



Designing an assistive & accessible schedule

Master's thesis in Computer science and engineering

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Cover: Mockup of the final prototype.

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Abstract

This master thesis project aims to focus on the topic of designing an accessible schedule for people with intellectual disabilities. This project was carried out at the request of Grunden Media. Grunden Media has requested a prototype and accompanying usability study to determine what should be considered when designing a smartphone application schedule. The user group are the participants at Grunden who will use the application to view their daily schedules. The research question for this thesis is: What are the best practices when designing a digital schedule for people with varying cognitive and motor skills? Both literature studies and interviews were conducted with employees and participants at Grunden Media throughout the design process to gather insights and evaluate the designed prototypes and provide an answer to the research question. The research and evaluation resulted in the presented best practices to consider when designing for intellectual disabilities. These include following guidelines such as WCAG, learning from people with disabilities by involving them in the process and providing alternatives to avoid exclusion when possible.

Keywords: User experience, user-centred design, interaction design, accessibility, intellectual disability, engineering, project, thesis.

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1

Introduction

In today's society, keeping track of appointments and events is just as important now as it was a millennium ago. The need for good scheduling solutions is and will always be a pain point for people with difficulties keeping track of everything themselves. This is even harder for people with intellectual disabilities where for example, understanding the passage of time can be more difficult. For these individuals, the interface should be tailored to their specific needs to accommodate them even further.

Grunden Media is an organisation based in Gothenburg. Grunden Media provides opportunities for people with mild intellectual disabilities to work with their different interests in the area of media and creative expression. Presently their scheduling is handled by a couple of people responsible, where common activities are announced on posters while personal schedules are printed and given out on a weekly basis. There can sometimes be difficulties keeping up with what is happening every day and hence Grunden Media has requested a solution for their problem. Because of the users cognitive disabilities, some feel that a regular calendar does not work since information can be difficult to take in. Grunden Media is requesting a custom-made schedule designed with accessibility in mind.

Some of the challenges that people with cognitive disorders face range from difficulties planning and keeping up with appointments, problem solving and loneliness as a result of the social barriers that their disabilities bring [1] [2] [3]. These challenges can be viewed from two different perspectives, the medical and the social model. The medical model implies that there is a problem with the individual while the social model implies that the society and environment needs to be adapted to accommodate their disabilities [4]. This project falls under the latter model since the aim is to find out the best practices by creating a tailor made solution for Grunden Media.

1.1 Research Question

The aim of this project is to investigate how a calendar can be made accessible for people with mild cognitive disabilities and reduced motor skills. After the project is completed the goal is to have a prototype and a set of best practices to apply when designing for people with cognitive disabilities. These best practices will be based

on both the research conducted and experience gained while designing a schedule interface for Grunden Media and their activities. The research question is as follows:

What are the best practices when designing a digital schedule for people with varying cognitive and motor skills?

1.2 Deliverable & Objectives

There is one objective and one deliverable for the project. The objective is a collection of best practices to be considered when designing interfaces for this target group. There is one expected deliverable for this project. This is an interactive prototype tailored to Grunden Media's needs, which will be handed off to Grunden Media after an iterative design process.

1.3 Stakeholders

The main stakeholder for the project is Grunden Media, whom the product is being designed for. This also includes their employees and participants who will be the people benefiting from the finished product. The mobile interface displaying the schedule will be designed for use by the participants but also the employees. The scheduling or admin view will be designed only for the employees. The mobile interface is the main focus of this project. The employees are those who work at Grunden Media as schedulers and supervisors etc. and will be referred to as employees in the report. The participants are those with disabilities who participate in the daily activities. Since anyone can be a member in the organisation Grunden, they refer to those part of the daily activities as participants. Henceforth, they will be referred to as Grunden participants in general and as research participants as extra clarification where needed. All research participants in this project are Grunden participants.

Chalmers University of Technology is also a stakeholder for this project. Their role is to ensure that the project is executed properly and that the report lays the foundation for academic work.

1.4 Limitations

Screen reader, text to speech, dictation etc, will not be designed as part of the project. These features are already included in most devices in the form of various accessibility features.

The prototype will only be used to explore different ways to make a schedule accessible and will not be developed into a finalised product.

The project will be limited to the Grunden participants, and those who are willing to be a part of the process, data gathering and user testing. This means that the project will encompass only the disabilities that are present in the participants who

are involved in the process and will not explore any other disabilities. This may exclude people who do not have the same disabilities or needs as those included in the project.

2

Background

The project is conducted at the request of Grunden Media to design a scheduling solution for their daily work. Grunden Media provide opportunities for individuals with intellectual disabilities to work and socialise. The project is aimed at helping their members keep track of what is happening on a weekly basis and to allow them to have better conditions for remembering and participating in that activity.

2.1 Grunden Media

According to Gilmore and Cuskelly [5], individuals with intellectual disorders are more vulnerable to feeling lonely in the social sense. This makes organisations like Grunden Media important to help develop social connections and create a sense of belonging. The daily activities that Grunden Media organise is also a part of their important work in creating awareness, equity, inclusion and claim more space in modern society through various forms of media productions and events. The media productions range from short films premiered at the Gothenburg film festival [6] to theatre, games, music and podcasts with notable individuals within different fields [7]. They also have a cafe run by the participants called the Grand Bazar.

According to Lööv and Wikström [8] participants in daily activities for people with intellectual disorders help develop and sustain social relationships, feeling a sense of meaning and being needed. Just as for anyone, an essential aspect is having work tasks that feel important. All of this creates an environment where these individuals can feel included.

2.2 Related Work

For people with intellectual disorders, hindrances that other people may experience as minor, may be compounded into a more difficult day-to-day routine. There are tools, both digital and physical, that aim to support these individuals. Some of the tools will be discussed further in this section.

2.2.1 RemindMe

RemindMe is a web based calendar meant to aid in work, school or daily life. It allows individuals to plan their schedule together with a support person or alone.

RemindMe utilises a feedback system to ensure that the user confirms that they want to attend before the actual event is underway. This is then displayed on a larger overview with the confirmed events being green and the declined events being red. Already attended events are displayed in grey, to allow for an easier distinction between the three [3].

The idea of choosing to participate in an activity is most likely not going to be explored in this project since the schedules are most of the time mandatory to follow. The feature could however be useful in the case of non-compulsory activities that deviate or otherwise override existing schedules.

2.2.2 Wellbee

Wellbee is a digital assistance tool for people who need help with scheduling, shopping or other daily tasks. Wellbee is meant to be used together with a support person and having all of the tasks be planned and inputted by them. Users can also video call, use a picture diary and plan clothing outfits [9].

A qualitative study has shown that the quality of life of its' users has been increased, citing increased sense of autonomy and feeling less stigmatised because of their disability. This gives the users a greater sense of blending in and feeling normal. The study also reports that planners are called for help less often after the user gets more acquainted with Wellbee [10]. Wellbee uses colours to represent each day in the week. One potential problem with their implementation of the calendar is the conflicting use of colours. The events themselves have an "effort" indication represented with colours. Since these colours are also used for the days, some confusion may occur between the two.

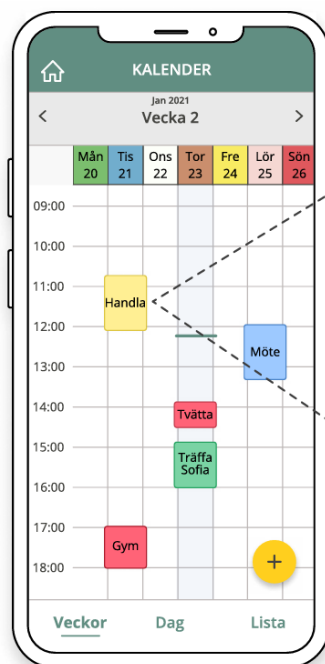


Figure 2.1: Wellbee [9].

2.2.3 DigiJag

DigiJag is a digital platform aimed at people with mild intellectual disabilities. DigiJag helps people with intellectual disabilities live a more independent life. Users can be part of groups and communicate with each other. There are tools like checklists and recipes among others to support organisation of tasks and activities. An admin can also publish material in the form of text, documents, pictures, films and links to a group, e.g. a class or an organisation. DigiJag can act as a portal so that some other web-based platforms, e.g. YouTube, can be made more accessible without having to leave DigiJag [11].

DigiJag utilises a couple of design principles that could be beneficial for this project and when designing for cognitive disabilities. The days are colour coded and each day uses a specific colour. Tuesday for example is blue/azure as seen in Fig. 2.2. There are also two different representations of time present in the design, which may also be useful when designing this project. The time is displayed in both analogue and digital form to accommodate for those who may struggle with one or the other.

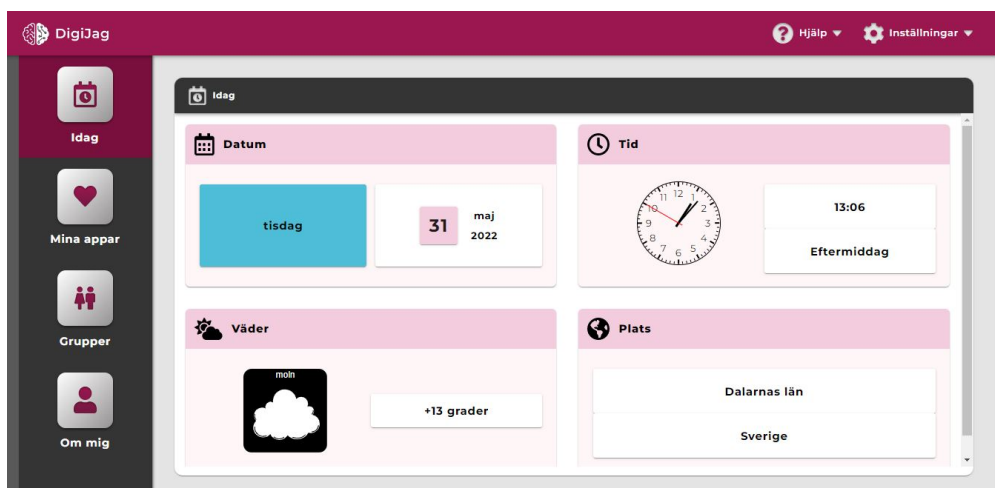


Figure 2.2: DigiJag [12].

2.2.4 Google Calendar

Google Calendar, in Fig. 2.3, is Google's own calendar solution which can be used on all devices including the web. Currently there are some limited accessibility options such as changing text and event colours, though these must be found by the user themselves and are not readily available. The user can not add any pictures to the listings that show up in the overview, making aids such as pictograms impossible to use.

2. Background

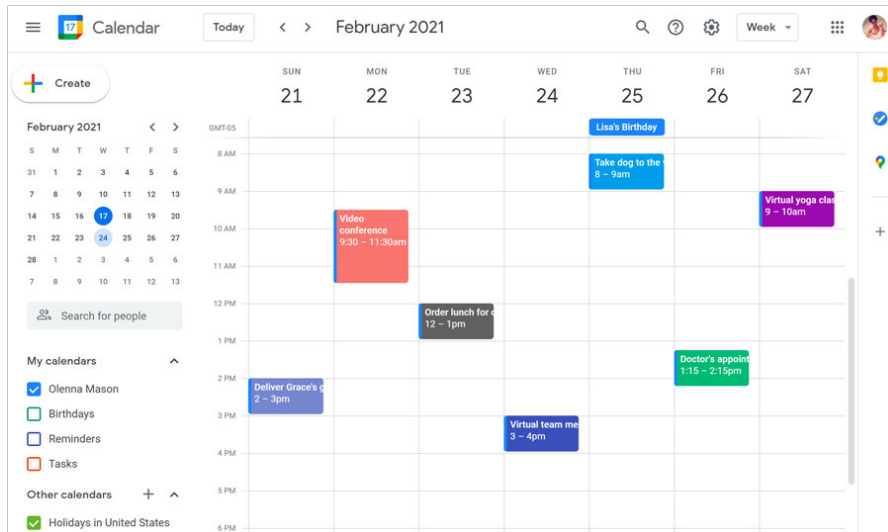


Figure 2.3: Google Calendar weekly view [13].

3

Theory

3.1 Cognitive Disability

The Centers of Disease Control, CDC, defines intellectual disability as follows:

"Intellectual disability is a term used when there are limits to a persons ability to learn at an expected level and function in daily life." [2]

Intellectual disabilities can vary in severity, though most bring with them a deficit in theoretical thinking. This affects adaptive functioning, meaning that most people will need some kind of support in their daily life. The three domains which adaptive functioning is divided into are: cognitive, social and practical. This project focuses on the cognitive domain, which handles reading, writing, arithmetic and concepts like time [14].

Some people may also be multiply disabled and have an intellectual disability combined with other disabilities (e.g. vision impairments or physical disabilities) which can cause further issues when using digital applications and interfaces that are not accessible enough.

Disability can be modelled in two different ways. The first is the medical model where people with disabilities are regarded as straying away from the norm because of their medical condition. The medical model is described by the Accessible Education Center as follows:

The Medical Model views disability as resulting from an individual person's physical or mental limitations, and is not connected to the social or geographical environments. The Medical Model focuses on finding a "cure" or making a person more "normal." [15]

The other way to look at it is from the social side. Here the social model treats the interactions between people with the disabilities and their environment, be it physical, attitudinal, communication and social barriers, as what makes them disabled. The implication here is that society as a whole has to change to accommodate these individuals on these levels by introducing assistive technologies and solutions, instead of the individual having to do the reverse [4]. It is important to note however, that if the assistive technologies or solutions do not work, they can have the opposite effect.

3.2 Calendars as a Scheduling Tool

Calendars have been used for a long time but the one used today is called the Gregorian calendar and is from around 1582 [16]. The use of calendars have stayed mostly the same; to keep track of events and appointments. Modern solutions also provide support to invite people through the calendar to automatically create an event, reducing the time people have to input the details of the event. In short, it still holds up as a cognitive support tool which is widely used by most people in all kinds of situations.

Individuals with intellectual disabilities may struggle with self-management skills such as organisation and scheduling. This can lead to exclusion in the form of missing various appointments, deadlines or forgetting planned leisure activities [1].

One suggestion to remedy this is to start education on time management tools such as day planners and calendars from an early age. This develops a stronger perception of time. Time should also be related to a practical event so that a connection forms easier, as well as having the events be portrayed on in an analogue or more visual representation. This can be wholly physical devices such as a marker boards with symbolic representation of the events that will take place that day [17]. Digital instruments should then be adapting these symbolic representations while also introducing some form of tactility that digital solutions may lack.

Assistive technologies, both hardware and software, can provide support for people with cognitive disabilities and improve quality of life. Supporting a persons strengths and accommodating their weaknesses when designing assistive technologies can minimise stressors and improve confidence and self-esteem. This applies even to simpler solutions. However, these solutions must be adapted and tailored to the user and their environment to ensure that the product will be effective. When not considering the context of the person, their needs, and their environment there is a high chance of them abandoning the product [18].

When providing a product for users with varying needs and desired features, it can become difficult to tailor the product and experience. Efforts must be made to ensure that all users will be happy with the solution and will want to continue using it.

3.3 Response Biases

Any kind of data collection with people involved is at risk of introducing each individuals biases in some way. The blanket term for this phenomenon is *Response bias*.

3.3.1 Social Desirability Bias

Social desirability bias is the term used when respondents tend to give answers that they perceive to be aligned with societal norms instead of their own beliefs or

displaying their true behaviour. This affects answers in a way that may make them look unusually normal [19].

Some of the ways to reduce the effect of social desirability bias is to provide anonymity to the respondent since touchy subjects may make them more prone to give socially acceptable answers. Confidentiality should also be a given. Finally, asking the questions in an indirect way also allows people to separate the answer from them personally.

3.3.2 Acquiescence Bias

Acquiescence bias, also known as agreement bias, occurs mostly when the respondent is asked to respond to a statement to which the answer can be yes or no. The bias refers to the inclination to agree with or say yes to the statement regardless of the contents or the respondents actual views [20]. There may be several reasons to why this occurs, such as wanting to please the researcher, not having enough knowledge on the subject and therefore just agreeing, or because they want to get through the survey or interview quickly.

3.3.3 Non-response Bias

Non-response bias occurs when the respondents differ from those that chose not to respond. This results in skewed representation in the target group when conducting surveys [20]. In the case of this project where disabilities can come in many forms and a range of severity, a wide representation matters. A possible way to help eliminate non-response bias is to engage with the target group to get more respondents and to also look at similar data in the case of finding out more.

3.4 Designing for Cognitive Disability

Designing for disabilities in general is a difficult task because of how many different kinds of aspects to it there are. Around 1.3 billion or 16% of the world's population have some kind of disability as reported by the World Health Organisation, WHO [21].

According to Cooper [22], a product should be accessible to both impaired and unimpaired users. Cooper also lays down some guidelines on what the product should fulfil to be considered accessible, these are as follows:

- *Users can perceive and understand all instructions, information, and feedback.*
- *Users can perceive, understand, and easily manipulate any controls and inputs.*
- *Users can navigate easily, and always be aware of where they are in an interface and navigational structure.*

3.4.1 Web Content Accessibility Guidelines

The Web Content Accessibility Guidelines (WCAG) are published by the World Wide Web Consortium (W3C) and describes how web content can be made more accessible by the use of different techniques [23]. This includes physical aspects such as text contrast or providing multiple ways of navigation, as well as reducing the amount of unusual words to allow more people to understand what is being said or shown.

Examples of WCAG guidelines that are relevant for this project and the intended user group:

Success Criterion 1.4.1 Use of Color

Color is not used as the only visual means of conveying information, indicating an action, prompting a response, or distinguishing a visual element. [23]

This particular guideline suggests that designers should use icons and other means of conveying information than with colour. This guideline is there to accommodate individuals with different kinds of colour blindness for example.

Success Criterion 2.5.5 Target Size

The size of the target for pointer inputs is at least 44 by 44 CSS pixels except when:

- **Equivalent:** The target is available through an equivalent link or control on the same page that is at least 44 by 44 CSS pixels;
- **Inline:** The target is in a sentence or block of text;
- **User Agent Control:** The size of the target is determined by the user agent and is not modified by the author;
- **Essential:** A particular presentation of the target is essential to the information being conveyed. [23]

Larger touch targets may help individuals with limited motor skills such as tremors or inflexibility, to use digital programs easier since it requires less accuracy when clicking or tapping.

Success Criterion 1.4.3 Contrast (Minimum)

The visual presentation of text and images of text has a contrast ratio of at least 4.5:1, except for the following:

- **Large Text:** Large-scale text and images of large-scale text have a contrast ratio of at least 3:1;
- **Incidental:** Text or images of text that are part of an inactive user interface component, that are pure decoration, that are not visible

to anyone, or that are part of a picture that contains significant other visual content, have no contrast requirement.

- **Logotypes:** Text that is part of a logo or brand name has no contrast requirement. [23]

Contrast ratio is especially important for those with visual impairments or colour blindness since they need the text to be easy to read. However, using a high contrast ratio benefits everybody and reduces the risk of missing information or not being able to distinguish different elements of an interface.

4

Ethics

The project will require some form of data collection since user studies and tests will be performed. The product is being designed and tailored to the requirements of Grunden Media and its members and employees and therefore information needs to be collected to identify those needs.

Disabilities come in a broad spectrum and as such it is important to attempt to represent as big a variety of people as possible. That also includes the different areas and levels of disabilities that people can have.

Before collecting data, consent from the research participants must be acquired in written form. Because the users can have difficulties understanding whatever is written on the consent form, it should also be explained verbally in simpler terms. There will be efforts made to anonymise data or collect general data which is not linked to individuals. This can be done by inquiring about general requirements and which disabilities are present in the organisation from the director or administration rather than asking individuals about their disabilities which may be a sensitive topic.

The focus can also be shifted to inquire about their requirements and desires for the interface since their specific disabilities are not important for the design process. The topic is *designing an accessible interface for people with varying cognitive and motor skills* and the guidelines will be of a more general characteristic.

When formulating a consent form and gathering consent from research participants, there are certain points which are important to consider and implement. This is important for all research, but can be of greater importance when the target group is people with intellectual disabilities. In the following list, are a few relevant points relating to ethics in research for intellectually disabled. These are only a select number of points from the 50 categorised recommendations provided in [24].

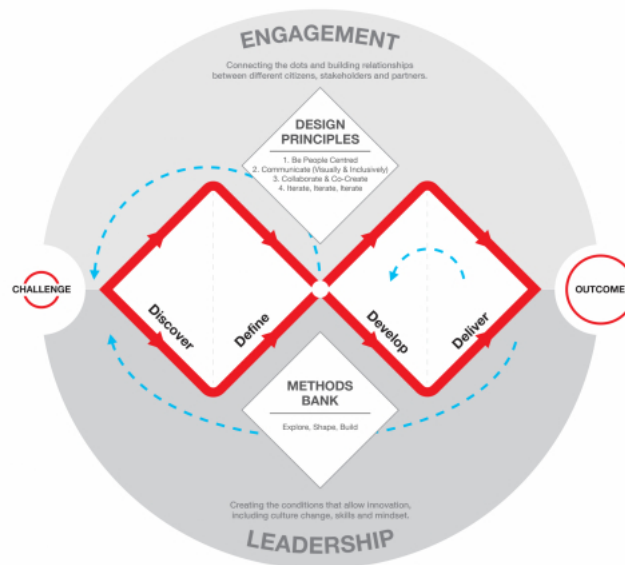
- There should be no deception or coercion to get people to participate.
- There is enough information about the research and the process, such as who is conducting the research, what the research is about, how information is stored and the participants' rights.
- Participants should be able to withdraw consent at any time.
- The raw, identifiable data should only be available and accessible by those conducting the research and that data is stored securely.

5

Methods

5.1 Design Methodology

In this project a specific methodology will be used to develop the product. The Double Diamond, as seen in Fig. 5.1, aims to help designers tackle complex problems by guiding them through different stages [25].



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Figure 5.1: The Double Diamond design process by Design Council [25].

- **Discover** - The discover stage broadens the designers understanding of the problem instead of letting them work on assumptions. This is typically done by speaking with the user group and observations.
- **Define** - The define stage then narrows down the problem, which aids designers delimit the project so as to not get scope creep [26]. If the problem is still too loosely defined then taking a step back and conducting more research is suggested.

- ***Develop*** - The development stage opens up the solutions and encourages giving various answers to the problem. This stage is essential since it drives the creatives process in a way that may result in an innovative final solution.
- ***Deliver*** - Finally the deliver stage involves testing the product and reiterating if it does not meet the demand of the product. User testing is key since a fresh set of eyes can be valuable in spotting key errors in the final design.

This is not a linear process and designers are encouraged to look back and reiterate to ensure that the final solution is good, since there is no way for it to be the absolute best solution [27].

5.2 Data Collection

Data collection is an essential part of the project. The goal is to collect qualitative data to lay a foundation for the rest of the project. Data collection also serves to provide knowledge in an otherwise new field.

5.2.1 Focus Groups

A Focus group is an effective way for gathering information about a topic. Research participants are selected from the targeted user group and will create the focus group, led by a moderator. The moderator is there to provide questions and steer the conversation in the right direction. It is important to make all the participants feel safe to allow for everyone to participate and bring their insights. Focus groups can provide the moderator with insights into what is valuable and important to the group [28]. In this case, this would be what they value in a calendar and what they do not like etc.

This method will be used when gathering and identifying the requirements for the application. The focus will be to find what the people at Grunden Media need the most in a calendar, both from the perspective of the administrator and the users. Focus groups may also be used when evaluating the prototype or application, if suitable.

5.2.2 Interviews

Interviews are a method to gain insight into the problem and they can be conducted in a structured or unstructured way. The structured way is more rigid with only the set questions being asked. These can be perceived as formal and allows for no follow up questions but may be more efficient in getting the questions answered. Unstructured interviews on the other hand are more conversational in nature and only has the questions as a general topic guide. These can be felt more as a conversation and relies more on the interviewer to guide the conversation gently in order to get the answers in the allotted time [28].

When interviewing people with cognitive disabilities, extra consideration is required to get the best results. It is important to prepare simple and clear questions to get

relevant answers. The interviewee may take longer while answering some questions and it is important to be patient and also understand when guidance is needed. The interviewer must identify if the interviewee is still trying to answer the previous question, and in that case give them the time needed. However, their answer may also be delayed because they are confused by the question, in this case the question may need to be repeated or rephrased as well as adding a follow up question to make it clearer. It is also important to articulate and speak at a slower pace if needed. Apart from that, it is important to speak and behave normally and not think about it too much [29].

Interviews will be used in the early stages of the project to extract requirements from the employees at Grunden Media. Interviews will also be used when evaluating the prototype in later stages.

5.2.3 Observations

Observations are conducted by watching people in the user group and allowing the designers to immerse themselves in their work or activities. This method is hands-off from the researchers side since interfering with the observees may affect them as well as them feeling more pressured from being watched. This method may be more difficult to implement in the earlier stages of this project since the people at Grunden do not have a current solution to their problem, though it can possibly be used towards the end when there is a finished product [28]. There are multiple ways of conducting research using observation, with three common methods being controlled, naturalistic and participant observation.

Controlled observation or structured observation, entails that the observer has some degree of control over variables in the environment. The goal is to manipulate these variables and observing any changes to the observees. This method is widely used in laboratory settings where there can be full control over as many variables as possible, in order to find cause-and-effect relationships [30].

The complete opposite of controlled observation is naturalistic observation, where observers are not allowed to participate or in other ways affect the environment being observed. This approach to observation is often used in fields such as anthropology, biology and ecology [31].

Participant observation is similar to naturalistic observation. The participant is observed performing day-to-day tasks but differs from naturalistic observation since interaction with the observers can occur in participant observation. The observation can vary in length, from one day or a few interactions to spanning multiple years. This observation method is often used to observe participants in wide ranges of environments and settings [32].

5.3 Data Analysis

After data has been collected, it has to be analysed. This can be done in many different ways, some aim to quantify qualitative data and some solely look at the

qualitative data as a whole. In this project the aim is to use the data to extract requirements and features that the participants at Grunden want and need.

5.3.1 Affinity Diagramming

Affinity diagramming is a versatile method and can be used during several stages of the design process. The method is performed by recording observations, insights, comments and the like, onto sticky notes. It is an inductive approach and instead of using predefined categories, the sticky notes are grouped together by similarities which together form larger categories in the end. Through this method, the common opinions of the research participants will be highlighted which indicates the most important aspects or issues to focus on [28].

5.3.2 MoSCoW Prioritisation

MoSCoW is a prioritisation technique well suited for projects and can help manage and understand priorities. The priorities have four different levels [33]:

- ***Must have*** - These are the requirements that must be present for the project to succeed. It cannot be delivered without these features.
- ***Should have*** - These are important features that should be present in the final product but it can be delivered without them.
- ***Could have*** - These are desirable features that are less important. They would be a nice addition to the project but will be the first features to be dropped if the deadline is at risk.
- ***Won't have this time*** - These are the features that are outside of the scope for the specified time frame. This helps limit the project and avoid features being informally introduced later on in the project.

The effort should be divided proportionally between must have, should have and could have. Must have should not exceed more than 60% effort as to not increase the risk of failure. A reasonable effort for the could have level is 20%. The effort and partitioning is a general recommendation and may vary depending on the team and project [33]. This method will be used when all requirements have been gathered to set the scope of the project and define the most important features which must be present in the final product.

5.4 Participatory & User Centred Design

Participatory design means, as the name suggests, to design together with the end users to gain insight into what the users want from a product. This is usually done in design sessions where the users can articulate what their dream product will look like, allowing the designers to understand their needs in a more informal manner [34].

Some methods that can be used include the *The Love Letter & the Breakup Letter* and general sketching workshops [28]. The love and breakup letter can show strengths and weaknesses in tools such as the printed schedules that are in use currently. The sketching can then help visualise everything more specifically in order to make it easier to extract the requirements.

Two methods that are also useful are prototyping and usability testing. Prototyping allows the designer to implement and rapidly iterate over a supposed solution, without committing to one. For digital interfaces this is typically done in software but paper prototypes are also recommended to use for the quick sketch nature of it. When the prototype is developed more and reaches a higher fidelity, it is usability tested. The tests are usually simple and seeks to extract user feedback in the form of the research participants thinking aloud, in order to make the final product more user friendly[28].

While organised workshops and participatory design elements can be great for involving the user in the process, they also require a lot of time and effort. This can make it difficult if it is important to quickly and efficiently gather specific and easily analysable data. Participatory design can provide interesting insights, however there are a lot of aspects needed to succeed.

In some user centred design, that participatory design is a part of, the user is less involved than with participatory design but is still a core part of the design process. User centred design is a process which is not bound by any specific methods, the chosen methods can be tailored to the project at hand. The main goal of this design approach is to make sure that the created product or service is easy to use, intuitive, and fulfills the needs of the users. To ensure the final product is accessible and desirable, user research and usability testing should be conducted throughout the iterative process [35]. It is important to involve the users in every step of the design process through the mentioned methods to identify requirements and to evaluate prototypes and designs.

6

Planning

The time plan for the project is presented as a Gantt chart in Fig. 6.1 and is split into several phases.

The first phase is the Planning report. There is approximately a month dedicated to writing the report and performing a literature study, gathering necessary and relevant information to use as a base for the project.

The second phase is the Design phase, where firstly, all of the requirements will be researched. This is followed by a week of prototyping and a showcase at Grunden Media. The showcase will consist of unstructured interviews with both the members and employees at Grunden Media. The members will be asked different questions regarding the colour and general clarity of the calendar overview. The employees will be asked more detailed questions on what they need in the tool to make their planning easier. With the necessary feedback from the showcase, a second iteration of the prototype will be made which will then be the base for the implementation in the next phase.

The third phase is the Implementation phase. The first step will be to research the best approach for developing the product, including finding the best frameworks and which Integrated Development Environments (IDEs) should be used during development and then perform setups for these. The setup is followed by two code phases, each ending with a meeting with supervisors to discuss progress etc. The final step will be bug testing, the last user tests and subsequently the final iteration using the feedback from those tests.

During the project there will be meetings, at a regular interval, with both the supervisor at Chalmers and the supervisor at Grunden Media to ensure everything is going to plan.

Documentation and report writing will be continuous throughout the thesis work. There are three weeks dedicated to finishing the report at the end of the project, followed by and overlapped with three weeks of making and preparing for the presentation.

6. Planning

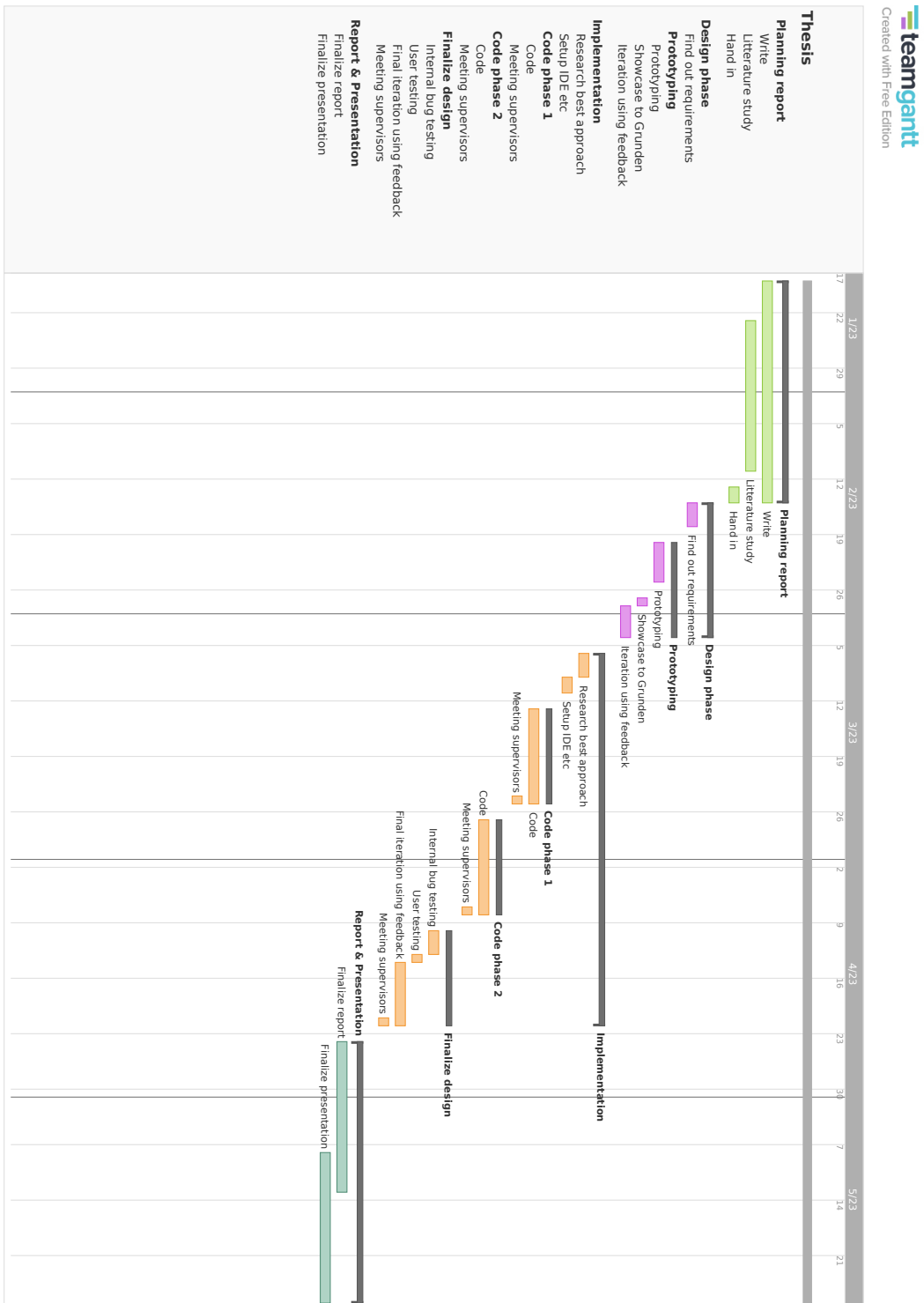


Figure 6.1: The time plan for the project in the form of a Gantt chart

7

Process

The process follows the Double Diamond design process described in the Methods section. However, the process differed slightly because of the circumstances. This chapter will present the first three stages Discover, Define and Develop while the Deliver stage will be the results.

The original approach to the project was to create a visually accessible calendar for the evening activities at the Grand Bazar (The cafe ran by Grunden participants). This was however changed because of their needs changing. As such, the project was shifted towards the daily activities and how the supervisors handled their scheduling. With that the scope of the project grew to encompass the design and implementation of a new scheduling web app. The web app would have a way for users to view their schedule as well as the supervisors being able to schedule everything.

Because the project grew too large there was a risk of major scope creep, thus the scope had to be narrowed down further. This change resulted in not creating a fully functional scheduling tool as initially preferred, but instead creating an interactive prototype and evaluating it with the participants at Grunden. Another effect of this change was switching focus from functionality for the admin users, to accessibility for the participants.

7.1 Discover

The discovery stage of a project typically entails some form of data gathering to ensure that designers are working with correct assumptions and observations. Interviews were the main tool to achieve this during this phase of the project, while observations would also supplement the interviews.

Data gathering is a crucial step in the design process, and even more so when designing for people with varying needs. As such, several interviews were conducted to better understand Grunden Media, its' members and their needs.

7.1.1 Literature Review

A literature review was conducted to understand intellectual disability better. This included research into how individuals with ID's are affected socially and in the self-management sense. One important thing found was that while it is easier to

generalise, every person is different from the next and that was something that had to be taken into consideration. ID's are a wide spectrum and some may have more severe impact on their lives than others. Accessibility guidelines from WCAG were also researched in order to further understand what needs to be done more practically.

The literature provided some insight into what elements could be implemented in the design, such as different time representations and different colours for different days. However, what the literature could not give answers to was what the general design should look like. How to display information and what flow and navigational features the prototype should have were questions that required interviews and user testing to answer. Here, both the insights from the literature and the lack of certain insights laid the foundation for the questions about what they thought about the implemented features from the literature and what other features they might need.

Since Grunden Media's participants have a plethora of different requirements and needs in a digital schedule, it was impossible to get answers to these questions from the literature. This led to formulating questions and preparing for requirement gathering which is described in the following sections.

7.1.2 Early Observations & Interviews

For the interviews and all of the testing, Grunden Media's locations were visited. The office location is a quaint mix of recording studios, computer stations and movie props. The atmosphere was welcoming and many were interested in the project. The general impression was that everybody knew each other.

The first interview conducted at Grunden Media was unstructured and served as a way to understand the organisation further. This interview was conducted with an employee at Grunden Media. Questions about what kinds of disabilities their participants had and how it affected their lives were asked. General questions about Grunden itself were also asked, such as how they operate, their current scheduling issues and their desires for the design.

The answers to the questions were noted and later sifted through to find the most relevant answers relating to the design. The findings suggested that some participants may have trouble with the perception of time. The answer to the question on that subject was "Yes, there can be difficulties with the perception of time or interpreting Thursday in three weeks, when is that?". It was also mentioned that some of the participants are illiterate. This sparked the idea that coding the days to colours could be something to help these users. On the question "What difficulties do your participants have with regular calendars?" the answer was "Highly individual". This confirmed what was learned from the literature review, and that further research with the participants at Grunden was required to understand some of their specific needs.

7.1.3 Interviews With Employees

Two semi-structured interviews were conducted with two individuals that work at Grunden Media. This was to gather requirements on what kinds of features the website should have. The two individuals have two different roles at Grunden Media. One of them is a supervisor who is soon to be a scheduler and the other is responsible for design and websites and who used to be a supervisor.

7.1.3.1 Interview Results

Currently they have 60+ InDesign files which are edited on a person by person basis which are then printed for the participants that may want it on paper. The supervisors also have a paper with their weekly schedule. With their current solution, there is a risk of miscommunication when rescheduling activities where a supervisor may be needed and they are not notified.

When there are changes in a participants schedule the approach to informing them differs between individuals. Some need to be told in person if the time or supervisor for the activity is changed while others may not. A fully digital solution where the schedule can easily be edited may work for many but some will still need the changes to be communicated before they see the change in the schedule.

They were interested in moving over to a digital solution. However, since the schedulers are very busy, the digital solution would need to be intuitive and more efficient than their current way of scheduling.

During the interviews, they were also asked to describe their most important features. This resulted in a collection of requirements for both the design and the features.

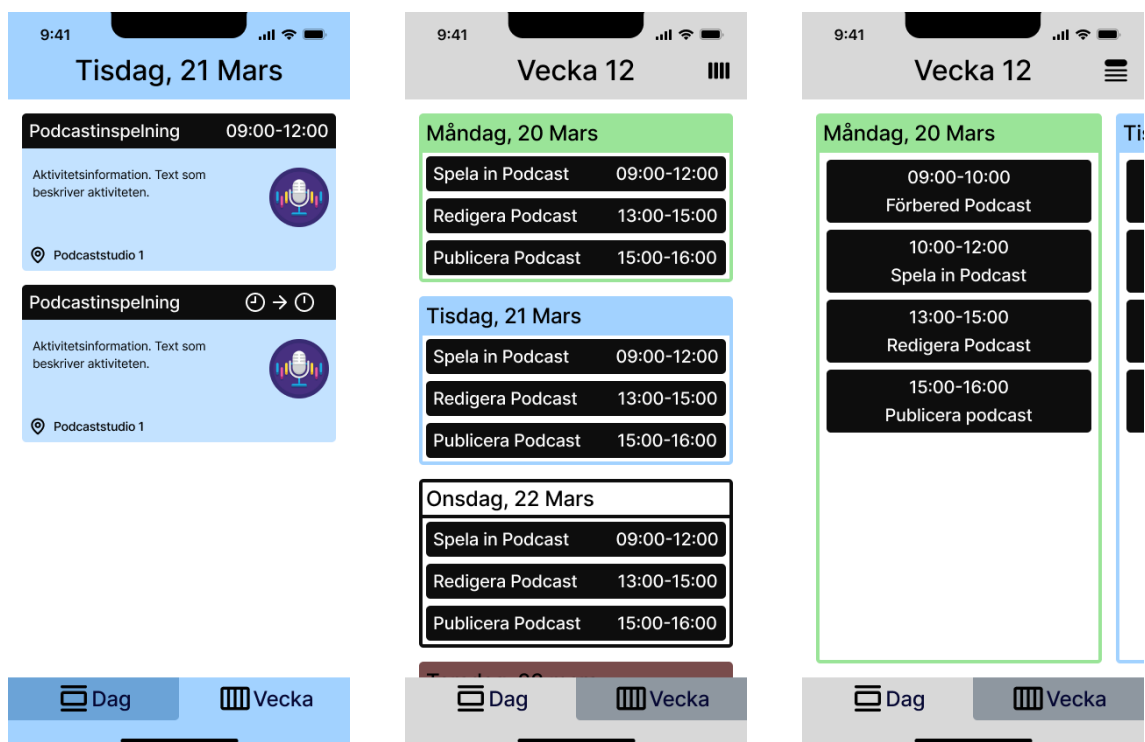
- **Scheduling** - Being able to schedule events, edit and delete them.
- **Printing out** - Some participants at Grunden may want the schedule printed out onto paper.
- **Connected schedules** - Each individual schedule should be connected to every other schedule. Meaning that if an event is changed in some way, it updates for everyone.
- **Room booking** - Each activity should have the option to book a room or location, with some safeguards to prevent double booking.
- **Recurring events** - Some activities may occur at the same time and same day each week. There should be an option to schedule this automatically rather than have to manually enter the information for each activity.
- **Overriding events** - If there is an activity for everyone it should override the other items in the calendar

These features had to be included in the design somehow. Most of the presented features would only be visible from the planning side.

7.1.4 The First Mockups

Based on what was learned during the first two interviews and the preceding literature review, two simple mockups were created. These emphasised the general concept and focused more on the layout, text size and readability as a whole. The mockups were used to gather feedback during the interviews and were shown after all of the questions about calendars were discussed. Two mockups were made to allow for exploration of different alternatives and not get stuck on one path. The designs explore different ways of visualising calendars, focusing only on daily and weekly views. Each day is represented by a colour for extra clarity and there are two alternatives for displaying the time of an event.

The mockups are similar but differ slightly, mostly in the method of displaying an activity and the weekly view. While the first mockup allows the option of choosing between digital and analogue time representations, the second mockup displays both at the same time. Having different representations of time is to make it easier for those who may have difficulties interpreting time in either digital or analogue form. In the first mockup there is also an option for how to display the week, either with vertical scrolling or horizontal scrolling to accommodate for different ranges of motion. The two designs are shown in Fig. 7.1 and 7.2.



(a) Daily view showing two ways of representing time.

(b) Weekly view with vertical scrolling.

(c) Weekly view with horizontal scrolling.

Figure 7.1: The three views of mockup one with a daily and a weekly view which can be switched between horizontal and vertical scrolling using the top right button.



(a) Daily view.

(b) Weekly view.

Figure 7.2: The two views of mockup two with a daily view showing analogue and digital time simultaneously and a countdown timer, and a weekly view with vertical scrolling.

7.1.5 Interviews With Participants

Three interviews were conducted with participants at Grunden Media with the purpose of gaining insight into their use and opinions of calendars. There were seven questions prepared to gain insight into the participants use and opinions of calendars and the answers to these questions were written down for later analysis. The questions were the following and have been translated from Swedish:

- Do you use any calendars?
- What type of calendar do you use? One on your phone or a small book?
- Can you give examples of what you use your calendar for?
- How do you think using a calendar works?
- Can you give examples for when it has worked well using a calendar?
- Can you give examples for when it has worked poorly using a calendar?
- Do you usually look at the calendar on the wall? (There is a large calendar in the form of a white board at Grunden Media)

In the analysis the responses to these questions were read and analysed to find patterns and common opinions. There was no full analysis since these interviews were only meant to understand their background with calendars and current use of calendars. The responses to the questions were elaborated on more or less and some research participants had no response or opinion for some questions. Those who currently used calendars preferred analogue versions. They also expressed that some calendar applications may be harder to understand, but that they would prefer a digital solution if they would be able to use it on account of them always carrying their mobile phone.

During these interviews the first mockups were also shown and evaluated where the research participants could freely explore the mockups and express their opinions and compare the two different mockups. The participants compared the mockups and expressed which elements and which designs from each mockup they preferred. The images of a microphone to indicate that the activity was a podcast were confused with a text-to-speech button by several participants. Some of the specific responses to the mockups were:

"Easy to use, the letters were clear. Sometimes when I read small text I get a headache."

"White text on a dark background is easiest to read for me."

"It would have been nice if you could zoom in, so that the text is easier to read."

Regarding the timer for how long is left until an event starts, one research participant said:

"That would probably work for me, that it tells you how much time is left until it starts."

7.2 Define

The define stage is where the all the information and findings from the discover stage were filtered through and the ideas narrowed down into the problem definition for the project.

7.2.1 MoSCoW

The findings and requirements were sorted using the MoSCoW Prioritisation to manage the scope of the project and also define the most important features and design requirements. The requirements are based on the first interviews with the employees and participants at Grunden Media with some findings from the literature review. The prioritisation was divided into two tables, Table 7.1 and Table 7.2, where the first one deals with the required features of the admin view and the second one deals with the required design choices for accessibility of the calendar and schedule view.

Having the schedules be connected with each other was a requested feature since Grunden Media's current solution had the issue of events not having any relation. This meant that editing one schedule did not update all others. It was requested that an activity was linked to the supervisors and the participants view of a scheduled activity. This was mostly a requested feature by the supervisors, but it would be of obvious benefit to all users. Having a configurable interface means adapting the interface to fit individual users needs. This could be changing text size, enabling and disabling the use of different time representations and choosing the direction for scrolling. The features were prioritised and placed in the categories based on several parameters. They were prioritised by what the employees at Grunden Media thought were important and also based on the participants' views on calendars. Lastly the project scope and what was feasible to design for within this project was taken into account when prioritising the features.

Must have	Should have	Could have	Won't have
Connected schedules	Print schedules	Attendance	Evening activities, Grand Bazar is separate
Recurring activities	Event priorities	Option to add picture to activity	
Calendar view for participants	View privileges, should only see certain things depending on access level		
Calendar view for admins	Edit events		
Book room/location for each activity			
Admins can schedule events			
Access schedule anywhere			

Table 7.1: MoSCoW prioritisation of features for the admin and scheduler view.

Must have	Should have	Could have	Won't have
Simple language	Colours adapted for colour blindness	Colour customisation	Pinch to zoom
Different types of time representation	Variable text size	Light/dark mode	
Configurable interface		Add your own events	
Pictogram colours for each day			

Table 7.2: MoSCoW prioritisation of the features for the accessible calendar view.

7.3 Develop

The development stage is where a solution to the defined problem starts to take shape. The first iteration of the solution was based on research and was meant to create a stable foundation for the rest of the development cycle. The majority of this stage is iterative prototyping, evaluating that prototype and making iterative changes.

7.3.1 Prototyping

During the prototyping phase, two prototypes were made. The first one is the calendar view where users can see their schedule, which was the main focus. The other prototype is the view for the admins and schedulers.

7.3.1.1 Prototyping of Participant View

The two initial prototypes were merged into one, taking influences from both depending on what was better received by the testers. The per-day colour was adapted to the rest of the interface to remind users what day it is when looking at their schedule. The colours were made darker to allow for a contrast level of AAA in accordance with WCAG 2.1. This change was made since a user expressed that it was easier to read some text more than others. The weekly view was changed to have horizontal scrolling to accommodate some individuals with motor impairments. To be able to display more information about an event without increasing clutter and impairing readability, popups containing more information such as participants and supervisors were added when tapping on an event. The removal of the images for each activity was a result of many of the research participants confusing the icon for a text-to-speech button. A first time setup was added to allow the user to choose between two different text options before using the prototype, one with smaller text and one with larger text.

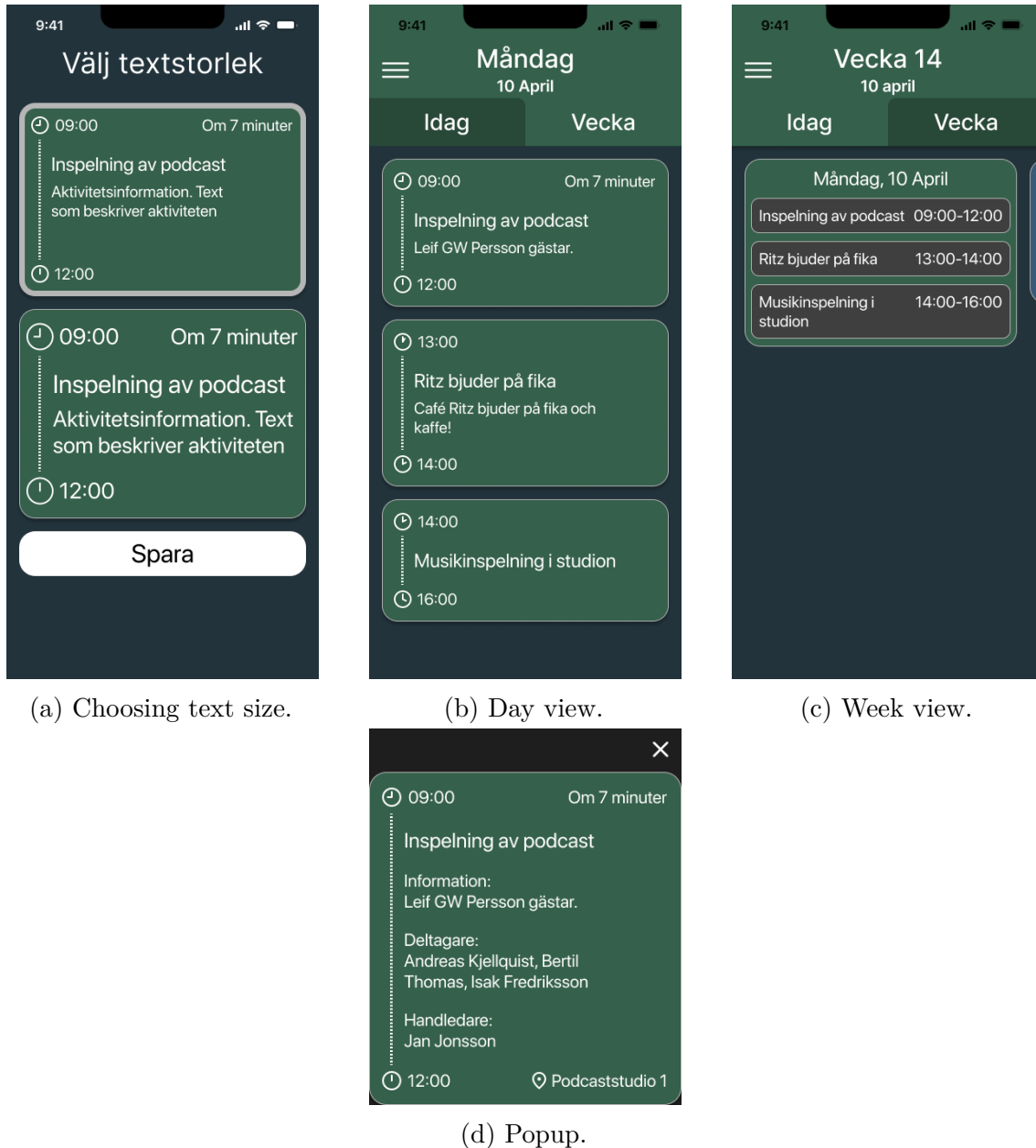


Figure 7.3: Prototype two with two views and a start screen for text size selection. The day view displays the events in a vertical feed with each tile showing the most important information about an activity. The week view shows each days activities in a tile with the corresponding colour for that day. The popup displays more information about an activity when tapping on the activity in the day or week view.

7.3.1.2 Prototyping of Admin View

Since the main focus of the project has been creating an accessible design of the calendar for the participants with varying intellectual disabilities, the admin view has been a smaller priority. The admin view was designed to show how the entirety of the system could look, from scheduling an activity to seeing it in the calendar view for the users. This prototype has not been iterated upon because of time limitations and not being the main focus but was created with the requirements mentioned by the employees which were prioritised in the MoSCoW table. The prototype is presented in the chapter Results.

7.3.2 Interviews With Participants

Five interviews were conducted to user test the prototype. The people who were interviewed are participants at Grunden Media and have varying forms of disabilities. The interviews were divided into two parts where they were asked to perform tasks within the prototype and then were asked a few follow up questions to determine their experience with the interface. Both the screen they were using and the audio were recorded to be able to look back at their reactions and thoughts as they were using the prototype.

The aim of these interviews was to test the navigation through the prototype and how easy it was to find and comprehend information. The tasks that the research participants were asked to perform were the following, translated from Swedish:

- Choose your desired test size.
- Find the activity "Recording of podcast" and find out the location of the activity.
- What are the activities on Friday and at what time do they start? Choose an activity and read out who the participants are for that activity.

These tasks were followed up with questions regarding the contrast of the colours and text, the text size and readability, if the information was understandable and if there were any issues with the presentation of the activities and information. After the questions they were also provided with the opportunity to express any other thoughts or opinions that were not already covered.

7.3.2.1 Interview Analysis

After the interviews had been conducted, the recordings were watched again to find results which may have been missed. All of the key information from the recordings was written on digital post it notes to be able to analyse themes and detect patterns. To analyse the data, an inductive approach was used to sort the data into categories and then also sentiment. The categories were colour, text, information and navigation which were also divided into the sentiments positive, neutral and negative. There were also two extra categories, one for feature requests and one for "other" which contained unrelated but still interesting information. Since the tasks and questions were already angled towards these categories, the outcome of

the inductive approach was somewhat expected. The analysis served as a valuable way of structuring and organising the gathered data so it could be more easily interpreted and used for the final iteration of the prototype.

Figure 7.4 shows the category text divided into the three sentiments positive, neutral and negative. The full analysis with all categories can be found in appendix A.1 and A.2.

Sentiment	Text		
Positive	No issues with readability	Text is clear	I like that the text for Monday 10 April is large and that the text size for teh event is a little smaller. Very good as it is
	Chooses large text	No problem with text readability	No issues with readability
Neutral	Would like to be able to change text size from within the app/prototype	Preferred the larger text setting after testing both	Chose large text
	Chose large text	Chose large text	
Negative	Still thinks the text is too small. Trouble reading most text	Would like the text to be more bold as well as larger	

Figure 7.4: The category Text from the inductive analysis divided into sentiments.

8

Results

After several rounds of interviews, testing and iteration of the design, there is a finished prototype which aided in answering our research question:

What are the best practices when designing a digital schedule for people with varying cognitive and motor skills?

In this chapter, we will first present the participant prototype and explain its different views and after this we present the scheduling prototype for admins. Lastly, we will conclude with the best practices.

8.1 The Schedule Prototype

The end result is a smartphone application that lets the participants and employees at Grunden Media see their individual schedules on the fly. The application allows the user to customise the interface in the form of colours, text size and time representation.

The final iteration of the prototype is based on the feedback from the preceding interviews. However, the few final changes have not been evaluated with the users.

The colour scheme changes depending on what day of the week it currently is, with the colours corresponding to the Special educational school authority (Specialpedagogiska skolmyndigheten) standard for representing days with colours for people with cognitive disabilities. The colours are meant to serve as an aid by associating a distinct colour with a single day of the week. Monday is for green and Wednesday is white for instance[36].

The prototype only focuses on displaying the current day and week, without the option of seeing further ahead. This is partly because a lot of their scheduling is done on a weekly basis, and being able to view months ahead of time would not provide many benefits according to the interviewed employees, since nothing, or very little, would be scheduled. It is also partly based on a response from an early interview with an employee, which has been mentioned earlier, "...there can be difficulties [...] interpreting Thursday in three weeks, when is that?".

8.1.1 WCAG Compliance

To be compliant with WCAG AAA levels of contrast, all of the text has been checked with a Figma plugin that scans for the contrast ratios. Another Figma plugin was used to simulate colour blindness to ensure that the palette used still was distinctive enough for individuals with different types of colour blindness.

All of the touch targets were made to comply with WCAG Success Criterion: 2.5.5 Target Size, and are at minimum 44 by 44 pixels.

The WCAG Success Criterion 1.4.1: Use of color, is related to colour blindness. As mentioned above, the colour palette has been analysed with a colour blindness tool, however all interactions are also complemented with either icons or text so as to not rely solely on colour for indications. Figure 8.1 showcases all colours used in the prototype with the colours going from Monday to Friday in descending order.

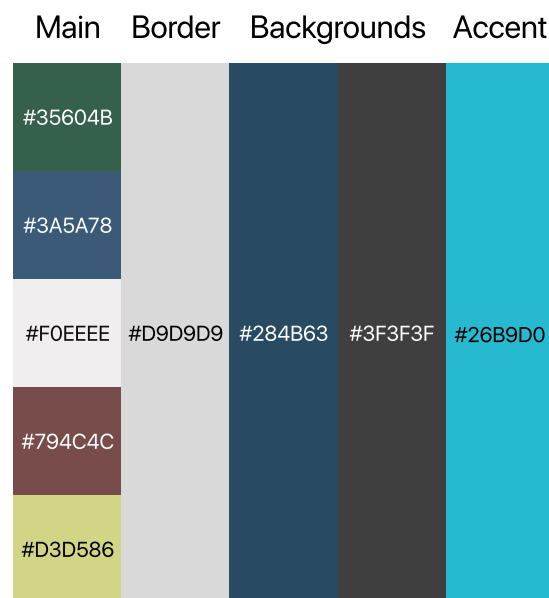


Figure 8.1: The colour palette of the application which complies with the WCAG contrast ratio for text and colours.

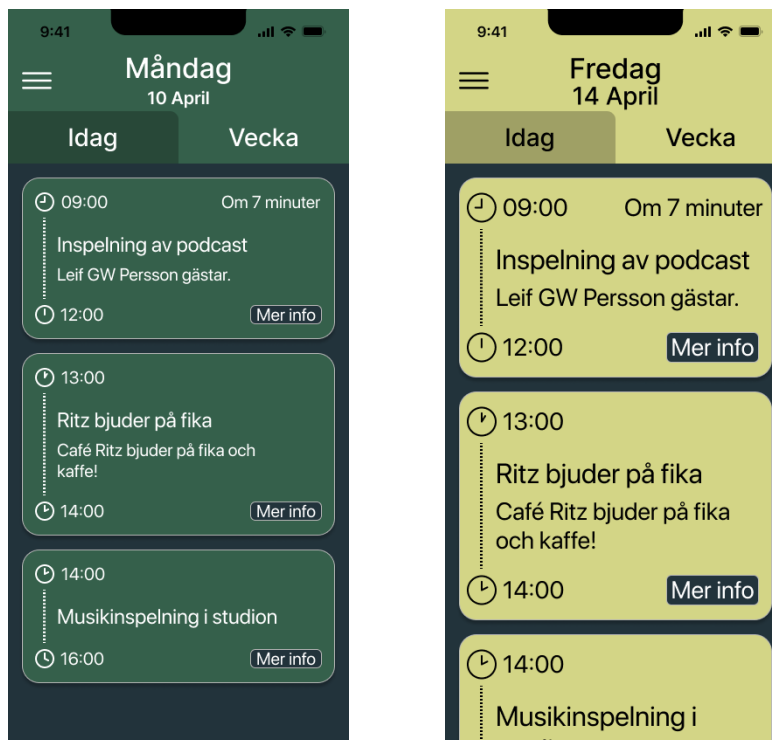
The font used throughout the majority of the prototype is SF Pro display with the top bar font being Inter. Both fonts were chosen for their excellent readability and in the SF Pro's case, to emulate the feel of an iPhone since the prototype was tested using an iPhone.

8.1.2 Today View

The user is presented with a vertically scrolling view of the daily schedule. In here the user can see when an activity starts and when it ends. The application also tells the user how much time is left until an activity starts, starting from 30 minutes before. The tiles contain different kinds of time representation, with options for analogue, digital or both. The user can click on each event to see an expanded tile with more information. Since there was some confusion that the events are clickable,

a "more info" (Mer info) button was added to each event. The whole event is still clickable to comply with the WCAG touch target guidelines but the visual element had to be smaller to not interrupt the design.

The today view is the central view and the focus of the application and it is the start screen and is presented in Fig. 8.2. It provides an overview of the current day without overwhelming and confusing the user with too much information. If the user wants to see coming activities they can switch to the week view by interacting with the button labelled "Week" (Vecka).



(a) View of Monday with small text.

(b) View of Friday with large text.

Figure 8.2: The today view of the final prototype with the added "More info" buttons. There are two different time representations and a countdown timer to accommodate multiple difficulties with keeping time. The layout is simple and activities are listed in chronological order. The larger text size aims to include people with visual impairments or find it easier to read large text.

8.1.3 Event Tile

The event tile, illustrated in Fig. 8.3, can be opened from both the day and week view by clicking on the desired activity. When open it displays some added information other than the most important information. The tile displays the time and title of the activity, as well as information about the event, participants, supervisor and the location. Each section of information is separated by dividers to enhance readability and reduce clutter. The information, participants and supervisors are all headings with the corresponding information on the row beneath.



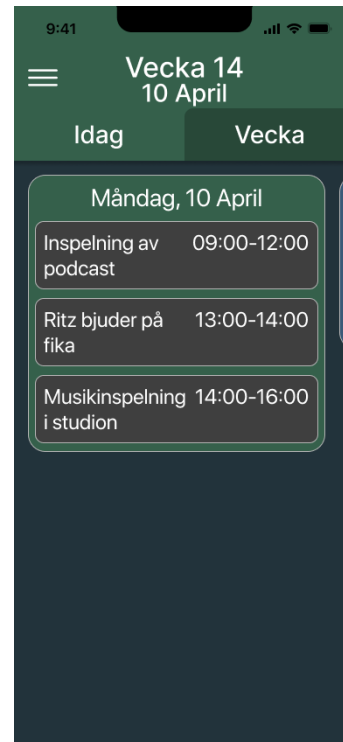
Figure 8.3: The expanded tile for an event on a Friday.

8.1.4 Week view

In the week view, shown in Fig. 8.4, there is an overview of the current week which uses horizontal scrolling by default. The top bar displays the week number and the days date and will have the same colour as the current day. Both of these features exist to make it easier to quickly identify what day it is. The days in the week are colour coded while also having a title with that days name and date at the top. Each day also has a list of the events for that day with the title of the event and the start and end time. To keep the interface simple there is no analogue time representation directly in the week view but each event is clickable to bring up the same expanded event tile as in the today view explained previously.



(a) Week view with small text and vertical scroll.



(b) Week view with large text and horizontal scroll.

Figure 8.4: The week view of the final prototype.

8.1.5 Settings

The studies indicated that since individuals have different needs, a settings menu was added to accommodate a wide variety of people. Some research participants disliked the green and white colours used for the days, while some participants expressed that analogue time representation did not provide any extra benefit to them. A research participant also requested the scroll direction of the week view to be vertical since they felt it was a more familiar gesture, like Instagram or Facebook. Most of the settings that the users can change are cosmetic since that was one of the standout features requested. Another requested feature was to choose what type of time representation to display, with a switch to toggle the analogue clock icons. Finally, there is an option to swap the scroll direction to enable users with motor skills difficulties.

The text size for the event tiles can also be adjusted with the press of a button. The changes are illustrated in the menu to help the user choose the one that is right for them. At the bottom of the page is also the option for changing users and logging out from the app. The idea is for users to get assistance in setting everything up in order to avoid unnecessary confusion. The settings menu is shown in Fig.8.5 below.

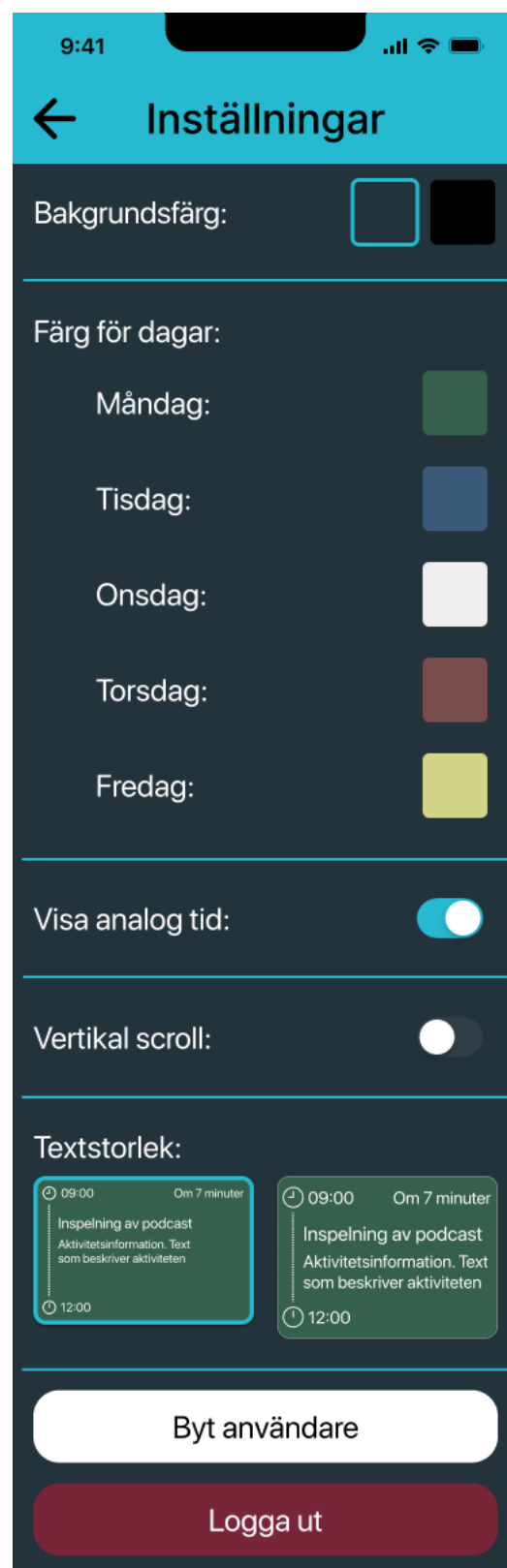
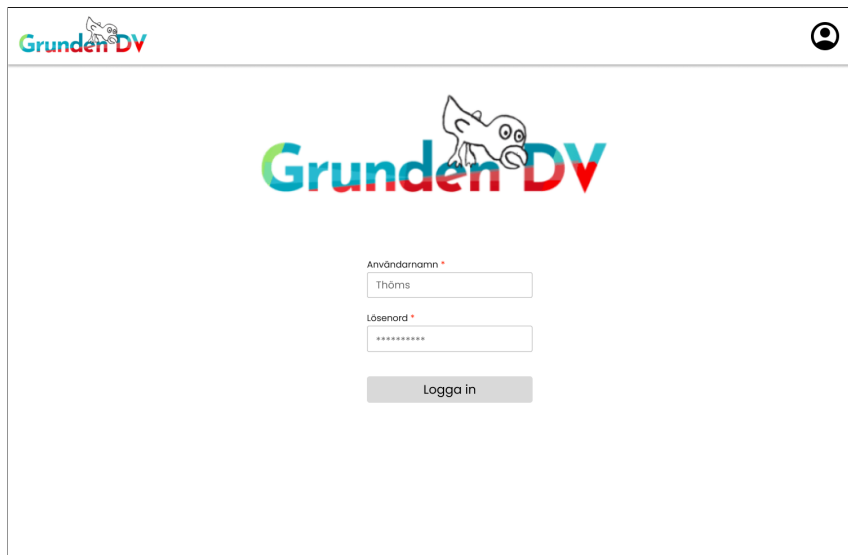


Figure 8.5: The full view of the settings page with colour-, time-, scroll- and text options. There are also buttons for logging out or switching user.

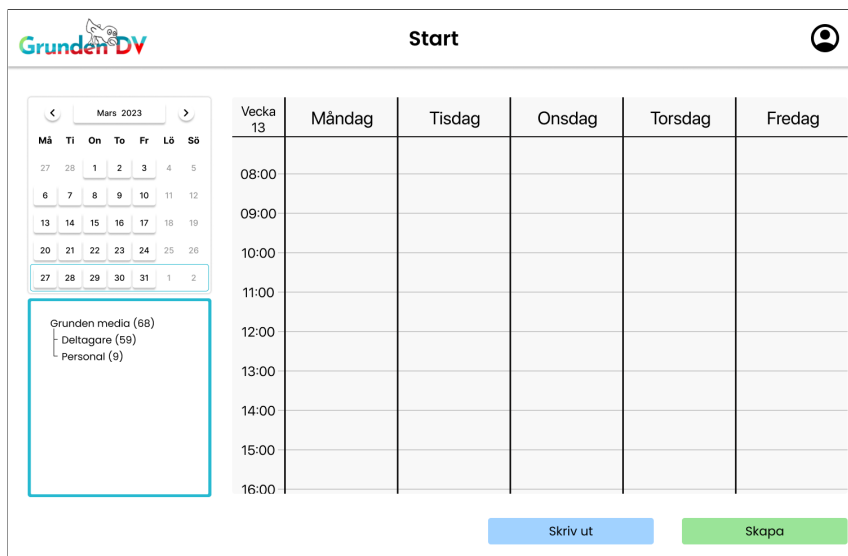
8.2 The Admin Prototype

A prototype for the schedulers was also made in accordance with the features requested during the interviews and is presented in Fig. 8.6 and 8.7. All of the activities would be scheduled with this tool and show up in the schedule view for those connected to the activity. This prototype is only meant to illustrate how the complete system can look like and was not iterated upon. It was also not tested in any way and as such may have problems in the design that we are not aware of.

The design incorporates scheduling new activities, setting different parameters for these, and selecting if they should be recurring on a weekly basis. Associating one or more employees (handledare) to an activity was also added to illustrate how affecting one schedule would affect all others.



(a) Login page with username and password.



Vecka 13	Måndag	Tisdag	Onsdag	Torsdag	Fredag
08:00					
09:00					
10:00					
11:00					
12:00					
13:00					
14:00					
15:00					
16:00					

(b) Home page with a calendar, weekly schedule view, and a list of participants and employees.

Figure 8.6: The two start views of the scheduler prototype where a supervisor can log in and then see a dashboard with an overview.

Grunden DV Ny aktivitet

Handledare: Handledare1 +

Mars 2023

Må	Ti	On	To	Fr	Lö	Sö
27	28	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2

Aktivitet: Podcast

Plats: Podcaststudio

Information: Spela in podcast

Tid: 09:00 - 12:00

Deltagare: Isak Fredriksson +

Återkommande varje 1 Vecka på Må Ti On To Fr

Skapa

(a) The form for creating an activity. The information to be entered is: supervisor(s), day, activity name, location, information, time, participant(s) and whether the activity should be recurring or not.

Grunden DV Isak Fredriksson

Mars 2023

Vecka 13	Måndag	Tisdag	Onsdag	Torsdag	Fredag
08:00					
09:00		Podcast Spela in podcast Podcaststudio Handledare 09:00-12:00			
10:00					
11:00					
12:00					
13:00					
14:00					
15:00					
16:00					

Grunden media (68)

- Deltagare (59)
- Isak Fredriksson
- Bertil Thomas
- Jan Jansson
- Veronica Storm
- Adam Väst
- Jonathan Pettersson
- Pontus Iac
- Fatima Abdallah
- Ida Eliasson
- Klint Östskog
- Elisabeth Olsson

Skriv ut Skapa

(b) A created activity will appear in the schedule for the corresponding participant(s).

Figure 8.7: The pages for creating an activity for participants and then seeing it in their schedule.

8.3 Best Practices

The literature study and user testing indicated that some of the following practices are important to consider when designing an application of this type, to support people with different disabilities. Other observations and discussions around the methodological aspects were also prevalent and as such were added to the findings.

8.3.1 Following Practical Accessibility Guidelines

In this section more tangible steps will be described in order to provide designers with some useful tools when designing for people with intellectual disorders. WCAG is, as mentioned in the theory chapter, a collection of guidelines compiled by w3c [23]. The WCAG guidelines mentioned in this best practises section are those which have been important or relevant during this project and is only a fraction of the total.

Colour contrast ratio of 4.5:1 should be used to comply with WCAG 2.1 guidelines. To check that the design meets the WCAG guidelines for contrast, our recommendation is to use available tools and plugins such as the "Contrast" [37] plugin for Figma to check the contrast and "Color Blind" [38] plugin for Figma to check visibility for colour blind people if needed. Colour contrast improves readability and benefits everyone but especially people with different visual impairments.

If colours are used to convey information, there has to be another indication such as underlining or bolder text [23]. This type of double coding is prevalent in the application, with colours being accompanied by text and different representations of time displayed simultaneously. There is both digital and analogue time on each activity but there is also a countdown timer to indicate when an activity is starting soon. Most of the research participants responded well to the countdown timer and expressed that they would like something similar in other applications they used.

Using existing patterns for navigational purposes is something that can be used to help users. In the prototype, this meant that utilising a scrolling feed to represent the schedule was something that most research participants could pick up at a glance.

Keeping the language used easy to understand and providing clarification when needed is essential to aid users who might have difficulties with reading comprehension.

Some users were observed to have a more difficult time to locate specific information, separating the information into smaller sections is beneficial to remedy this. In the prototype, this was achieved by using dividing lines between each piece of information.

While following guidelines are a well established way to approach a problem, one must still remember that all solutions cannot be found in some list. WCAG and similar recommendations do provide some value but they should mostly be used as a basis for innovating on your own and creating solutions to fit the specific problem at hand.

8.3.2 Learning From & With People With Disabilities

As two researchers with limited insight into what living with various disabilities is like, there was a lot of information and nuance that would have gone missed if we did not visit Grunden Media.

Individuals with cognitive disabilities have varying needs for digital interfaces, and while literature can give an indication for what to think about, the best alternative is to also involve the target user group to better understand their individual needs. It is important to also note that people may be multiply disabled which can also influence their requirements in a digital interface. One instance of this encountered in the testing was a research participant that had mobility issues in their arms as well as tremors in their hands, leading to the user holding the mobile device horizontally during use. Unfortunately, the interface was made to be viewed in a vertical orientation which lead to a mismatch in the use situation and potential discomfort on their part.

We noticed that there can be a risk of creating a "formality barrier" when we visited their locations. This can create a risk for different kinds of response biases. To remedy this, we suggest spending time by participating in their daily work so they get to know you and your project better. This also has the benefit of showcasing hidden issues with interfaces they use on a daily basis, which may serve as a good source of inspiration.

The formality barrier is a term coined during this project. It describes the tendency to introduce biases as a result of formality between the interviewer and the research participant. This is even more important when interviewing people with intellectual disabilities as they are more susceptible to acquiesce, nay-say and select the last mentioned option [39].

There is a lot to learn from talking with the people at and visiting the locations of organisations like Grunden. Insights like this can greatly benefit the design process. Another added benefit is seeing things that you would not get from asking in an interview.

8.3.3 Providing Alternatives

Providing alternatives to accommodate everyone can signify providing alternatives within the digital interface, but can also signify providing an alternative to the digital solution. It is easy to think that everyone wants a digital solution when in reality that may not be the case, for varying reasons.

Provide options and alternatives to include everyone or as many as possible. There is most likely not a universal solution for everyone's needs. Therefore, it is important to provide alternatives to accommodate for a variety of different needs. An example from the project is the use of both digital and analogue time representation, or the ability to change the scroll direction of the week view.

Regardless of the solution provided, some people will still want a simple schedule printed on paper. It is important to acknowledge this and not only provide one

solution with no alternatives. This could cause exclusion where the aim is inclusion through design.

Provide access to accessibility tools when user testing. There are two examples where users asked for customisation outside the prototype. One user asked for the screen to be a warmer colour, so night shift (a function in iOS which makes the screen a warmer colour) was enabled on the phone used for testing. Another user asked for pinch to zoom to be able to see the text clearer. While this was not possible within the Figma prototype, this could have been achieved through using the zoom accessibility function in iOS if it was already set up. Most people personalise their phones to suit their needs, hence letting users personalise the testing device before testing could increase the familiarity and make them more comfortable.

Providing alternatives is crucial to maximise inclusivity, both within the solution and during the user testing. There are many different disabilities, which means it may be difficult or impossible to provide a single solution that fits everyone. This can be remedied by letting the users customise the interface and chose text size, time representation, colours or providing alternatives to include as many as possible.

8.3.4 Final Thoughts

Regardless of following guidelines, involving users in the design process and providing alternatives to include people, there are still most likely people who are going to be excluded. Therefore, it is important to know who you are excluding and what disabilities are not being designed for. It is impossible or near impossible to design for everyone, but it is still important to know who is not being designed for. It is possible that they could be included in future iterations, research or other products.

9

Discussion

During the course of the project, ten individuals were interviewed, eight of them being Grunden participants and the rest being employees at Grunden Media. This participation rate in contrast to the 60+ total participants there are at Grunden Media shows only a part of this multifaceted issue regarding their schedules. Getting more participants to tell their experience with scheduling would give a more well-rounded perspective on the subject.

Despite this, we are thankful for the people that participated and gave us insight into how their daily lives are affected by some of their impairments. These include but are not limited to visual impairments, motor impairments and intellectual disabilities.

9.1 The Prototype

The resulting prototype tried to incorporate as many features collected from the interviews and MoSCoW prioritisation as possible. Some features from the admin requirements are based on implementing the system and therefore could not be added to the designed prototype. The admin requirements that were not implemented due to this were: event priorities, view privileges, attendance and adding pictures. Scheduling evening activities was already excluded. The features for the schedule that were not included in the design were: light/dark mode, adding your own events and, pinch to zoom.

A schedule viewer is inherently less interactive, since the only thing users are most likely to do is look at the schedule without the ability to make changes to it. During the interviews with the employees, this feature was discussed. If this was implemented, there would have to be different access levels since the employees did not want this feature to be available to everyone. Because of this, there was a bigger focus on ensuring that the interface was accessible and the information being easily consumable. A core feature that many calendars have is adding events on your own. Since this is handled by the scheduling staff at Grunden, this feature was not incorporated. Similar applications, such as RemindMe, Wellbee and DigiJag, lets both the user and a relative or caretaker add events to the calendar. Since the app is only intended to be used for Grunden Medias daily activities, this feature was not considered. If the app was expanded to work as a general purpose calendar, careful consideration would need to be taken to separate different calendars, as well as not allowing the user to schedule overlapping events without being notified that

an overlap will occur. This is partly because we do not know if they can deviate from the schedule.

Figma was the prototyping tool used during the project and comes with many options for simulating gestures and app behaviour. Gestures are a part of that toolkit and is something that could have been used during the testing. We opted not to since setting up the possible interactions would have costed precious time. This is however something to consider, since many users tried to swipe away, pinch to zoom and otherwise interact with the prototype in unforeseen ways during the testing.

The colours used in the interface is also something that has been discussed internally. The only real requirement is that they complied with WCAG guidelines regarding contrast and that they represented the days of the week. The colours were however a point of contention when testing since some of the users wanted to customise them further on account of disliking some of them. More consideration should be taken to find colours that look good, even though there will always be users that will not like them. An alternative is to have different presets that comply with the WCAG standards to make customisation easier.

9.2 Methodological Considerations

The low participation rate can be attributed to many things such as not being interested, not wanting to or simply not having the time to participate. One way to remedy this is to spend more time at Grunden's locations, to observe and build trust with the participants there. This can reduce some of the formality which may turn some participants away. The issue of formality can also introduce non-truthful responses by introducing response biases. One instance of this was a participant saying that they could read most of the text clearly in the first test, and then saying the opposite during the second test, despite the text being larger. Gaining the participants trust also has the added benefit of creating empathy for the project which may push some individuals into approaching with their own ideas for a solution. This can also have the added benefit of reducing any response bias on account of them being more comfortable with the interviewers [39]. Seeing how Grunden Media looks like on a day to day basis provides perspective on how often there are misunderstandings with the current scheduling solution. It can also inform designers to how the feel of the app should be, in terms of design language. Observing the participants under a longer period would also lend insight into how often people check their schedules on a daily basis, if they do.

To give the testing of the prototype a more authentic feel, the individual research participants' real events could have been used for designing the prototype. However, since the participants were not known beforehand, this would not have been possible without extensive planning and organisation. The events used in the prototype were inspired by the events that take place at Grunden. During user testing, we noticed that some research participants pointed out irregularities about the made up events. For example, there is usually only one responsible supervisor for the quiz, whereas in the prototype, more were added. One participant expressed concerns that they

were signing up for something, or being bound to the events if they interacted with the prototype. After being reassured the events were just examples there were no issues. Whether this affected the interview and responses is difficult to say. One way to fix this would be to spend some time at the events at Grunden to gain knowledge on how things like supervisors are handled. This could then serve as a basis for the fake events in the prototype.

A further expansion of using real events in the prototype could be letting them test the prototype for a week with their real schedule and then report their experience at the end through interviews. This approach would give the research participants a real feel of what it would be like using a real application. The approach however, also introduces some issues. Firstly the prototype would have to be adapted to several different screen sizes to make sure it looks good for all the participants participating in the test. There is also the issue of displaying the right day, which would have to be manually changed in the prototype each day. Lastly, since this would be a less controlled user test, the outcome and the responses could vary greatly.

Since the first prototype was created by us, using the requirements and suggestions from the interviewed employees at Grunden, some personal biases may have influenced the design. An option is to involve the user more by providing a design workshop or similar where the participants could brainstorm ideas and make simple sketches of a calendar interface and desired features. This could highlight aspects that were not considered when making the first design. There is the question of whether there are some people with limited motor skills who may not be able to participate in sketching, so the workshop would need to be adapted to include everyone who wants to join in some capacity. Participants could participate in the workshop in many different ways, such as sketching, discussing and prototyping etc. which could make this a viable method to use for future work.

Disabilities come in many different forms and combinations, and because of this it is difficult to create a solution which fits everyone. One way to solve this is by allowing users to customise many aspects in an interface, while keeping the functionality the same. There is a risk however, in giving users the options of changing colours which can affect the accessibility of the application, e.g. not enough contrast and unreadable text. In a fully functioning application you could have text that switches between black and white depending on the background. There is also the issue of having too many options to fiddle around with, which may introduce further unnecessary cognitive load.

More time should have been spent at Grunden to ensure that we knew our users better so that we had a better grasp on how their disabilities affected their daily lives. More focus could have gone into investigating what they are interested in and capable of and build around that, instead of looking at their disability in a vacuum.

Alternative solutions are sometimes perceived as worse than the proposed design solution. This can however be a result of our individual biases coming into play. As interaction designers it even more important to not be fixated on one specific type of solution and instead be open to other methods. One example of this were printed schedules that some Grunden participants needed to have. Printed schedules may

have the problem of being more cumbersome to update or being lost. They can also have the benefit of being able to be placed on a wall for more visibility or just be a preference that an individual might have. Regardless, while it may be the less than optimal solution for some, analogue options or other alternatives should not be ruled out and dismissed.

9.3 Future Work

An aspect to explore further for future work is the text size, since even the large text size was too small for one participant to read all of the information. While accessibility tools built into phones, like zoom, could be used to enlarge text, there could be more options for text size to reduce the need for zoom. More research could be conducted to provide more text options with both larger text and more bold text, as was the suggestion from that participant. One participant also suggested being able to swap text colours from white on black and vice versa, more research on how this could be implemented without impacting readability is needed. If allowing white text everywhere the colours for each day would have to be reconsidered. Since the colours are inspired by pictogram but use alternative shades there is only so much that can be changed. Wednesday for example is white and cannot be made darker to allow for white text. Research could be conducted on how beneficial using these colours is or if it is enough that the colours are different from each other. In that case the user could pick the colours of the day themselves like shown in the settings page of the prototype.

One suggestion for future work is to research how notifications can be used to remind users that they have an upcoming activity that is about to begin. This would include investigating how these would look, behave and be worded in order to work for this user group. They could possibly use the application settings to make the notifications cohesive with the rest of the design. Careful consideration would also need to be taken with what information is included in the notification without being too verbose or confusing for the users.

Despite all the initial considerations, the project still had to be narrowed in scope. Many factors were not considered, these included but were not limited to, blindness and text-to-speech screen readers. More work could be done to incorporate existing assistive technologies into the project.

Initially, we tried using an image for a podcast activity in the first mockup. The research participants mistook this for a button to activate text to speech. The meaning of images can be confused and more research is required to determine what images or icons can be used without confusing the user. The use of images can help illiterate individuals understand whatever is represented on the screen and as such feel more included. It is therefore important to further explore the option of using images to represent activities and include more people.

Finally it would be beneficial to conduct another usability test to trial the small changes we made to the interface such as the dividing lines and the more information indicators. It would also be good to test if the different settings provided any value

or if they would be kept at the default parameters. It would be interesting to also see how many users would choose to adopt the digital schedule versus wanting to keep using the paper schedule. To get a valuable and conclusive answer to this question, all of the participants at Grunden would have to be queried.

10

Conclusion

This study aimed to find the best practices when designing an accessible schedule for people with intellectual disabilities and was conducted in collaboration with Grunden Media who provide daily activities for people with intellectual disabilities.

The research question for this project was "What are the best practices when designing a digital schedule for people with varying cognitive and motor skills?". This question has been answered by doing literature studies, interviews, prototypes and usability tests. The findings from the literature studies and evaluations have been part of an iterative process to find a set of best practices to answer the research question. These were then implemented into the prototype in various ways.

Best practices concerns to follow already existing accessibility guidelines, for example about colour contrast and readability, using simple language, accompanying colours with additional elements to convey information and using existing patterns for navigation.

Another aspect is to learn from the intended user group by involving them in the design process through e.g. interviews and user tests. Work towards decreasing the formality of the user involvement to subsequently reduce biases. If collaborating with an organisation working with disabilities, such as Grunden Media, visit their location and experience the environment if possible.

Providing different alternatives is also something to be considered. People are individuals with different needs, preferences and ability to perform tasks. As such it is essential to present the user alternatives to the solution and even the option to forego one altogether.

When designing for people with intellectual disabilities, or any disability, knowing your users through research, interviews and user testing is even more important to make sure the product is accessible for the target users. Through this study and the gained experience, we have presented a number of best practices.

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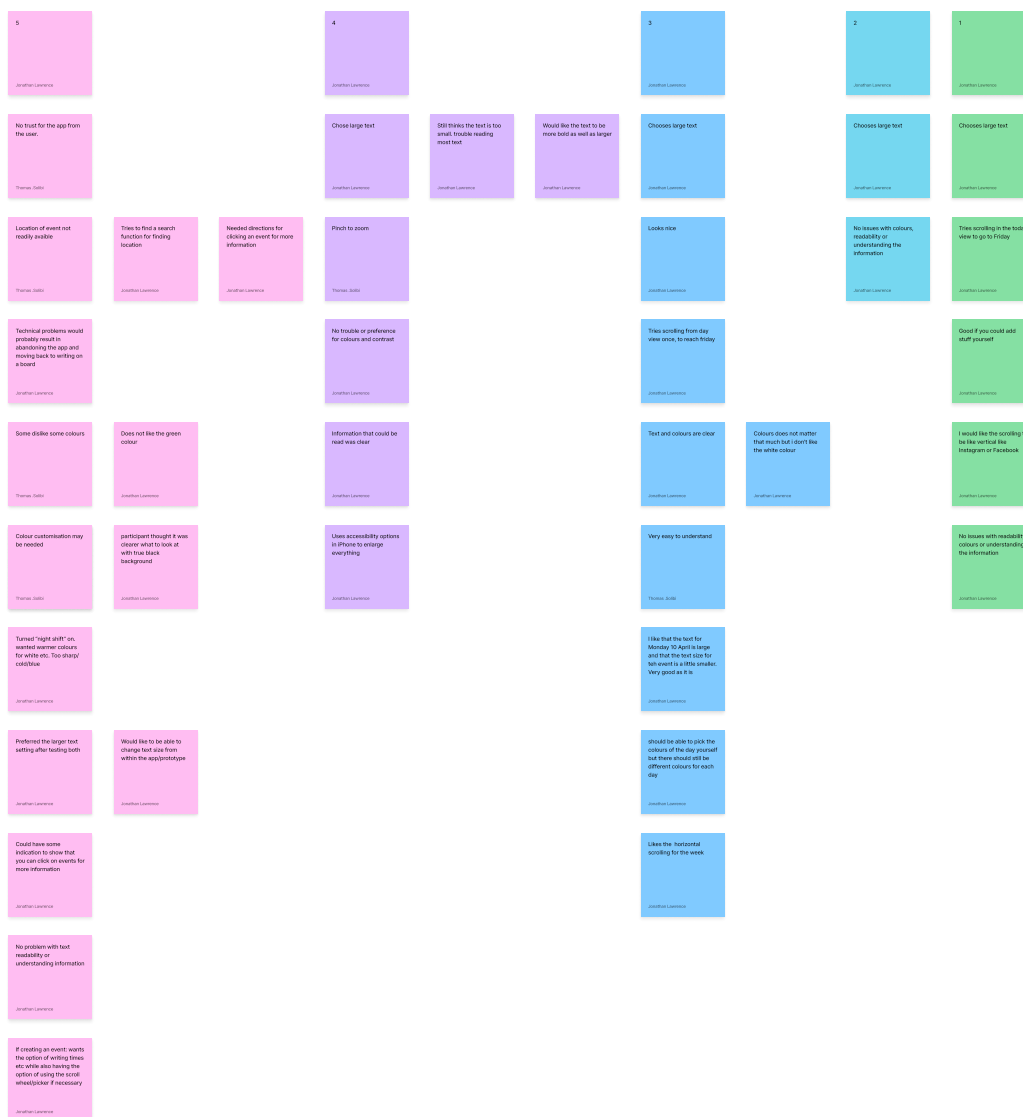
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A

Affinity Diagram

A.1 Unsorted participant responses taken from recordings.



A.2 Participant responses sorted into categories using inductive analysis

