent to which usability heuristics can influence cognitive load, it is essential to recognize that usability heuristics primarily focus on reducing extraneous cognitive load. The findings in this thesis however, suggest that most of the experienced cognitive load is intrinsic, therefore the reduction of extraneous cognitive load may be minor in comparison to the intrinsic load of using the platform, observing and dealing with the materials.

The application of usability heuristics to LIFT scenarios cannot replace a knowledgeable facilitator. A simpler scenario and a more experienced facilitator will experience less cognitive load as compared to a novice facilitator.

Although novice facilitators were addressed in this thesis, an important point is that we can only reduce cognitive load to a certain extent by addressing the platform. The most important thing to consider when reducing cognitive load is for facilitators to understand the scenario, simulation training (such as SIM Begin), and the platform they are using. Therefore, to adequately address the cognitive load, we must increase the skillset and knowledge of the facilitator.

8.1.2 ANSWERING THE SUB-QUESTIONS

Q.1. To what extent can LIFT Scenarios be simplified without losing its accuracy?

Q.2. Can the usability metrics application enhance workflow?

Q.3. What does the Ideal simulation Scenario look like?

Q.4. What does the facilitator /Observer do to prepare?

Q. 1- TO WHAT EXTENT CAN LIFT SCENARIOS BE SIMPLIFIED WITHOUT LOSING ITS ACCURACY?

This question is difficult for to assess the simplification of the platform may inherently reduce the guidance and go against design heuristic 1. Simplifying as mentioned in design heuristic 8 aesthetic and minimalism does not mean minimalism it focuses primarily on reducing noise, unused visual or textual features. This ties back to some of the cognitive load effects such as redundancy effect which when removing redundancy you remove noise and then you improve aesthetic and minimalism. There is a design trade-off between the level of simplification and amount of guidance at the users disposal.

Q. 2 - CAN THE USABILITY METRICS APPLICATION ENHANCE WORKFLOW?

The application of usability metrics can enhance some elements of the workflow. Looking at flexibility in use (UH7), it specifically discusses the varying needs for the different expertise of the users. Implementing aspects of flexibility in use, we implement discoverable accelerators which reduces some of what may become noise and redundancy through developing expertise. Therefore enhancing the workflow. Think about all the keyboard shortcuts used that enhances the efficiency to which a task is done.

Q. 3 - WHAT DOES THE IDEAL SIMULATION SCENARIO LOOK LIKE?

The ideal simulation scenario is addressed in chapter 3 when looking at simulation training as well as in chapter 4 comparing the ideal to the actual scenario through a story board. In a simplified form an ideal simulation scenario consists of; clear learning objectives, good observation, debrief that focuses on tackling underlying values rather than an incorrect action. As well as key take aways.
A successful training is often done with an experienced facilitator.

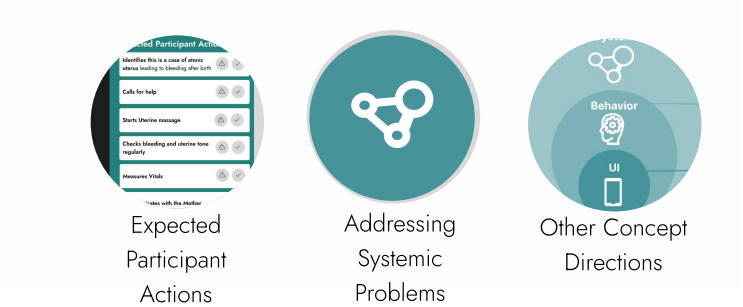
Q. 4 - WHAT DOES THE FACILITATOR /OBSERVER DO TO PREPARE?

The facilitators preperation is tackled in chapter 4, through discussions with Laerdal and a user journey map.

All facilitators get training on simulation training through a SIM begin course focusing on conducting a good brief and a good debrief with the CORE Context Observation Reflection Enhancing practice, methodology.

Before a training they oftentimes look through the scenario so they know what to expect.

8.1.3 FURTHER RESEARCH



Further research that is required is manifold.

Including finding ways to simplify the expected participant actions, addressing systemic problems, context of use. other factors influencing performance such as motivation and attention.

EXPECTED PARTICIPANT ACTIONS

For the specifics of this thesis, more research can be put into how to formulate easy-to-understand expected participant actions, which may include:

- An easy translation tool so that participant actions can be altered depending on the country and language spoken in the clinic and or hospital
- A system of using similar participant actions in the hospital training overall.

ADDRESSING SYSTEMIC PROBLEMS

Secondly, this thesis worked on a narrow scope; therefore, many aspects were not considered when developing prototypes and designs for the system. This aspects can be further developed and understood through more research.

1. Lower digital literacy
2. Cracked, broken screens.

OTHER CONCEPT DIRECTIONS

Additionally, further research can examine one of the other concept directions, such as

- The Training system, how to improve quality holistically
- Adaptability to various users, ways of using, and skill sets.

CONTEXT OF USE

Since a lot of the cognitive load is dependent on the facilitator. Testing in the actual context of use with the real facilitators is necessary. This allows for understanding of the distractions the attention resources and motivation of the facilitators.

MOTIVATION

Further research should also look at motivational effects and selective attention. Through discovering ways to increase motivation within the platform as well as ways to maintain attention.

ATTENTION

Further research should also focus on attention and observation. Due to the new digital age the attention span has drastically reduced. However, keeping and maintaining attention is necessary for a successful training. Further research could therefore focus solely on attention and simulation training.

8.2 Reflection

8.2.1 WHAT WENT WELL

USING QUALITATIVE AND QUANTITATIVE RESEARCH METHODS.

The use of both qualitative and quantitative research methods in the user tests helped complement each other. The quantitative methods include forced ranking and comparison between metrics as well as prototypes. This can be used as a starting point for discussion in the qualitative analysis. Quantitative analysis aims to see the data, what it is and how people ranked and the patterns that emerge. Where Qualitative can address why the patterns emerge and why people voted that way.

EXPLORATION AND EMPHASIS OF THE SIMULATION TRAINING

This thesis focused on a broad exploration of a variety of exercises. The breadth of the exploration aims to see the simulation training and the other elements from a broader perspective.

A LOT OF LEARNING

This thesis focused on and allowed for extensive learning about cognitive load, simulation training, usability heuristics, and user testing. Additionally, a personal goal was to get more comfortable with various types of user testing and observations. This goal was achieved through a variety of user testing methods to understand cognitive load and usability.

TESTING WITH ACCESSIBLE GROUP

Although testing outside the target group is generally not advisable, the accessibility and amount of time master students can offer help, generates a deeper understanding of why a product is used in a certain way. Although the resulting data can not be generalisable, it does not mean that the data holds no value. The data from testing outside the target group can be used to develop better user tests and ask the right questions when testing with the target group that has a limited amount of time.

Testing with healthcare professionals is always challenging since they have a limited amount of time; it is essential not to waste any of it, as they often do not have time for additional questions or reflections on their actions. Therefore, testing outside of the target group with people who are able to have the time to reflect more on their actions can act as possible explanations for that behaviour happening in the real context of use.

8.2.2 WHAT CAN BE IMPROVED

ACCESSING THE CORRECT TARGET GROUP;

One of the main challenges and limitations of this research is accessing the correct target user, which can be achieved by developing versions of the prototype and observing the process in the context. This adds to the realism of the product. Since this step was not taken, we cannot generalize the results.

However, the insights gathered might act as points of reference if similar behaviour is observed in the context of use.

QUANTITY OVER QUALITY

Throughout the process I noticed my inclination towards focusing on continuing to use a variety of methods. The higher quantity the better. However the quantity of methods, approaches and topics tackled in this thesis, results in less analysis and less depth in the topics discussed. This could have been avoided by setting a clear realistic scope from the beginning acknowledging the limited initial knowledge of the topics.

MOTIVATION MAY IMPACT MORE THAN COGNITIVE LOAD

The effects of motivation on attention may have affected the self rated scores.

Looking back at figure 3.3.1 the divided attention may be affected by the motivation and time. This model focuses more on short term however a training that lasts over an hour it is unrealistic to expect undivided attention from either practitioner or facilitator. Generally attention span is 10 minutes at a time.

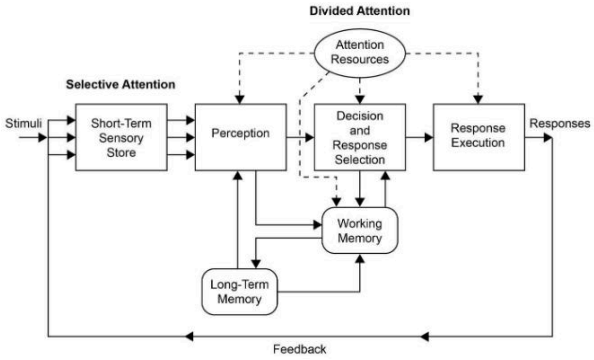


Fig 3.3.1 Lee et al (2017) "human information-processing model of cognition"

To keep the attention, there must be enough motivation caused by intrinsic motivation, understanding the importance of the training and their importance as a facilitator.

It is also important to address the decreasing attention span as a modern problem of the new digital age where the attention span has drastically gone down.

Furthermore as addressed in the cognitive load section the facilitators are not able to give divided attention since they are by default required to multitask. Therefore can not have divided attention on a sole task.

This thesis did not discuss the effects of motivation as a potential factor in experienced task difficulty .

8.2.3 HOW WELL DID THE CHOSEN METHODS GENERATE DESIRED OUTCOME?

Was I able to answer the question To what extent usability Heuristics aid in reducing cognitive load experienced by the observer's while using LIFT Scenarios during medical simulation scenarios?

I could have leaned more into the usability heuristics through how each heuristic is visible in LIFT Scenario and ranked the Heuristics and more strategically addressed them in the app. However since this was a new topic it made it quite difficult to identify the heuristics let alone strategically apply them.

This thesis tackles a lot of methods. Attempting more quantity sometimes reduces the overall quality. Although the quantity of methods allow for more broad analysis it does result in less analysis and proper execution of the methods. Choosing a few user tests and analysis methods would mean that there is more time to deep dive into the method and the best way of approaching it.

I was not really able to understand the observers experience first hand which impacts the ability to answer the question focusing on the cognitive load experienced by the observer. Most of the insights from this thesis are gathered from design students.

8.2.4 CONTRIBUTION TO RESEARCH

This thesis contributes to research in many ways;

1. By examining the usability and cognitive load of a digital training support platform, regardless of its specific subject matter. Using a restaurant-based simulation scenario, the study isolates the platform's design features and interaction patterns, providing a clearer understanding of how facilitators experience and manage cognitive load.
2. Through combining key take aways from simulation methodology literature this master thesis can serve as a reference point to understand simulation training at a base level.
3. Through simplifying complex research methods, they can easier be applied in low resource settings.

SHORT TERM

This research simplifies a lot of research methods. For example simplified eye tracking through code-charts, that requires significantly less analysis time. This research can contribute to ways to make research methods more accessible to apply within less time and expertise.

MIDTERM

This research connects usability heuristics and Cognitive load, showing how they are connected which can serve as a starting point for more research.

LONG TERM

The long-term impact could be a way to systemically improve training platforms, through adjusting the content, the training platform can be evaluated through multiple subject lenses.

8.2.5 CONTRIBUTION TO LAERDAL

For Laerdal Global Health, this thesis evaluates LIFT Scenarios usability and areas that impose or reduce cognitive load for facilitators. Additionally, it covers areas for further research and improvement. Although the study employed a non-healthcare context, the findings highlight design elements that can be refined.

SHORT TERM

There are a lot of quick fixes that have been adjusted within LIFT scenarios, for example, the buttons that seem clickable but are not. These help Laerdal Global Health improve upon LIFT Scenarios immediately.

MIDTERM

The Methods used in this thesis are easy to apply within the companies own research methods. Addressing cognitive load through observation, user tests and evaluations can easily be adjusted for similar products.

LONG TERM

Pilot testing and developing better understanding of potential user errors with non- target group can be done as a way to develop a better test strategy for the real participants.

8.2.6 PERSONAL GROWTH

This thesis has led to a lot of personal growth and acceptance. Acceptance that I cannot always perform at my best, and acceptance that there are things I do not yet know how to do. Acceptance that I always think I have not done enough.

That being said, I have learned a lot about myself and what drives me to work hard and do projects well.

For my productivity, I have realized the importance of not working alone and surrounding myself with people who can support me in the process.

Additionally, I have embraced the power of minimum and maximum goals to reduce the expectation level.
A minimum of 200 minutes of focused work a day, in sets of 25 minutes, works really well.

8.2.7 PROFESSIONAL GROWTH

This thesis has taught me a lot and helped me apply the knowledge gained throughout the courses at TU Delft.

Before starting this project, I was unfamiliar with usability heuristics, Cognitive load, and simulation training methodology. Now I know some of the basics, which is a big step.

I really enjoy combining Qualitative and Quantitative research methods. Although I want to become better at this, I am getting more comfortable with various design methods.

I learned the importance of curiosity in research, and I want to continue being a curious person. Whether that is understanding how cognitive load works, the best way to test usability, or why a person does what they do. Curiosity is what drives me to be the designer and researcher I want to be.

Citation

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Visuals
Use of Generative AI

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VISUALS:

Icons are from Figma Icons8 plugin
Illustrations are created by Elin Wahlqvist with inspiration from Storyset.
Images from LIFT Scenarios are screenshots of the application.
The improving improvement model image on page # 4 is from https://www.iitoolkit.com/process/introduction.html

USE OF GENERATIVE AI

I tried not to use a lot of generative AI in this project, however I did use it in the following ways. I used Grammarly to help correct sentence structures and spelling mistakes.

GRAMMARLY AI:

was used to improve upon some of the paragraphs as well as reflect on the arguments posed in the thesis: Grammarly contributed to this text by responding to these AI prompts: Prompts created by Grammarly - "Improve it" - "Suggest counterarguments"

CHAT GPT

Chap GPT was used to;

- Discuss the project with
- Mental health support
- Discuss potential visuals to explain cognitive load factors
- To understand cognitive load factors
- Brainstorm test plan

Appendix

Project Brief

A

CHECK ON STUDY PROGRESS

To be filled in by SSC E&SA (Shared Service Centre, Education & Student Affairs), after approval of the project brief by the chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total	EC
Of which, taking conditional requirements into account, can be part of the exam programme	EC

★	YES	all 1st year master courses passed
	NO	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

Name Date Signature

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES	★	Supervisory Team approved
NO		Supervisory Team not approved

Comments:

Based on study progress, students is ...

★	ALLOWED to start the graduation project
	NOT allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Name Date Signature

Personal Project Brief – IDE Master Graduation Project

Name student Elin Wahlqvist **Student number** 6,073,875

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Exploring usability heuristics ability to simplify observervation in scenario based training

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

For healthcare professionals, it is important with consistent training and practice in emergency situations. One effective way of practicing skills is through scenario based training and observation. One training method is SBAR(Situation, Background, Assesment, Reccomendation)(Oh, 2021)(Yoon, 2018). SBAR allows health care proffesionals to refresh their skills and practice emergency situations without the consequences of their mistakes. SBAR effectiveness is dependedent on the debriefing at the end of the scenario (Issenberg, 2009). A debriefing requires good observation of the scenario.

The facilitation, done by a trained medical professional, includes preperation, observation and debriefing. Facilitating is not a simple task (Davier, 2017), observing multiple staff during the training while keeping note of task completion during a set time is quite challenging for many observers, despite years of experience. Tools are used to aid in facilitation of these trainings (Mommers, 2023). Laerdal creates tools for these situations. Laerdal focuses heavily on team based scenario training, with products such as LIFT scenarios(Image 1). This project focuses on how to simplify the role of the facilitator in the simulation training LIFT scenario.

→ *space available for images / figures on next page*

introduction (continued): space for images

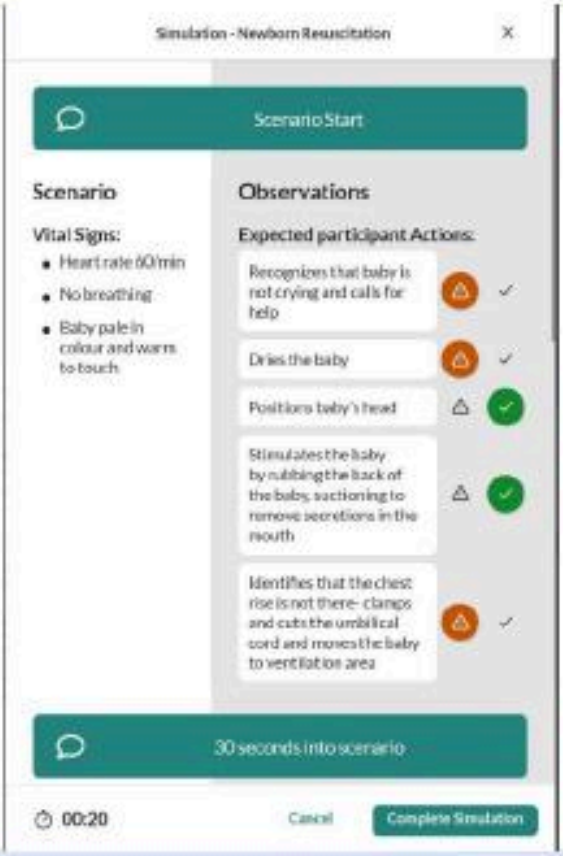


image / figure 1 Lift Scenario Observation checklist for quick initial Assesment

image / figure 2

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

I want to explore if the facilitators role of the observer during simulation practice, can be simplified through applying usability heuristics. Defining usability according to the ISO 9241-11-Guidance on usability "Usability is the extent to which a product can be used by specific users to acheive specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (Bevan, 2001). Focusing on effectiveness and efficiency, by using parts of the 10 usability heuristics including, Consistency and standards, user control and freedom, Recognition over recall and System and Real world. (Nielsen, 1994)

Facilitators have to observe and take notes simultaneously, within the Lift scenarios. Since Laerdal focuses heavily on various training scenarios that require teamwork and observation as a means to facilitate learning it is of the upmost importance that the observation is made as effective as possible. Observations are difficult to make due to the amount of things to observe and the time pressure. Observations aid in accurate assesment and reccomendations helping medical staff improve their skills. Adressing the observation and note taking within two of Laerdals Products will hopefully generate relevant knowledge that could be applied to other products. Therefore hopefully, the result of this thesis can develop understanding of the extent to which the role of the observer can be simplified through usability.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Create a prototype to understand if the application of usability heuristics to the existing observation tools LIFT Scenario can simplify the facilitators role of the observer during the scenario training.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

I will approach the graduation project by using parts of the improving improvement cambridge university method (https://www.iitoolkit.com/). This method focuses on a systems approach, breaking down the process into stages to create structure. The steps considered consist of, understanding the context, defining the problem, developing the solution, collecting the evidence and lastly making the case. This process is chosen for this graduation because of the structure it gives to the various stages of the design process. The method goes from idea to implementation therefore can aid in holistic thinking of the ideas, which may help possible implementation of the concepts into the original design.

I will understand the context and problem through a literature review, Context system map, cognitive Walkthrough and an infromation architecture breakdown.
I will find the solution through a research through design approach creating and evaluating solutions.

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	28 mar 2025
Mid-term evaluation	16 maj 2025
Green light meeting	16 jul 2025
Graduation ceremony	15 aug 2025

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:

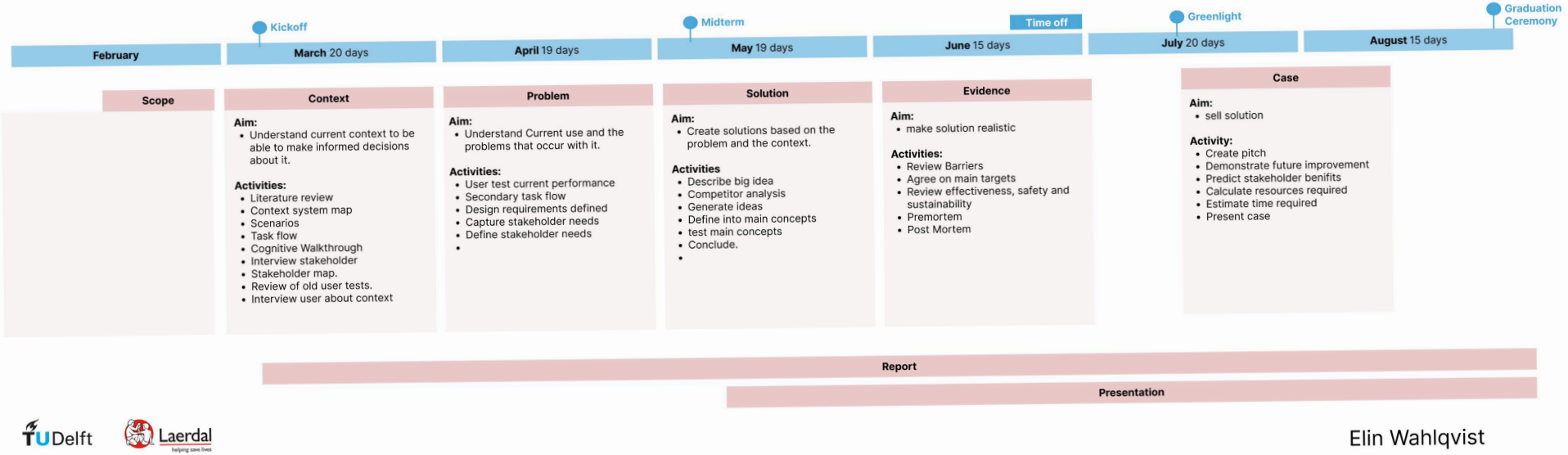
Motivation and personal ambitions

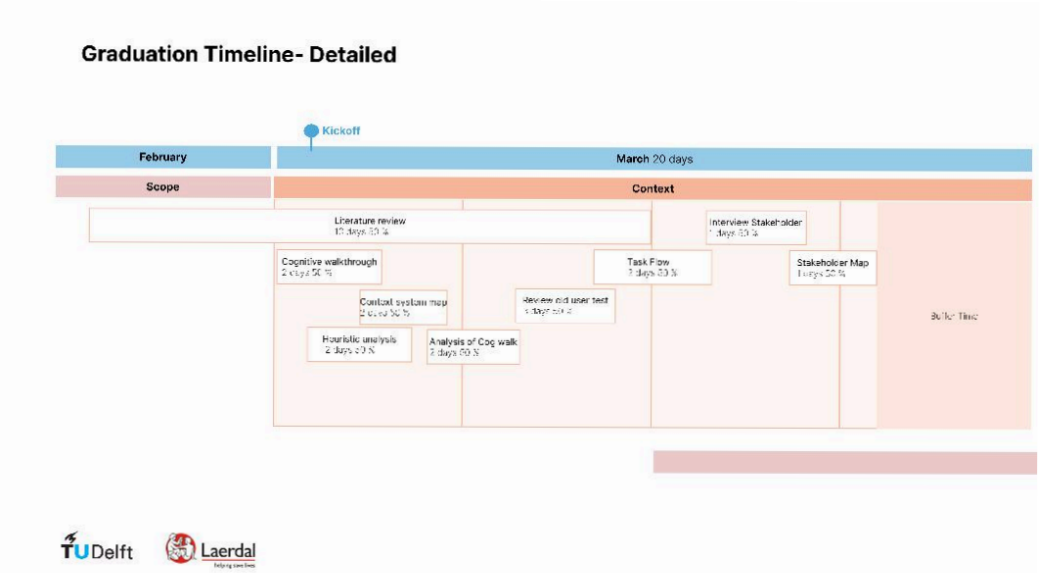
Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

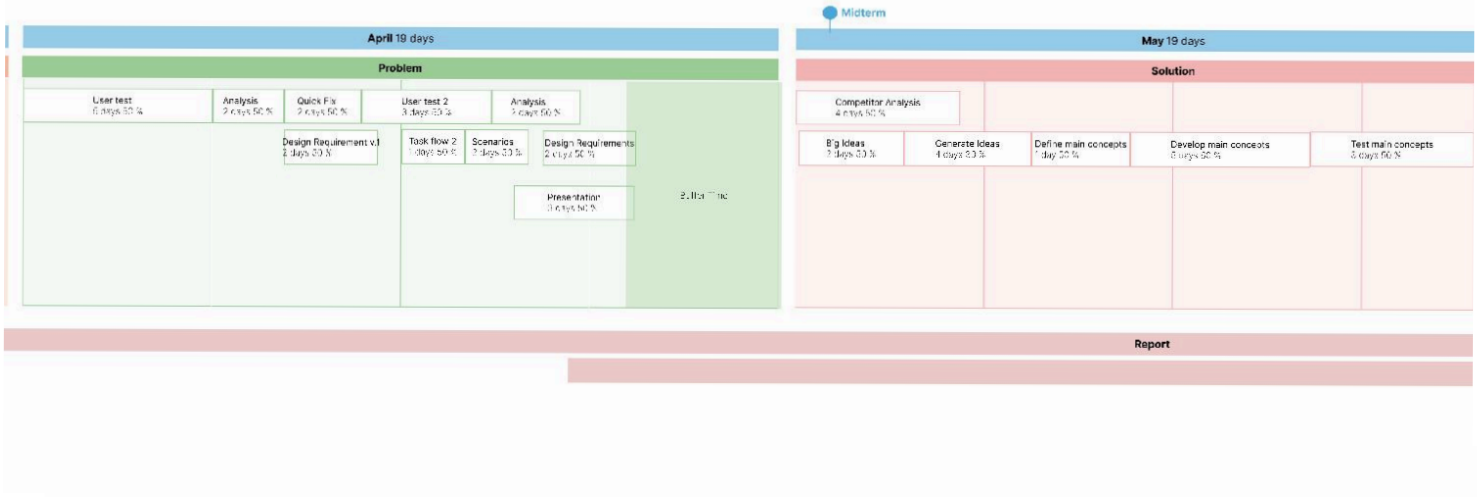
Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

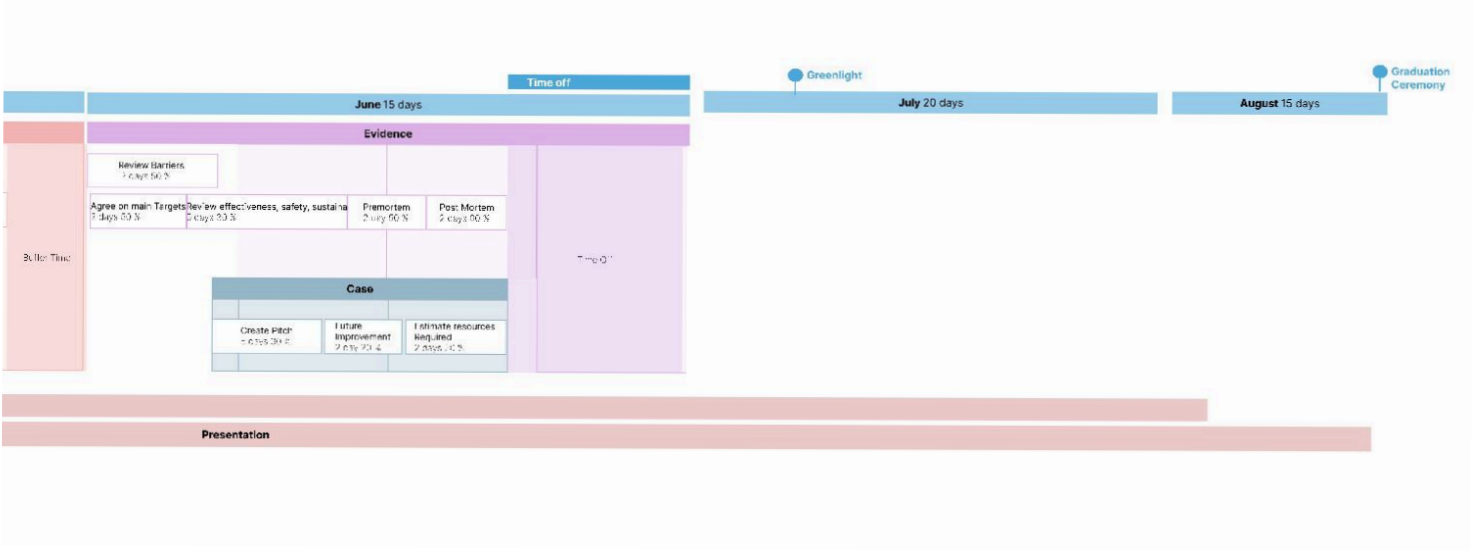
I want to work on this project as my thesis because I want to gain more in depth knowledge of usability principles and human factors, as well as approaching a product from a usability perspective. I want to gain knowledge about the usability principles and how they are applied in specific products. I want to learn more about how to test the collaboration and information processing, that is part of the LIFT Scenario.

Graduation Timeline-General




Graduation Timeline- Detailed
Kickoff
February
March 20 days
Scope
Context
Literature review
Interview Stakeholder
Cognitive walkthrough
Task Flow
Stakeholder Map
Contact system map
Review old user test
Heuristic analysis
Analysis of Cog walk
Buffer Time
TU Delft
Laerdal


Midterm
April 19 days
May 19 days
Problem
Solution
User test
Analysis
Quick Fix
User test 2
Analysis
Design Requirement v.1
Task flow 2
Scenarios
Design Requirements
Presentation
Buffer Time
Competitor Analysis
B'g Ideas
Generate Ideas
Define main concepts
Develop main concepts
Test main concepts
Report


Time off
Greenlight
Graduation Ceremony
June 15 days
July 20 days
August 15 days
Evidence
Review Barriers
Agree on main Targets
Review effectiveness, safety, sustaina
Premortem
Post Mortem
Buffer Time
Case
Create Pitch
Future Improvement
Estimate resources Required
Presentation

Interview Questions for SESAM Experts #1

Interview Questions 03-18, 13:30

Introduction:

Thank you so much for willing to participate in this interview, your input really helps me understand the context of the graduation. My graduation like mentioned before is from Tudelft in a collaboration with Laerdal and focuses on the observer in simulation trainings. This interview will be used in combination with literature to understand the context of simulation based training their challenges and advantages. This session will be audio recorded on an audio recorder, the audio recording will begin now. The audio recording will be transcribed then deleted any transcription will be removed of any personal detail. The data will be stored until after the thesis.

Quality of training

1. What would you say is the goal of simulation-based training?
2. In your experience what are the benefits of simulation training and what skills can it serve to improve?
3. What are common pitfalls and struggle areas when implementing simulation-based training?
4. How does the simulation training differ from the actual scenario?
5. How do you make simulation-based training more realistic?
6. How do you assess the quality of the training?
7. How often do you think people should go through simulation-based training?
8. You are doctor yourself, what have you felt works for you in learning and refreshing technical and communicative skills within medical situations?

Role of observer

1. In your practice, how do you assess the training, is there someone who observes?
2. What do you see is important to do when observing people in a simulation scenario?
3. What would you say are the main challenges the observer faces during a training?
4. How do you practice being observer?
5. Do you use any type of memory aid or way to remember what to observe for the observer?
6. What are qualities to look out for in a facilitator/teacher?

Scenario

1. You mention that you focus specifically on training the staff for simulation scenarios, what does that entail?
2. How do you work on transferring information from simulation to real life situations?
3. What do you see as important when developing scenarios for simulation training?
4. Do you use any theoretical frameworks when creating scenarios?

Interview Questions for SESAM Experts #2

Introduction:

Hi (Insert Name) , thank you so much for taking the time to meet with me today. My name is Elin Wahlqvist and I'm a Master student at TU Delft conducting research on simulation-based training as part of my master thesis together with the company Laerdal Medical.

The goal of this conversation is to learn more about your experiences with simulation teaching—how you plan, run, and evaluate these sessions, especially from the perspective of both the facilitator and observer.

I have a few questions prepared, but please feel free to elaborate on anything you feel is important or relevant, even if it goes beyond what I ask. There are no right or wrong answers—I'm really just here to learn from your insights and experiences.

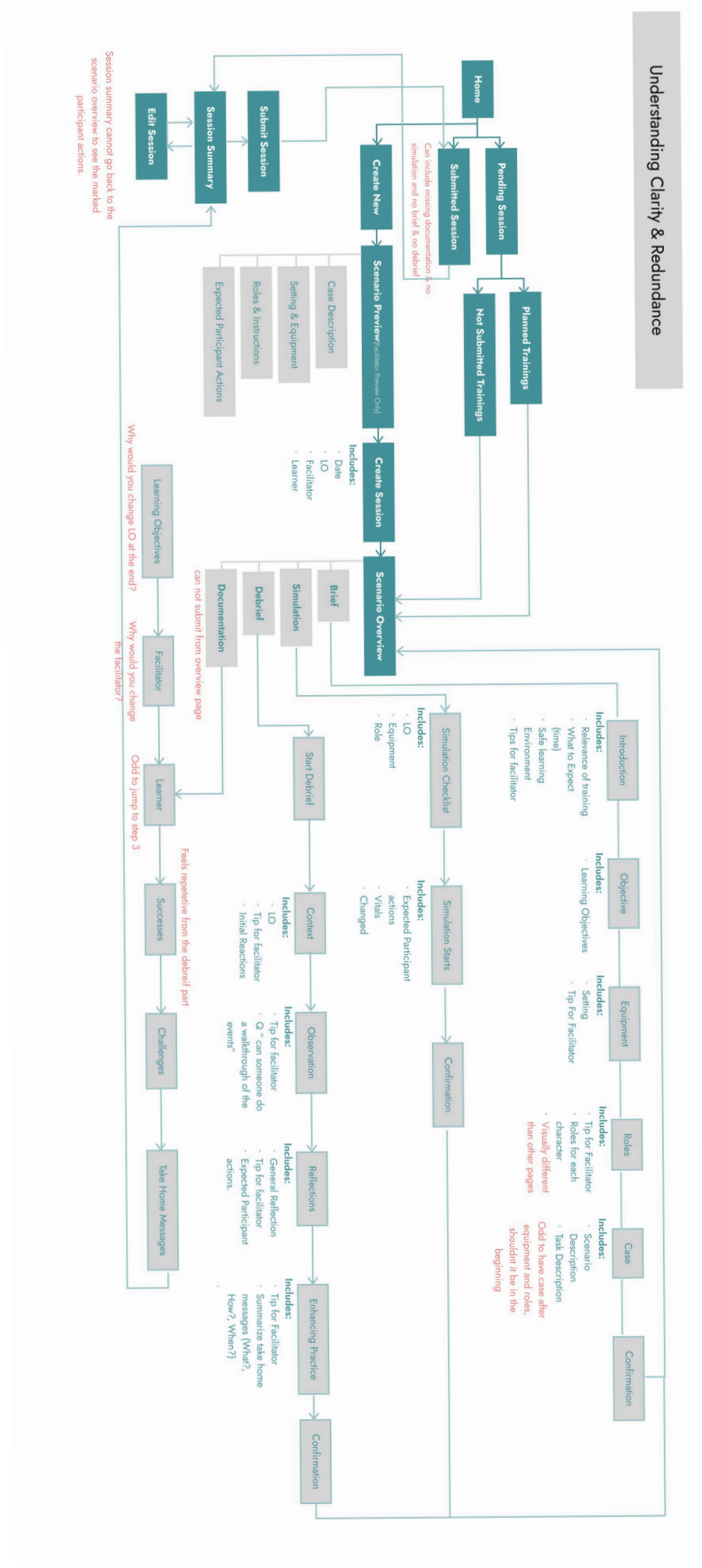
If it's okay with you, I'd like to take some notes/record the conversation. The interview should take about [25] minutes. The audio recording will be transcribed, anonymized then deleted.

Before we dive in, do you have any questions for me? Or is there anything you'd like to know about the purpose of the interview?

Questions

1. Can you walk me through the simulation scenario you typically teach?
2. How do you prepare for a simulation session?
3. How many students usually participate at one time,
4. how frequently do you run these training courses?
5. During the simulation, who is responsible for observing the students, and how do they go about it?
6. Are there specific behaviors or skills the observers are asked to focus on during the simulation?
7. Do observers use any tools—such as notebooks or checklists—to help them remember or document what they see?
8. Are observers given any training or practice in how to observe, brief, or debrief effectively?
9. How does the debriefing process typically work after a simulation session?
10. In your view, what makes a simulation training session successful?
11. What factors help enable a successful training experience?
12. Conversely, what challenges or barriers can hinder a successful session?
13. What is it like for you to observe students in these scenarios?
14. Can you share a bit about your background, how you got into simulation-based teaching and developed your current approach?
15. Realism seems to be a key factor in effective simulation. How do you create a realistic experience for your students?
16. How do you assign roles to students during the simulation, and what guides that decision?

Flow Chart


Understanding Clarity & Redundance
Home
Pending Session
Submitted Session
Not Submitted Trainings
Planned Trainings
Create New
Scenario Preview (Facilitator Preview Only)
Case Description
Setting & Equipment
Roles & Instructions
Expected Participant Actions
Create Session
Includes:
· Date
· LO
· Facilitator
· Learner
Scenario Overview
Brief
Simulation
Debrief
Documentation
can not submit from overview page
Introduction
Includes:
· Relevance of training
· What to Expect (time)
· Safe learning Environment
· Tips for facilitator
Objective
Includes:
· Learning Objectives
Equipment
Includes:
· Setting
· Tip For Facilitator
Roles
Includes:
· Tip for Facilitator
· Roles for each character
Visually different than other pages
Case
Includes:
· Scenario Description
· Task Description
Odd to have case after equipment and roles, shouldn't it be in the beginning
Confirmation
Simulation Checklist
Includes:
· LO
· Equipment
· Role
Simulation Starts
Includes:
· Expected Participant actions
· Vitals
· Changed
Confirmation
Start Debrief
Context
Includes:
· LO
· Tip for facilitator
· Initial Reactions
Observation
Includes:
· Tip for facilitator
· Q " can someone do a walkthrough of the events"
Reflections
Includes:
· General Reflection
· Tip for facilitator
· Expected Participant actions.
Enhancing Practice
Includes:
· Tip for Facilitator
· Summarize take home messages (What?, How?, When?)
Confirmation
Learning Objectives
Why would you change LO at the end?
Facilitator
Why would you change the facilitator?
Learner
Odd to jump to step 3
Successes
Feels repetetive from the debrief part
Challenges
Take Home Messages
Session Summary
Session summary cannot go back to the scenario overview to see the marked participant actions.
Submit Session
Edit Session

Appendix D

Testing UI

Recruitment Whatsapp message D0

Heursitic Evaluatic.

Goal: Evaluate usability of LIFT Scenarios according to Heuristics focusing on those affecting the cognitive load.

Timeline:

Introduction 5 min Explain structure, get consent

Heuristic Analysis Example 5 min Explain 10 usability Heuristics & example

LIFT Scenario background 5 min Explain Lift scenario

LIFT Scenario use freely 5 min Use freely platform

Heuristic Analysis 25 min Explain 10 usability Heur

Ranking issues 10 min Prioritize issues

Outro and general reflection Questions 5 min Questions to reflect on topic

---

Script:

Introduction 5 min Explain structure, get consent

Thank you for coming today and participating in this test. I will walk through the structure of the testing. We will start by going through the 10-usability metrics used in this test. The Nielson usability methods in a practice example. These will be demonstrated in an example. I will then go through what the product is and what context it is in. Then you will use the product for 5 minutes freely to familiarize yourself with it.

Then I will give you the heuristic Evaluation sheet where you can analyze the different pages based on the heuristics, the highlighted heuristics are the most relevant ones and the ones you should primarily focus on. The other heuristics are not as important but if you feel you have time then please look at those as well. You will be given 25 min for this task

Then you will get a red, green and yellow marker. Please place a dot next to the most pressing issues according to you. You will have 10 minutes for this task. I will remind you of the tasks as the time passes, I am here for any questions or concerns along the way.

I will then ask you some wrapping up questions.

This session will be screen recorded and will be audio recorded using a recorder. You will be able to look at the screen recording later. The data gathered will be kept until October 2025. The audio recording will be transcribed removed of any personal details and then deleted. You have the right to withdraw from this study and you have the right not to answer some of the questions.

You will now have some time to look at the consent form and sign if you agree.

Heuristic Analysis Example 5 min Explain 10 usability Heuristics & example

The 10 usability heuristics I have chosen to use in this study are from Nielson Group. Usability Heuristics are used to find usability issues within the product they are categorized into 10 main themes.

I will quickly walk through the usability Heuristics.

So that was a little about the usability heuristics and how it can be applied. I don't expect that you will remember everything, I am here if you have any questions, and you will have access to these sheets to help you notice more things. Each heuristic also has attached questions that you can ask yourself.

LIFT Scenario background 5 min Explain Lift Scenario

Before we dive into the app I will share some background information on it. The app comes from Laerdal Medical company that focuses on simulation-based training to reduce the death associated with childbirth for the child and the mother. The users of the app are health care professionals. One healthcare professional is chosen to be a facilitator. This facilitator guides other Health care professionals through the scenario training.

LIFT Scenario use freely 5 min Use Freely Platform

I will put on screen recording on the phone and now let you use the app freely for 5 minutes. If you have any questions, please ask.

Script- Heuristic Evaluation D2

Heuristic Analysis 25 min Explain 10 usability Heuristics

I will now ask you to fill in the usability heuristics sheet, you will have access to the phone and app in front of you. As well as some printed images of screenshots of the app. It is important to note that this is just used as a basis if you notice other usability issues you do not find match in any of the categories you may note them down. Skip any ones you do not find anything for and focus on the highlighted heuristics. You have 23 minutes to find as many issues as you can.

Ranking issues 10 min Prioritize issues

Now I will ask you to prioritize the answers, using red for most critical and the yellow for medium and blue for least critical (non-problems).

You have 10 minutes to complete this task.

Outro and general reflection Questions 5 min Questions to reflect on topic

Can you explain why you made this one red?

What do you think of the general usability of the app?

If you were to put yourself in the observers' shoes, what would you find difficult in using this as a guiding tool for scenarios?

Do you have any additional comments or questions?

Thank you for taking the time to do this heuristic analysis! I am very grateful for your time and effort. Please take a muffin if you would like.

Material:

Printed

- Heuristic evaluation sheet filled in
- Heuristic evaluation sheet not filled in
- 10 Heuristic Evaluation
- Questions
- Script
- Consent sheets
- Page with Screenshots

Technical

- Phone
- Phone Charger
- Audio Recorder
- Laptop
- iPad
- Script

Participation

- Fruit
- Chocolates
- Soda
- Napkins

Informed Consent- Heuristic Evaluation D3

About the Research

This Heuristic analysis is part of a Master Thesis focusing on simplifying the role of the observer during Simulation training for medical professionals, this study is done by the Master Student Elin Wahlqvist from the TU Delft in collaboration with Laerdal Medical.

The purpose of this heuristic analysis is to understand the usability of the digital product LIFT Scenarios. The data will be used for the Master Thesis and to help understand observation-based simulation training and usability issues within facilitation guides such as the LIFT Scenario. If you choose to participate you accept to be part of a **Heuristic Analysis** with an approximate duration of **90 minutes**. During the analysis notes and audio recording will be taken, as well as a screen recording of the use. If you are uncomfortable with any of these data collection methods, you may opt out of them. The audio recording will be transcribed and then deleted.

To the best of my ability your contribution to this study will remain confidential. I will minimize any risks by processing and analysing all collected data anonymously (without your name or other identifiable information). The data will be stored on a private Microsoft teams' group, and on TU Delft One drive and will only be accessible to the student conducting the research and their TU Delft supervisors.

Your participation in this study is entirely ~~voluntary~~ and you can withdraw at any time.

Contact person: Elin Wahlqvist, E.S.Wahlqvist@student.tudelft.nl

What you will do as a participant

As part of the Analysis,

1. Explanation of the 10 usability heuristics from Nielson group, with an example.
2. Use the application for a set time with a specific task.
3. Fill in the 10 heuristic evaluation for the app
4. Rate your findings
5. Questions

As a participant you are not expected to know the 10 usability heuristics. However, you are expected to the best of your ability and with the knowledge you have analyse the usability of the app.

Informed consent statement participant

I am aware that this research consists of the following activities:

1. Heuristic Evaluation

I am aware that data will be collected during the research, such as notes and audio recordings. I give permission for collecting this data and for making audio recordings during the research.

- ☐ I give permission for both **Audio Recording** and **Notetaking**
- ☐ I ONLY give permission for **Notetaking**

I give permission to store the transcribed data for a maximum of 5 years after completion of this research and using it for educational and research purposes.

I acknowledge that after the completion of this analysis, and by providing an email I will get a 5 Euro Amazon Gift card through the provided email. I acknowledge that I will receive this email by the end of day on the day of the test.

With my signature I acknowledge that I received sufficient information about the research and understand the nature of my participation. I can ask questions for further clarification at any moment during the research. I participate in this research voluntarily and was given sufficient time to consent

Nielsen Norman Group

Heuristic Evaluation Workbook

EVALUATOR:
DATE:
PRODUCT:
TASK:

1 Visibility of System Status

The design should always keep users informed about what is going on, through appropriate feedback within a reasonable amount of time.

- Does the design clearly communicate its state?
- Is feedback presented quickly after user actions?

Issues	Recommendations

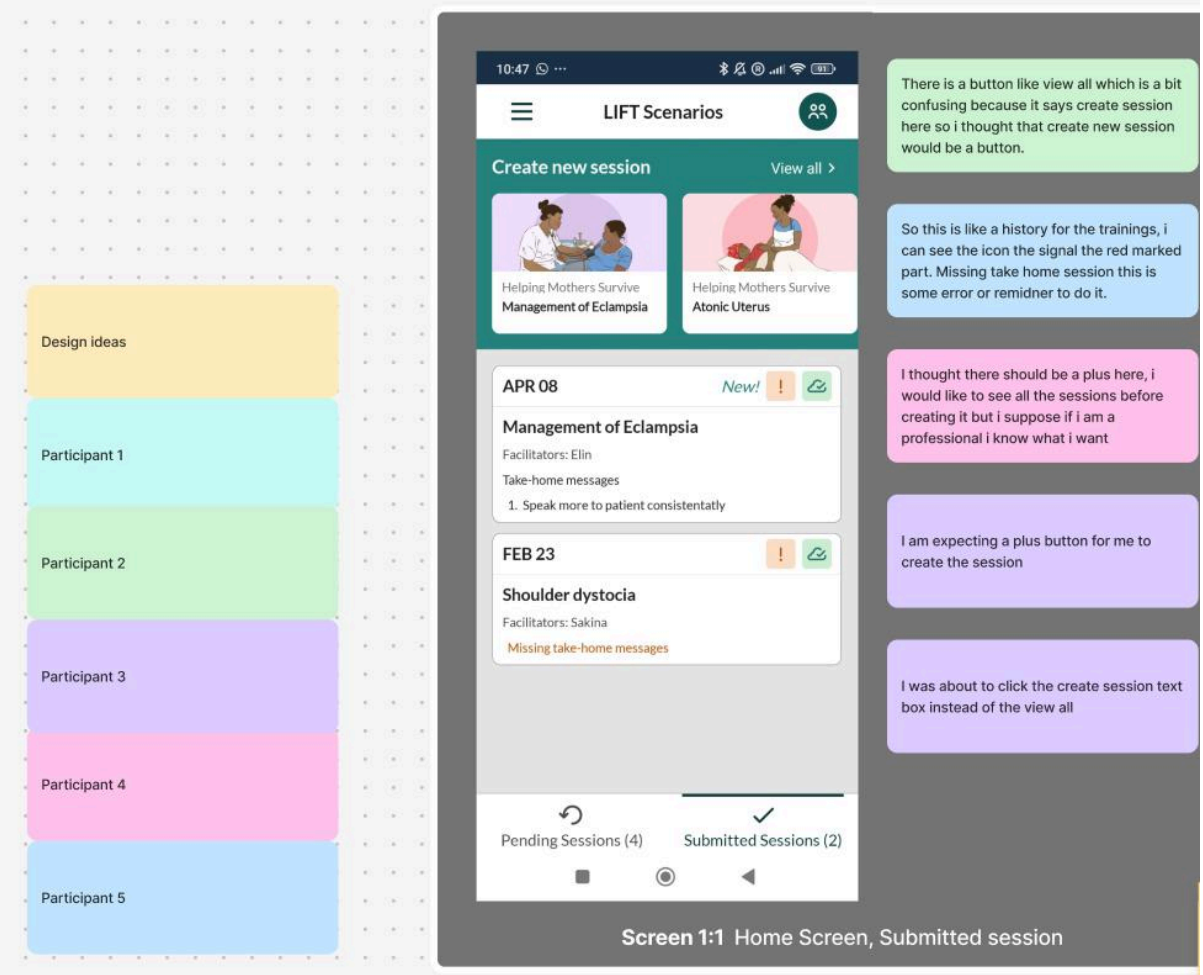
2 Match Between System and the Real World

The design should speak the users' language. Use words, phrases, and concepts familiar to the user, rather than internal jargon. Follow real-world conventions, making information appear in a natural and logical order.

- Will user be familiar with the terminology used in the design?
- Do the design's controls follow real-world conventions?

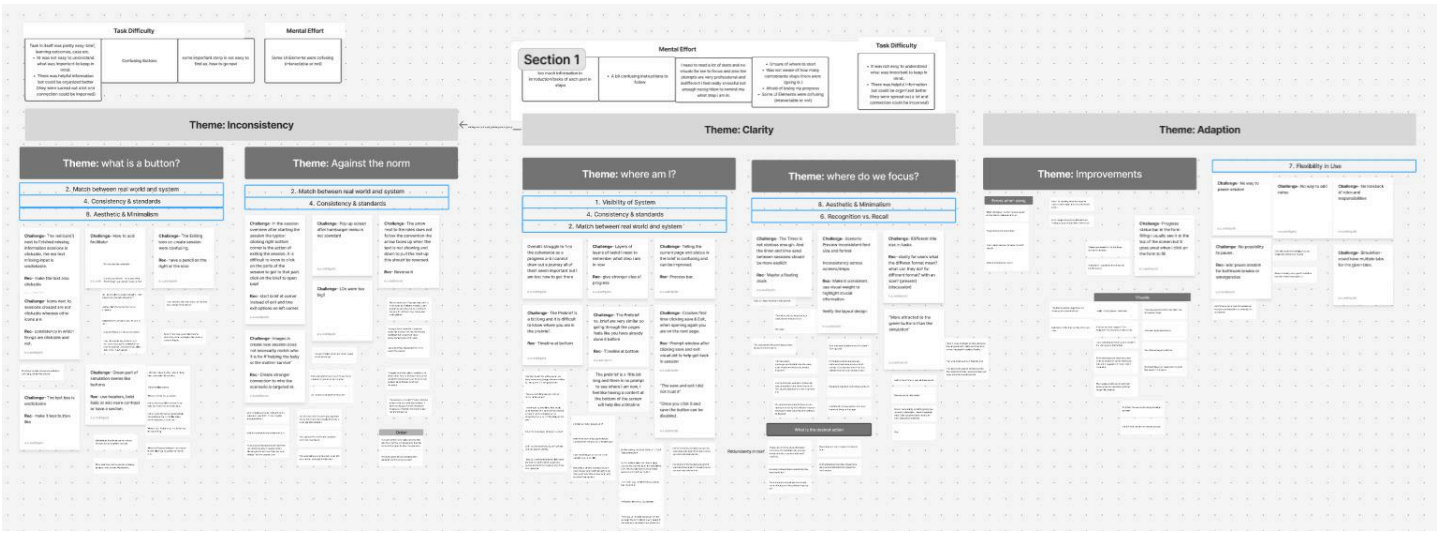
Issues	Recommendations

Cognitive Walkthrough Example D5



Thematic Analysis Example

D6



Appendix E

Testing Behaviour

Measuring
Cognitive Load

Structure of the test

10 min; Introduction

5 min- Consent and structure of test

5 min- Background & Lift Scenarios

5 min; Initial test

3 min- Cognitive self assesment sheet

5 min- Digit Span test

40 min; Use App

10 min- Go through Brief

5-10 min- Look at video and simulation

10 min- Debrief

15min; Questions and Wrap up

5 min- TLX survey

10 min- Interview Questions

Pt____

Cognitive Readiness Digit Test

Instructions: Read each sequence of numbers aloud at a rate of one digit per second. After each sequence, ask the participant to repeat the digits in the same order.
Optional: You may repeat this in reverse order for a backward span task.

3-1-7 Yes ○ No ○ 6-2-8-4 Yes ○ No ○ 9-3-7-5-2 Yes ○ No ○ 4-6-1-3-9-7 Yes ○ No ○ 2-8-5-3-9-4-6 Yes ○ No ○ 1-7-2-9-3-5-8-6 Yes ○ No ○ **Pt____**	3-1-7 Yes ○ No ○ 6-2-8-4 Yes ○ No ○ 9-3-7-5-2 Yes ○ No ○ 4-6-1-3-9-7 Yes ○ No ○ 2-8-5-3-9-4-6 Yes ○ No ○ 1-7-2-9-3-5-8-6 Yes ○ No ○ **Pt____**	3-1-7 Yes ○ No ○ 6-2-8-4 Yes ○ No ○ 9-3-7-5-2 Yes ○ No ○ 4-6-1-3-9-7 Yes ○ No ○ 2-8-5-3-9-4-6 Yes ○ No ○ 1-7-2-9-3-5-8-6 Yes ○ No ○ **Pt____**
3-1-7 Yes ○ No ○ 6-2-8-4 Yes ○ No ○ 9-3-7-5-2 Yes ○ No ○ 4-6-1-3-9-7 Yes ○ No ○ 2-8-5-3-9-4-6 Yes ○ No ○ 1-7-2-9-3-5-8-6 Yes ○ No ○ **Pt____**	3-1-7 Yes ○ No ○ 6-2-8-4 Yes ○ No ○ 9-3-7-5-2 Yes ○ No ○ 4-6-1-3-9-7 Yes ○ No ○ 2-8-5-3-9-4-6 Yes ○ No ○ 1-7-2-9-3-5-8-6 Yes ○ No ○ **Pt____**	3-1-7 Yes ○ No ○ 6-2-8-4 Yes ○ No ○ 9-3-7-5-2 Yes ○ No ○ 4-6-1-3-9-7 Yes ○ No ○ 2-8-5-3-9-4-6 Yes ○ No ○ 1-7-2-9-3-5-8-6 Yes ○ No ○ **Pt____**

Cognitive Initial test E2

Pt____

Cognitive Readiness Assessment

Please rate your experience

Control Variables

1. How well did you sleep?

Fill in the circle that accurately represents your circumstance

Very Poorly	Poorly	Fair	Well	Very Well
1	2	3	4	5
○	○	○	○	○

2. Have you consumed caffeine in the past 3 hours? Yes ○ No ○

Fill in the circle that accurately represents your circumstance

3. Are you currently on any medications that affect attention or alertness Yes ○ No ○

Fill in the circle that accurately represents your circumstance

4. Have you exercised in the past 24 hours? Yes ○ No ○

Fill in the circle that accurately represents your circumstance

4. On a scale from 1-10 how stressed do you feel right now?

Fill in the circle that accurately represents your circumstance

Not stressed at all	1	2	3	4	5	6	7	8	9	10	Extremely stressed
	○	○	○	○	○	○	○	○	○	○	

6. Do you have any diagnosed attention or memory-related condition(e.g. ADHD, anxiety)? Yes ○ No ○

Fill in the circle that accurately represents your circumstance

Self Report- Attention and Working Memory

Rate each statement based on how often it applies to you in general, using the scale below

1= Never, 2= Rarely, 3= Sometimes, 4= Often, 5= Always

	1	2	3	4	5
1. I find it difficult to stay focused on tasks for a long period of time	○	○	○	○	○
2. I often forget what I was just thinking about.	○	○	○	○	○

Cognitive Initial test

E2

Pt____

Cognitive Readiness Assessment

Please rate your experience

1= Never, 2= Rarely, 3= Sometimes, 4= Often, 5= Always

	1	2	3	4	5
3. I get distracted by background noise easily	○	○	○	○	○
4. I have trouble holding multiple pieces of information in my mind at once	○	○	○	○	○
5. I can concentrate well even when I'm tired	○	○	○	○	○
6. I find myself rereading text because I lost focus.	○	○	○	○	○
7. I can follow complex conversations without losing track.	○	○	○	○	○
8. I struggle to shift my attention from one task to another.	○	○	○	○	○
9. I rely on reminders or notes because I forget things easily.	○	○	○	○	○

Open ended (optional)

Is there anything else you think might affect your performance today (e.g, fatigue, emotional state)

Analysis- Behaviour

E3

Appendix F/ G/H

Behavior insights F

This text focuses on the observation of the LIFT scenario simulations. I am sending you the observations here and will compile the observations from the other non lift scenarios and send bothe documents via email.

Observations- Facilitation of LIFT Scenarios
This document contains the observations from Safer simulation Centre on May 20th and May 21st, 2025. This document focuses specifically on the simulations using the LIFT scenarios. However, many simulations and varying types of simulations were observed and observations are in another document.
When explaining LIFT Scenarios
For each facilitator LIFT Scenarios was explained and they had a chance to quickly use it. This lasted for about 10 minutes. Through this explanation we got certain insights.

- The facilitator looks through app, making sure they know how to start, exit and return.
- They want to understand how the buttons work, when should they press what (check box or warning symbol)
- They want to see the case and the vitals before starting the session so they can adjust according to the scenario.
- General very positive impression, this is something they want to implement
- Facilitator preview only is not shown to facilitators rather the actual scenario brief, simulation and debrief pages.

Facilitator 1 (Middle aged- tech Savy)
Before simulation

- The facilitator looks through the app, making sure they know how to start, exit and return.
- They want to understand how the buttons work, when should they press what (check box or warning symbol)

During Scenario
General

- Uses lift in combination with paper, that explains the case scenario and the specifics of the patient.

Brief

- Jumps over some parts of the brief, goes to roles then to simulation.

Simulation

- Walks around the room during the simulation.
- Is still setting up some material when the simulation starts.
- Is responsible for guiding the participants to the material if they should need it.
- Discusses with practitioners during the simulation.
- Observes for a while first then marks for a while. Not marking one by one but multiple at a time.
- It takes some time to read the steps, but they don't seem overwhelmed or stressed by observing and checking.
- Does not mark all of them but goes chronologically. However, sometimes, notices an action happening later than the
- intended time so goes back and marks it later.
- When its ended they say out loud "Its done!"

Debrief

- Moves to a separate room with comfortable chairs, snacks and coffee.
- Starts with, "thoughts, ideas, how was it?"
- Then "what did you do in regard to ABCDE?"
- Writes down notes when doing debrief
- Throughout the debrief asks the participants to justify the purpose of taking certain actions.
- Look at the tablet frequently.
- Goes through the debrief page by page
- Goes through expected participant actions. Addresses a few mistakes in detail.
  - When they did something less than ideal they say
    - 1st " Regarding A, Breathing, I saw that you didn't check in the mouth" Can someone explain why this is not great"
    - Tells standard procedure
    - Continues by telling a crazy story about the point "someone forgot to check the mouth and there was a whole pen there."
- Can someone explain something that went really well.- uses clear language and enunciates the really.
  - Continues by probing "why is this good to do" "how can we implement this?" When is this a good time to be implemented?"
- Gets shyer participants involved by calling them by their name "what do you think ____"
- Is honest about their own mistakes and connects what the practitioners are discussing to their own work experience"

Documentation

- Does documentation alone
- Adds names of learners- feels like this task could be done earlier
- Gives up during take home message. "Take home messages, Aja"

After Simulation

Facilitator wrote comments during the simulation about things that could be addressed including:

- The expected actions also have a certain time frame they are expected to do it in, what do I do if they do the action later than intended. Can there be a certain time expectation? Or a markation of an action that is done later than intended.

    - A comment that says late or something during the debrief
- Some actions related to the patient should be abnormal. It would be nice if it is somehow noted that the participants have a problem there so that the facilitator notice this is something that practitioners should address.
    - This is recommended as a warning sign that you can click on that may say "patient has problem in eye" the pop up disappears when you click on it again.
- It would also be nice if some sections lead to various outcomes of the patient and change in vital signs based off if the action has happened or not.
    - For example. Was the treatment given (Button for YES) (Button for NO)
    - Depending on the button you click different vital signs are shown and different expected participant actions.
-

Facilitator 2 (Newer facilitator- tech Savy)

Before simulation

- The facilitator looks through the app, making sure they know how to start, exit and return.
- They want to know where the case is and see it before doing the scenario

During Scenario

General

- Uses LIFT Scenarios more page by page addressing each of part of the page.
- Uses timeline to toggle between brief and debrief.

Brief

- Follows the structure of each page diligently.
- Spends time saying the vital signs for the practitioner, checks LIFT Scenarios for the vital signs.
- Takes some time before putting the actions as X or Check
- Spends a lot of time reading the expected actions
- Does not seem overwhelmed by observing and checking the list
- Scrolls through the list before scanning
- Vital signs were very useful.
- Only puts checkmarks
- .

- Debrief~20 min long
- Follows the structure of the debrief page- by- page
- They don't go through so many of the expected actions themselves let's the participants speak and discuss while guiding the discussion.

Documentation

- Does not do documentation or put learners.

Facilitator 3 (Older facilitator-tech sceptic)

Before simulation

- The facilitator was showed the brief, simulation and debrief pages during the break before the simulation, however wanted to skip over the brief and use the app just for the checklist.

During Scenario

General

- Said they would like a whole morning to practice using the app before using it for their simulation.
- Used the vital signs in the simulation to set vital signs on the machine, kept LIFT Scenarios on the simulation page

Brief

- Does not use any tool for the brief, neither LIFT Scenarios nor Paper.

Simulation

- Gives the simulation checklist to an observing practitioner.
    - Observing practitioner uses checklists with ease not marking some things because they were not relevant.
    - Only puts checkmarks
    - Was not rushed during observation
    - Walks up to view some parts of scenario but most of the time observes from chair.
    - The tablet gets annoying to hold at some point they put on their lap.
    - Spend some time reading the steps.
    - Goes through the steps one by one
    - When done attempts to scroll down further. Put the tablet to the side.
-

- Facilitator
  - Calls out vital using the tablet that adjusts the vitals.
  - Comments on the actions of the participants throughout the scenario.

Debrief~20 min long

- Does not use LIFT Scenarios debrief.
- Facilitator asks practitioners if they can run through their impression based on the checklist.
  - Practitioner (on the simulation page of LIFT Scenarios) runs through the expected participant actions from a general P.o.v. "they followed the ABCDE structure well and were efficient"
- Asks for a run through of what happened according to the ABCDE
- Does not ask for main takeaways.
- The facilitator and the patient (also a practiced facilitator) go through the debrief together.
- No memory aid was used during the debrief.

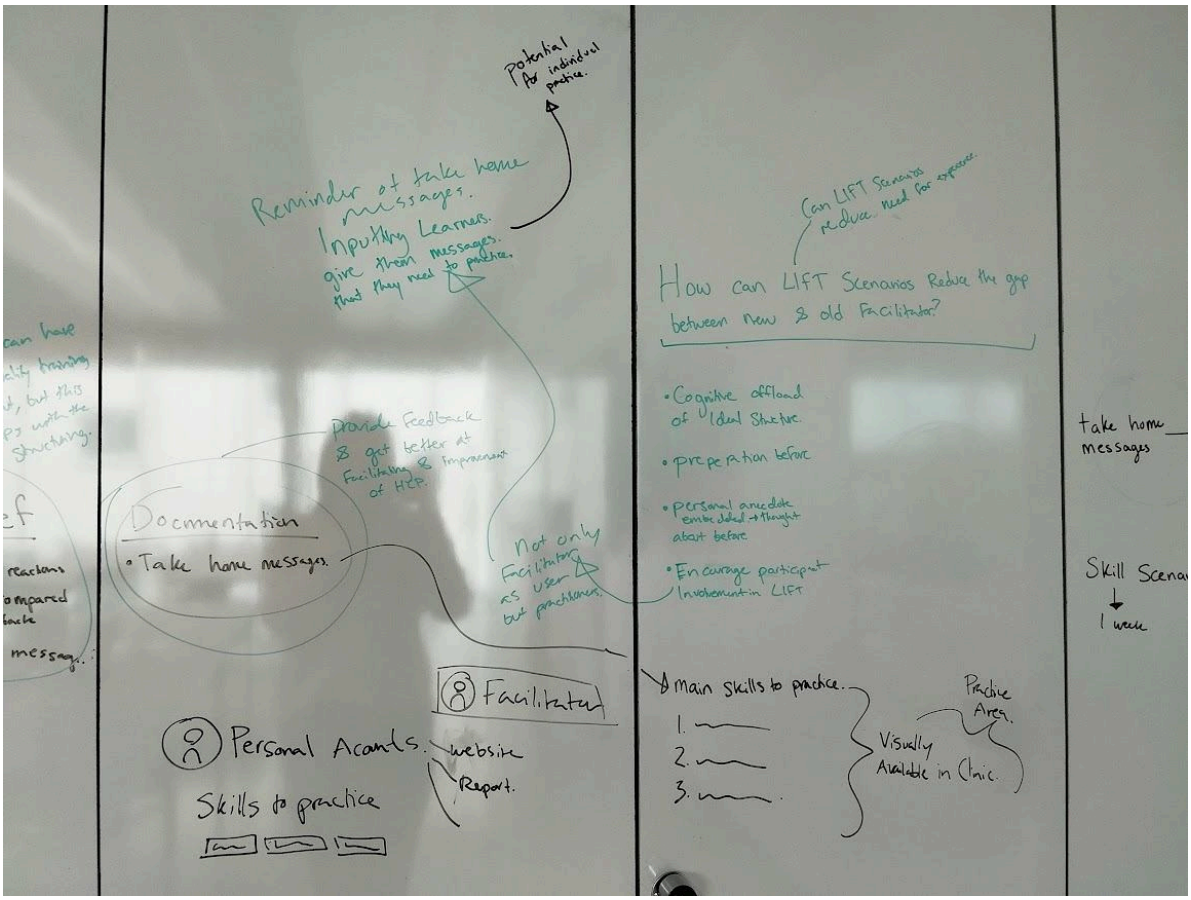
Documentation

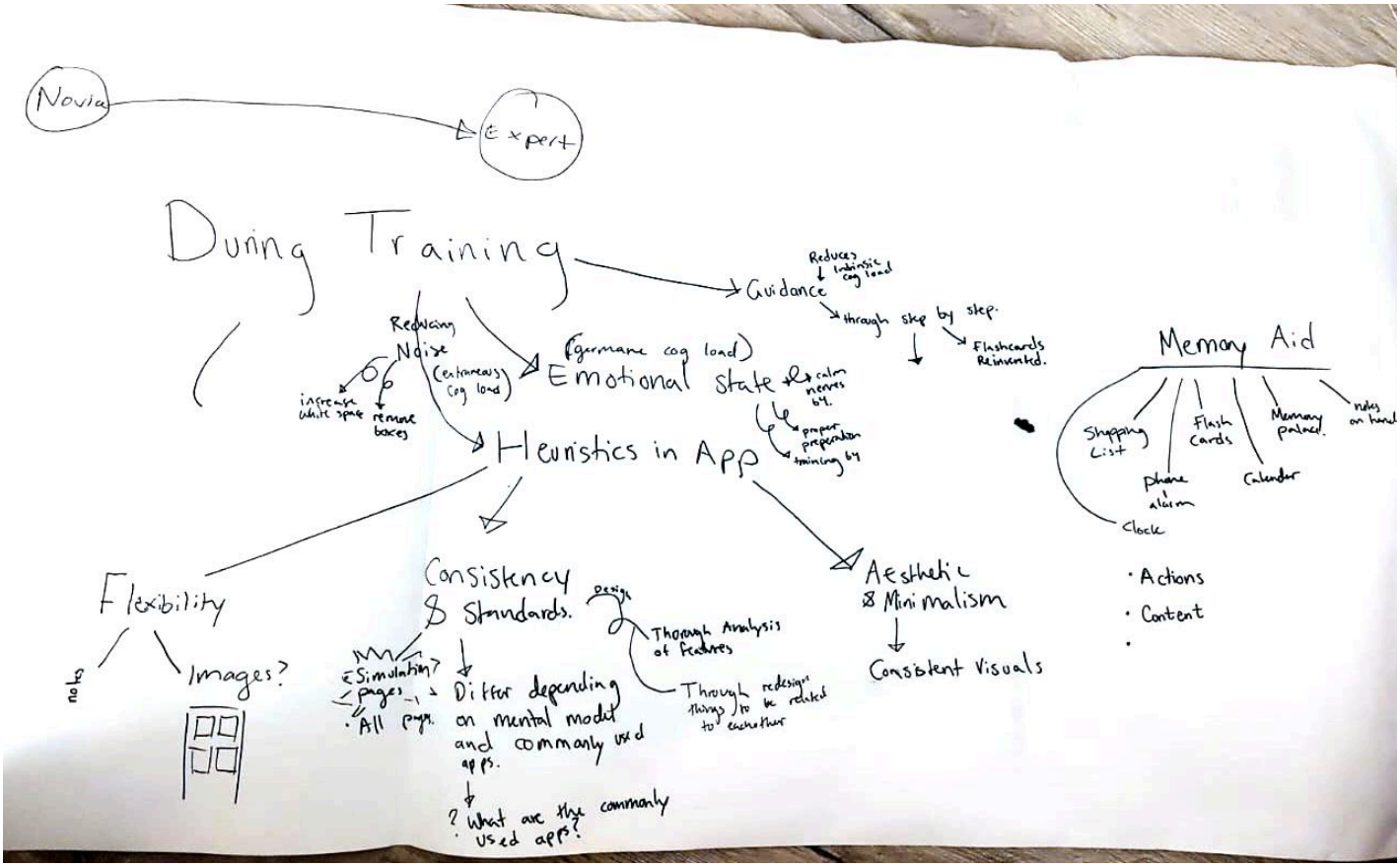
- Does not do documentation or put learners.

After Simulation

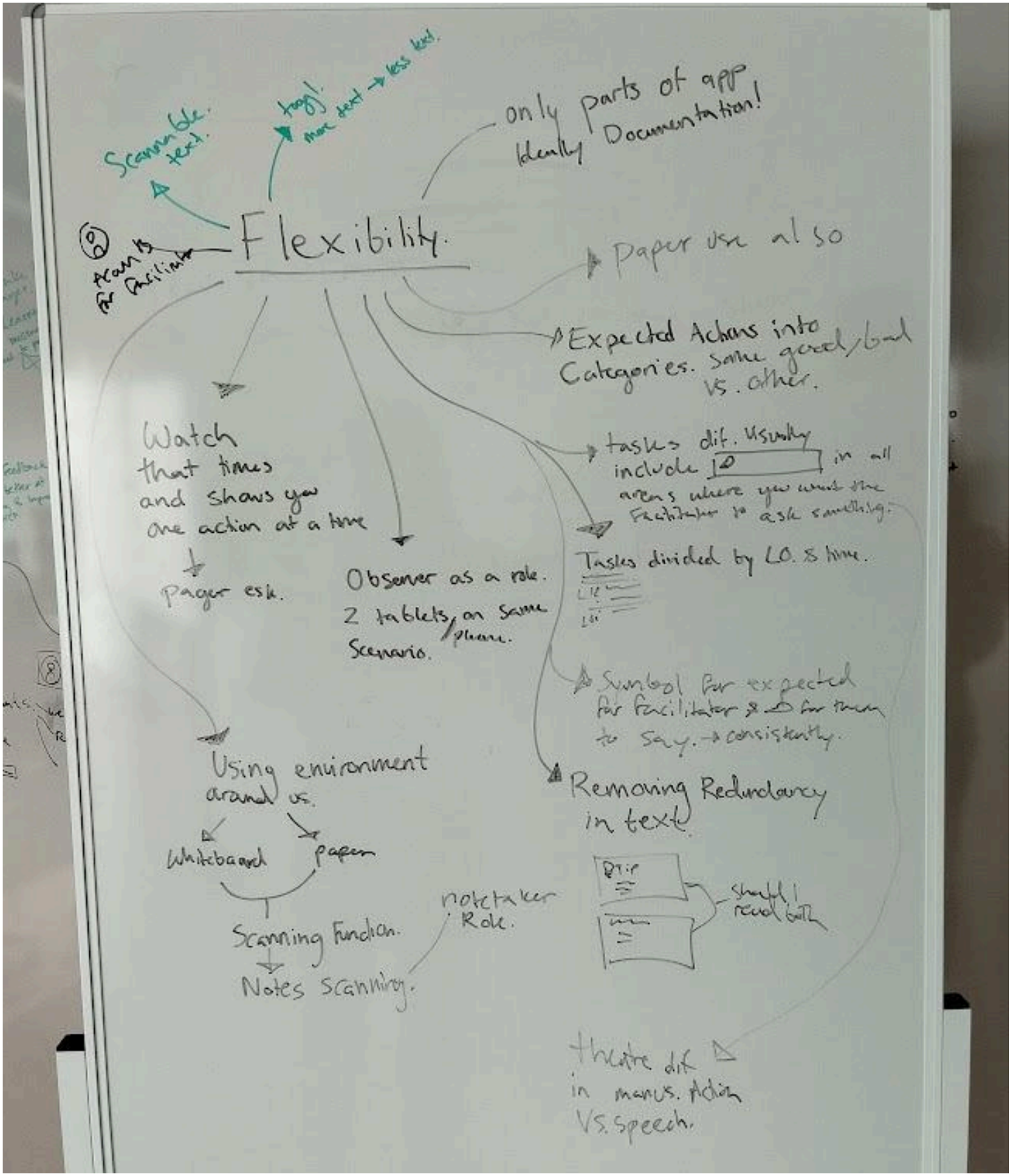
- Finds the app to be simple to use however would like to be able to properly practice with the tool before using it in the simulation.
- They perceived that the simulation and debrief would be helpful.
- They said that they believed it would be easy to fill in the expected participant actions while facilitating the session (Including adjustment of vital signs).

Brainstorm- Concept Direction G1



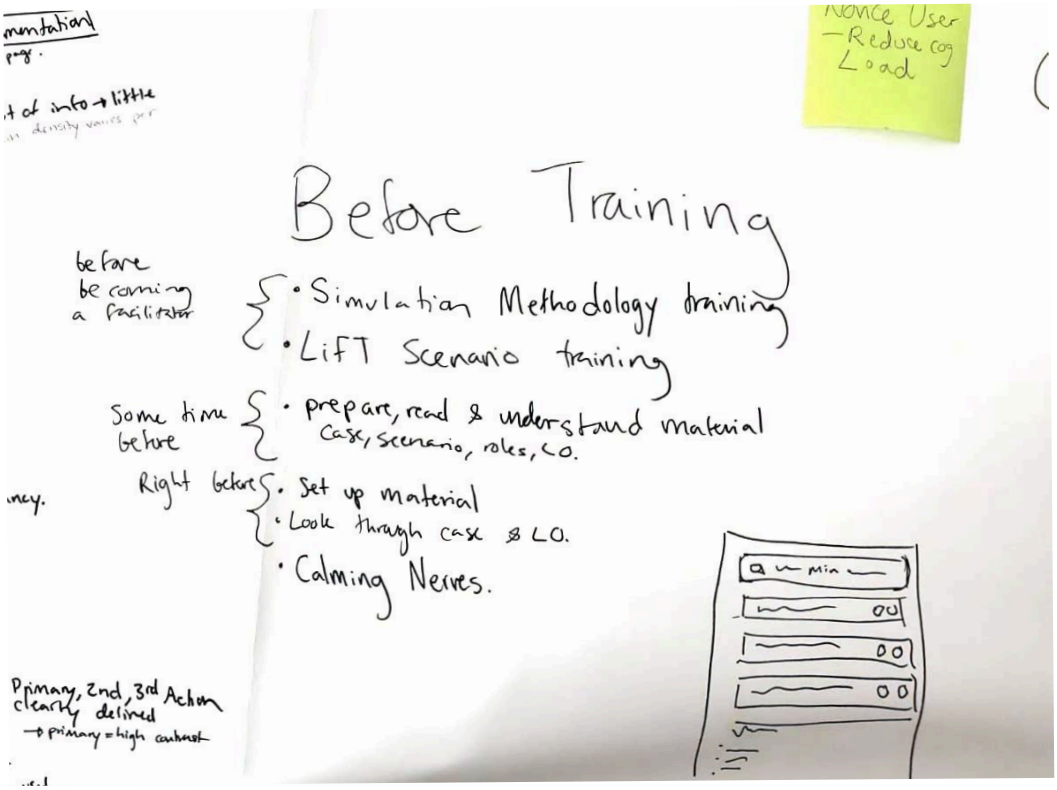


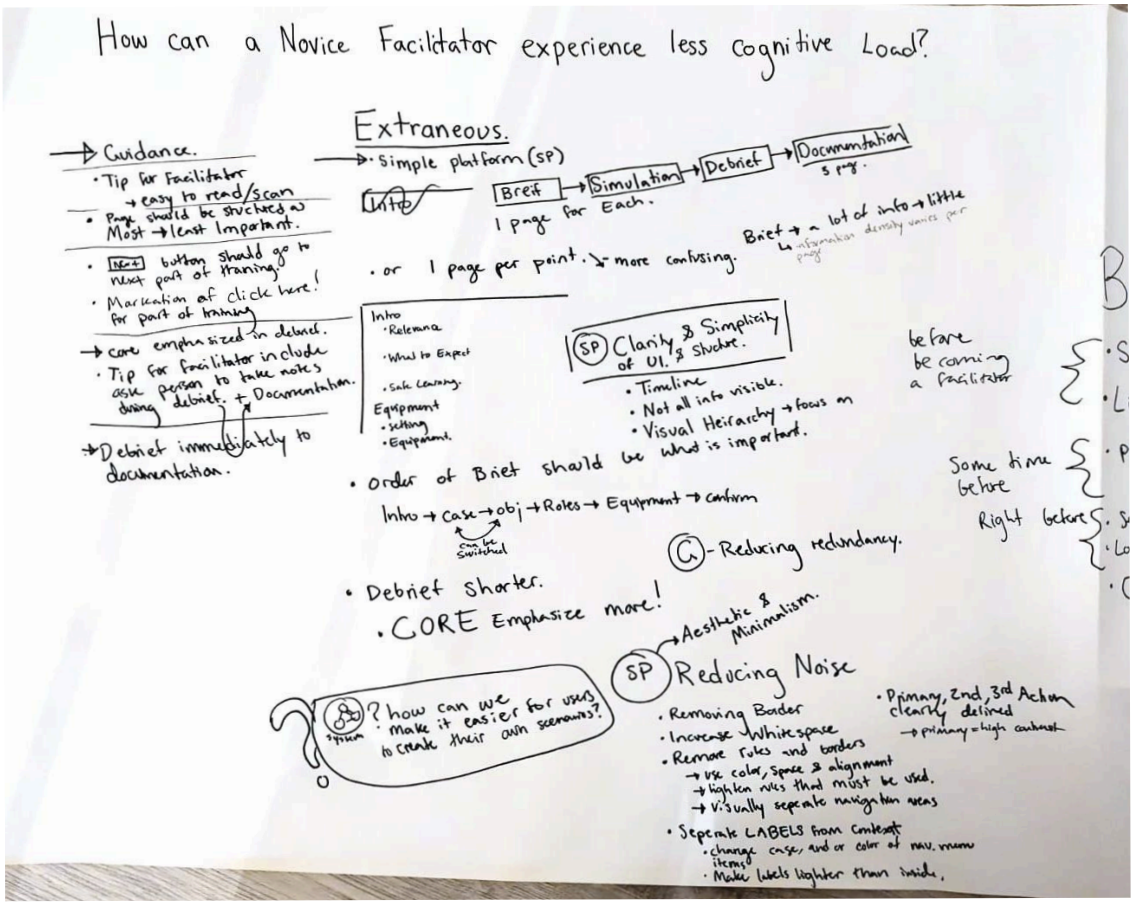
Brainstorm- Concept Direction G1



Brainstorm-How can we___?

G2





Brainstorm-How can we___? G2

How can the memory aid bridge the gap between the new facilitator and the experienced one?

Profiles that determine the difficulty level amount of noise in the app. - adding flexibility however requires the individual to put the difficulty in settings adding a set up time. As well as login.

Training of new facilitators. Feedback rounds and pages that help the facilitators improve

Reducing the cognitive load through reducing noise.

What is noise for old and new facilitators

Adding more non technical tips on facilitation. Tips for facilitator part of the preperation material

Dealing with the stress and overwhelm of being a new facilitator can be in the practice material. And throughout.

What is the difference between old and new facilitators?

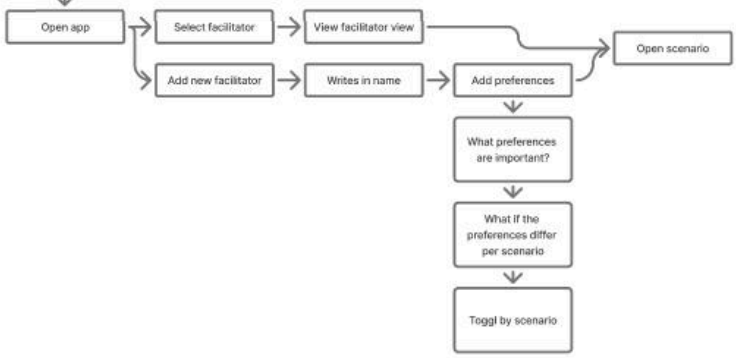
Login via biometrics- invasion of privacy

Login by pressing what facilitator- first step?

Create an overview of what the desired actions are have one thing that relates to the actions, one that relates to what they should ask participants

Make it more obvious what the desired action is.

how do we slowly progress in teaching?



How to reduce the time for interpretation

Clear text under symbols to indicate what they mean

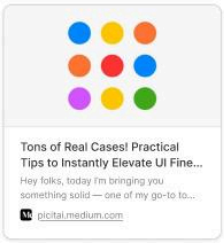
Some of the actions highlighted that pertain the the LO

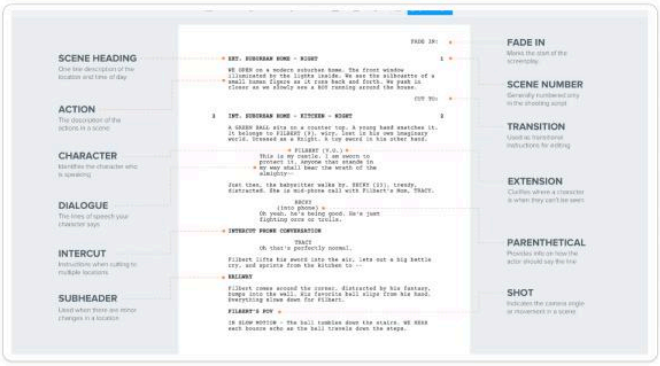
Easy to observe, observation guidelines or broken down the part into steps.

Some steps broken down others not.

rolling list of expected actions.

Reduce redundancy





Code Charts structure

H

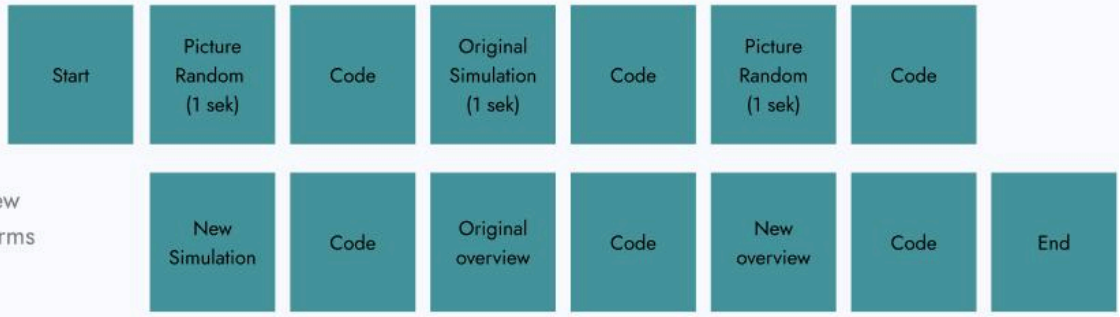
Visual Heirarchy

Overview Page & Simulation

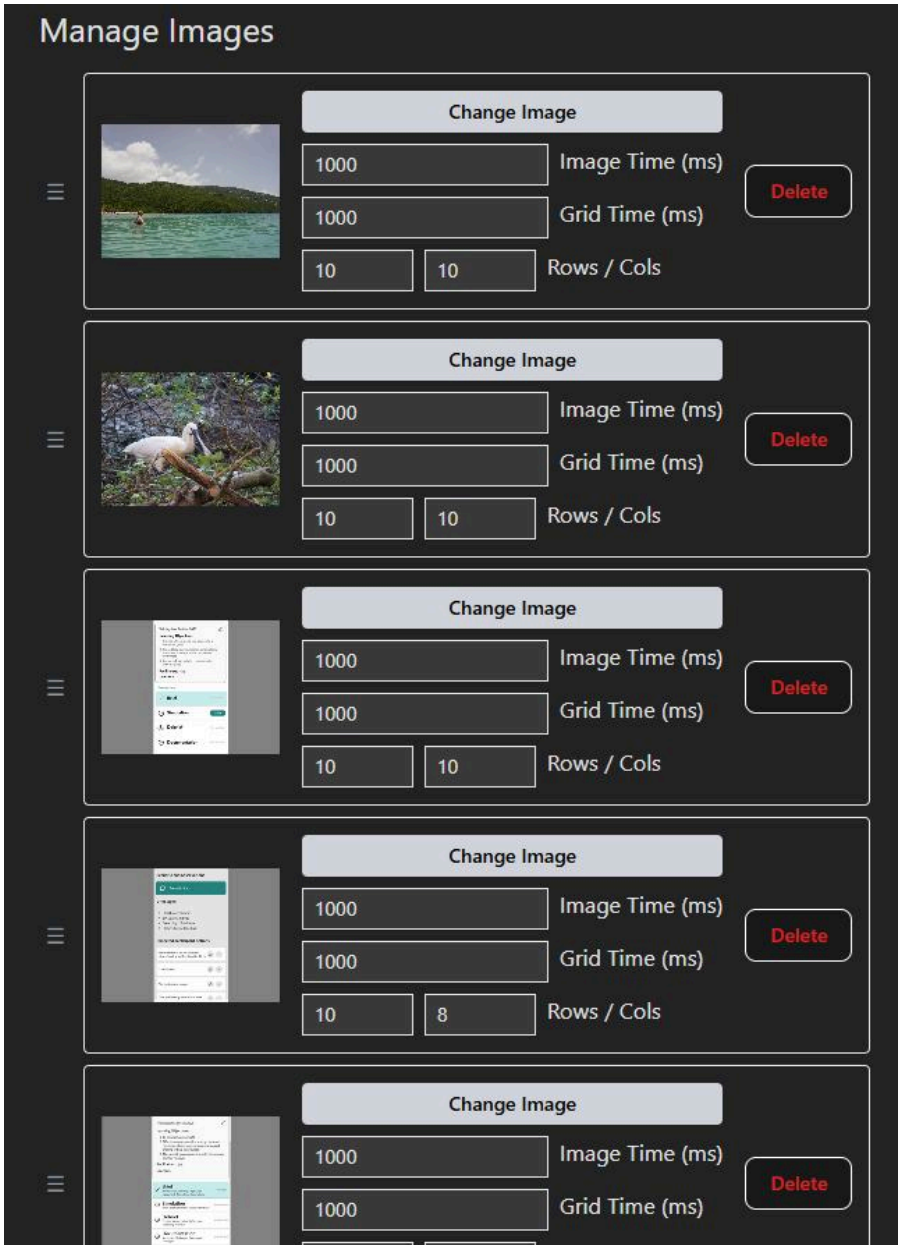
Code Charts test, see image then see codes, then write code

2 Versions
- original first
- New first

Aim: Compare the original and new simulation and overview page in terms of heirarchy



2 practice images
then the real ones
each image is shown for 1 second



Appendix I

Evaluating the Prototypes

Prototype Evaluation

Goal: Evaluate the perceived cognitive load of the LIFT Scenario prototypes in comparison to the original.

IV: 3 prototypes are tested the independent variable is the type of prototype.

- Guidance prototype
- Reduce noise prototype
- Original

DV: Experienced cognitive load

Null Hypothesis: The mean value of the cognitive load experienced in all the groups is the same

Alternative Hypothesis: The mean value of the cognitive load experienced in all the groups differ.

Analysis Method: T- Test of NASA TLX

Timeline:

5 min- Introduction Explain structure, get consent

5 min- LIFT Scenario background Explain Lift scenario

8 min- LIFT Scenario prototype 1 Go through the training of the platform

5 min- Cognitive load self-assessment Fill in the self-assessment on cognitive load

8 min- LIFT Scenario prototype 2-Go through the training of the platform

5 min- Cognitive load self-assessment Fill in the self-assessment on cognitive load

5 minute break

8 min- LIFT Scenario prototype 3 Go through the training of the platform

5 min- Cognitive load self-assessment- Fill in the self-assessment on cognitive load

15 min- Outro and general reflection Questions to reflect on topic

~70 min

Script:

Introduction 5 min Explain structure, get consent

Thank you for coming today and participating in this test. I will walk through the structure of the testing. I will then go through what the product is and what context it is in.

This test aims to evaluate the created prototypes and the cognitive load of using them.

As part of the test, you will be asked to become a facilitator and use 3 versions of the app and answer a few questions after having gone through each version. Please answer as honestly as possible.

The platform you will be testing variations of is called lift scenarios, it aims to guide people through training. Today you will become a facilitator and use lift scenarios to guide me through the training. I will now show you the pages of lift and what is expected of you when following the pages.

As a facilitator you will guide me through the training and observe the scenario in a video. You will evaluate and discuss their performance.

I am mainly focusing on the app itself and how it can aid in facilitating a session

LIFT Scenario background 5 min Explain Lift Scenario

Before we dive into the app I will share some background information on it. The app comes from Laerdal Medical company that focuses on simulation-based training to reduce the death associated with childbirth for the child and the mother. The users of the app are health care professionals. One healthcare professional is chosen to be a facilitator. This facilitator guides other Health care professionals through the scenario training using the app to help them facilitate the training.
(Show Pages)

The training consists of a brief, a simulation and a debrief section that we will focus on now. The brief aims to explain the structure of the training; the simulation is used as a checklist to observe the behavior of the participants going through the scenario and the debrief aims to get participants to discuss what happened in the simulation and how the can improve.

As part of the test I will ask you to become the facilitator, guiding me through the training, however we will use a non- medical scenario, handling a gluten free order at a restaurant.

I will now ask you to use this app. I want you to pretend like you are going through the training, please explain what you would do if you were facilitating the training. First, I will show you some of the pages, so you know what to expect. This is the brief explaining the training's relevance and structure and preparing participants, Then is the simulation the simulation is used to help observe the participants' actions you will watch a short video and observe the first 2 minutes of the actions. Then there is the debrief to reflect on what happened.

This session will be audio recorded using a recorder. The data gathered will be kept until December 2025. The audio recording will be transcribed removed of any personal details and then deleted. You have the right to withdraw from this study, and you have the right not to answer some of the questions.

You will now have some time to look at the consent form and sign if you agree.

I will now ask you to start facilitating I will be the participant. Do you have any questions?

Prototype testing O 8 min use prototype O

(Play video 1 when relevant)

Cognitive Load assessment 5 min assess cognitive load

Now I will ask you to rate the perceived difficulty of the task of facilitating and observing

You have 5 minutes to complete this task.

Fill in the task load index.

Prototype testing N 8 min use prototype N

Now I will ask you to do the same for the second version of the app.

(Play video 2 when relevant)

Cognitive Load assessment 5 min assess cognitive load

Now I will ask you to rate the perceived difficulty of the task.

You have 5 minutes to complete this task.

Fill in the task load index.

Break- 5 min

Prototype testing G 8 min Use prototype G

And the same for the third version.

(Play video 3 when relevant)

Cognitive Load assessment 5 min assess cognitive load

Now I will ask you to rate the perceived difficulty of the task.

You have 5 minutes to complete this task.

Fill in the task load index.

Outro and general reflection Questions 15 min Questions to reflect on topic

1. Which of the prototypes was the easiest for you to follow? Why?
2. Did you at any point not know what to do? Or where you were in the app?
3. Looking back at the rated cognitive load scores would you change any rating now after you have completed all the prototypes?
4. Was there any part of the visuals that confused you or that you didn't understand?
5. Did you at any point feel overwhelmed while looking at the prototypes? When?

During testing you saw two new prototypes and one original, some of the pages differed.

6. (show timeline)- when you see these timelines where would you say that you are in what page under what sub element?
7. (Show simulation page)- when using the simulation checklist, can you explain how you approached the pages, if there was any difference between the pages?
8. (Show guidance)- During one of the prototypes there were words such as explain ask, how did you interpret these? Did this change how you approached or read the part below?
9. (Show tabs)- During another prototype there are tabs to hide some of the information, what do you think of this feature?
10. Do you have any additional comments or questions?

Thank you for taking the time to do this test! I am very grateful for your time and effort. Please take a muffin if you would like.

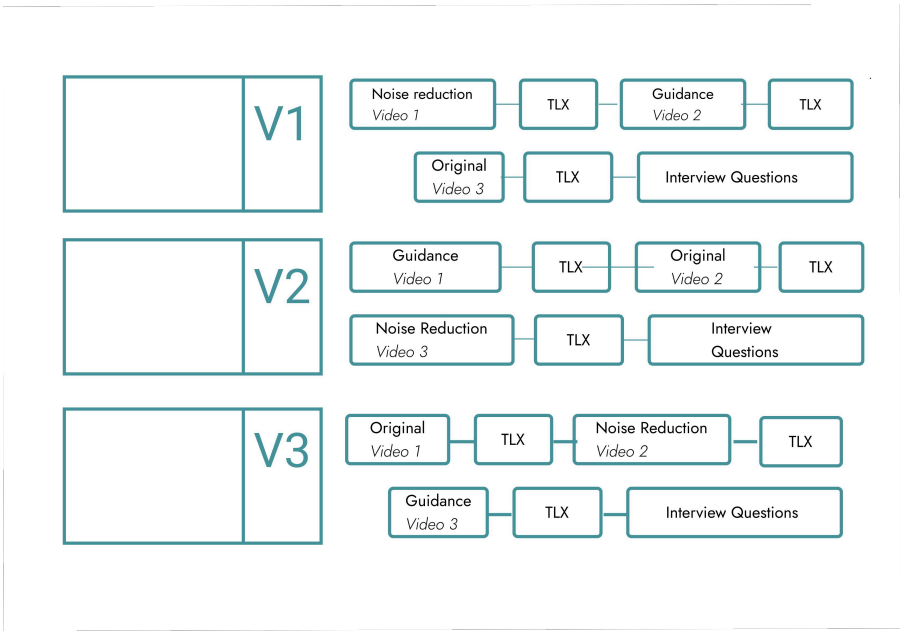
Material:

Printed

- Printed versions of the pages to ask more questions
- Script
- Consent sheets
- Brief, simulation and debrief pages of each prototype
- Page with Screenshots Timeline
- Page with simulation pages
- Page with tab
- Page with Guidance prompts
- Printed TLX form

Technical

- Phone
- Phone Charger
- Audio Recorder
- 3 video of food scenario.
- Laptop
- iPad
- Script



Participation

- Fruit

Informed Consent Form: Concept Evaluation

About the Research

This Concept evaluation is part of a Master Thesis focusing on simplifying the role of the observer during Simulation training for medical professionals, this study is done by the Master Student Elin Wahlqvist from the TU Delft in collaboration with Laerdal Medical.

The purpose of this concept evaluation is to compare the cognitive load experiences by the facilitator in the different prototypes of the digital product LIFT Scenarios. The scenario for this user test will be a restaurant scenario. The data will be used for the Master Thesis and to help understand observation-based simulation training and issues within facilitation guides such as the LIFT Scenario. If you choose to participate you accept to be part of a **User Test** with an approximate duration of **60 minutes**. During the user test, notes and audio recording will be taken. If you are uncomfortable with any of these data collection methods, you may opt out of them. The audio recording will be transcribed and then deleted.

To the best of my ability your contribution to this study will remain confidential. I will minimize any risks by processing and analysing all collected data anonymously (without your name or other identifiable information). The data will be stored on a private Microsoft teams' group, and on TU Delft One drive and will only be accessible to the student conducting the research and their TU Delft supervisors.

Your participation in this study is entirely voluntary and you can withdraw at any time.

Contact person: Elin Wahlqvist, E.S.Wahlqvist@student.tudelft.nl

What you will do as a participant

As part of the User Test

1. Listen to Background about Lift scenarios and research
2. Do a baseline test
3. Act like a facilitator and use lift scenarios Prototype 1 to go through the training. Look at the video when it comes to the observation part. Debrief
4. Fill in a questionnaire
5. Act like a facilitator and use lift scenarios Prototype 2 to go through the training. Look at the video when it comes to the observation part. Debrief
6. Fill in a questionnaire
7. Act like a facilitator and use lift scenarios Prototype 3 to go through the training. Look at the video when it comes to the observation part. Debrief
8. Fill in a questionnaire
9. Answer Interview Questions

Informed consent statement participant

I am aware that this research consists of the following activities:

1. User Test

I am aware that data will be collected during the research, such as notes and audio recordings. I give permission for collecting this data and for making audio recordings during the research.

- ☐ I give permission for both **Audio Recording** and **Notetaking**
- ☐ I ONLY give permission for **Notetaking**

I give permission to store the transcribed data for a maximum of 5 years after completion of this research and using it for educational and research purposes.

With my signature I acknowledge that I received sufficient information about the research and understand the nature of my participation. I can ask questions for further clarification at any moment during the research. I participate in this research voluntarily and was given sufficient time to consent to

Participant ID: .....

my participation. I understand that I am free to withdraw and stop my participation in the research at any given time. I understand that I am free to not answer questions which I prefer not to answer.

_____	_____
Last name	First name
___ / ___ / 2025	_____
Date (dd/mm/yyyy)	Signature

Pt____

Initial Test

Please rate your experience

---

1. I have experience with Allergies

Yes	No
○	○

2. I have worked in a restaurant before

Yes	No
○	○

3. I know allergy safe practices

Yes	No
○	○

4. I have experience facilitating

Yes	No
○	○

5. I am comfortable leading groups

Yes	No
○	○

Guidance

1. +/- 16.263
2. +/- 15.5
3. +/- 15.646
4. +/- 12.251
5. +/- 16.012
6. +/- 14.759

Original

1. +/- 16.966
2. +/- 19.155
3. +/- 19.899
4. +/- 16.129
5. +/- 14.824
6. +/- 22.377

Reducing Noise

1. +/- 15.352
2. +/- 21.453
3. +/- 14.058
4. +/- 13.079
5. +/- 12.953
6. +/- 17.263

The error range was calculated through adding the sample to calculator.net standard deviation calculator see example below.

95 % confidence was used.