Investigating University Students' Use of iPhone Screen Time Feature and Developing Interventions to Promote Reduced Phone Usage

Thesis Report

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Abstract

This study investigates how university students employ the Apple's Screen Time feature to respond to difficulties associated with high smartphone usage, which have been found to have negative effects on the mental, physical, and social wellbeing of users. Carrying out the mixed-methods research approach, the study uses heuristic evaluation, surveys, interviews, and contextual enquiries to evaluate the effectiveness and usability of the iPhone's Screen Time tools. Findings reveal significant disengagement among users and limited feature engagement, highlighting gaps in design interventions to promote digital well-being and self-regulation. The research also indicates deficiencies in design interventions to address digital well-being and self-regulation needs: aspects such as gamification and personal persuasive technologies can be improved in future research. In the context of this work, the following theoretical frameworks have also been embraced: self-determination theory, Fogg's behaviour model, and selected human-computer interaction guidelines to support a design thinking approach towards building user-orientated solutions. The recommendations for how to incorporate design changes to enhance the usefulness of the Screen Time feature are to add behavioural prompts as well as aesthetically appealing graphic interfaces for effectiveness and for practice of maintaining sustainable, healthier habits and higher levels of digital awareness. By offering guidelines for creating user-centric tools that foster constructive smartphone use, this work contributes to the theoretical and practical discourse on digital well-being.

Keywords: Screen Time Management, Digital Wellbeing, Mindfulness, Smartphone Overuse

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1. Introduction

Smartphones have transformed the way we work, communicate, and pass the time in today's world, making them essential tools. But their widespread use has sparked worries about excessive screen time, which has been connected to detrimental effects like decreased social relationships, poor mental health, and decreased productivity. Zhang et al. (2023) expressed that due to technological advancements, mobile technology use has significantly increased, and worries over excessive use, dependence, or addiction to mobile phones have been raised globally.

The modern world we are living in now is interconnected with everything. Everything is so fast that whatever is happening in any part of the world, we get to know about it instantly. This has become possible because of the technologies that we are using now. Almost everything has become so digital that we cannot skip the web of technology even if we want to. We have to embrace this digital world where technology has become a part of our daily lives. Things have become so accessible that everything is now in our hands. To be more specific, it is our smartphone (Naikoo et al., 2018) .

The mobile phone was invented as a technology that was supposed to help us communicate from a distance. Keeping the idea the same now has such a broad impact on communication. Now this tiny device helps us to control everything. From maintaining our daily lives to collecting information, getting the news from around the world, and whatnot. It has such an integration in our lives that everything we do in our lives stays in our hands and keeps control over everything (Miller et al., 2021, p79-103).

If we take Denmark as an example, a person who is living in Denmark cannot afford to leave his smartphone at home. They need it throughout the day for a variety of purposes, from Mitid to Eboks or DOT apps. Even if you want to check the transportation schedule, you need to use the Rejseplanen app. Using a smartphone for reading a newspaper or study material has become a practice long ago. And if we talk about entertainment, it has no limit on it. So, in any sort of scenario, it is becoming impossible to skip the usage of the phone. Moreover, we have an issue of smartphone addiction (Barashdi et al., 2015).

We are slowly getting trapped by this small digital device (Zhang et al., 2023). Sadly, we are concerned about it but can not help it. To get rid of this, there are so many current technologies that are trying to cover up. The screentime feature from the iPhone is one of them. It actually helps users to have an idea about their usage and some features to control their phone usages. The articles we have reviewed regarding this have also shown that the intention behind this feature was to hold back users over usage of their smartphones from the perspective of university students (Olivieri, 2021).

1.1 Background

A person's subjective perception of the ideal balance between the advantages and disadvantages of mobile connectivity is known as digital well-being. Emotional and cognitive evaluations of how digital interaction has been incorporated into daily life define this experiential condition. Digital well-being is attained when people have minimal loss of control and functional impairment, as well as maximum regulated pleasure and functional assistance (Abeele, 2021).

According to a study, long-term mobile phone use (LTMPU) is linked to the incidence and prevalence of the majority of sleep disorders and mental health issues, and the discontinuation of LTMPU was associated with lower risks in most of these problems at follow-up (Liu et al., 2019). A large number of students reported that excessive smartphone use makes them less active, causes headaches and dry eyes, and interferes with their sleep (Rai et al., 2016). Excessive use of mobile phones has a detrimental effect on life, but these harmful effects can be mitigated if their use is appropriate and limited (Aman et al., 2015). Students who use their phones excessively will experience higher levels of stress. They found that the perceived stress can be lowered by maturity and age; moreover, perceived family support could also help as a stress-reduction strategy (Alsalmia et al., 2020). It's not absolutely certain, but addiction to cell phones is somehow linked to both the physical and mental health of adolescents (Shoukat, 2019). In another study, Subba and others found that the usage of mobile phones by medical students seemed to be troublesome, where a significant number of them reported experiencing *ringxiety* (becoming highly anxious, and using their phones in places and at times that were restricted) (Subba et al., 2013).

In a study, Zhang and others found that the "problematic mobile phone usage (PMPU) scores were significantly decreased by general group counselling, mindfulness therapy, cognitive behavioural therapy, time management therapy, and attention bias training. Besides, there was no significant heterogeneity in general aerobic exercise or mind-body exercise. Additionally, interventions decreased mobile phone use time and improved a number of psychological symptoms (such as despair, anxiety, loneliness, stress, attentive attention, and inadequacy) while lowering the level of individual PMPU" (Zhang et al., 2023).

Moreover, the growing, though contentious, conversation about the drawbacks of excessive technology use, which is currently spearheaded by both mainstream media, represents the bad side of this issue (Foer, 2017).

By using a smartphone for work at night, its impact on sleep led to higher fatigue the following morning. Daily work involvement is afterwards reduced by morning tiredness. Using a smartphone has indirect impacts on involvement and tiredness the following day that are comparable to those of using a computer, tablet, or television (Lanaj et al., 2014).

Feeling insecure, staying up late, strained parent-child relationships, strained school relationships, psychological issues like behavioural addictions like compulsive buying and pathological gambling, low mood, tension and anxiety, boredom during leisure time, and behavioural issues—of which hyperactivity was most strongly linked—were all linked to excessive or excessive mobile phone use. Even if using a phone keeps social relationships intact, children and teenagers who are addicted to them require immediate care. To solve these new problems, interventional research is required (Sahu et al., 2019).

High self-control positively compensates the negative effects of low parental monitoring on problematic teenage mobile phone use, while high parental monitoring positively compensates the negative effects of low self-control on problematic teenage mobile phone use. These forces of internal and external control balance each other out in the context of problematic teenage mobile phone use. Girls were more affected than boys by the relationship between parental control and self-control regarding problematic teenage mobile phone use. In other words, girls with low parental monitoring benefited more from self-control than did boys with low parental monitoring; girls with low self-control more from parental monitoring than performed boys with low self-control; girls (but not boys) with inadequate parental monitoring tended to be removed from problematic mobile phone use by increasing levels of self-control; and girls (but not boys) with inadequate parental monitoring were kept farther away from problematic mobile phone use by higher parental monitoring. Even though females struggle more than boys with problematic mobile phone use, these addiction issues can be significantly reduced by promoting either positive environmental (like parental supervision) or positive individual (like self-control) variables. The female population should be the primary focus of research on the variables causing problematic mobile phone use and the outcomes of interventions (Hu & Wang, 2022).

In another study, Leong, Lee & Chow found that socialising helps to build emotional bonds between parents and teenagers to deal with the issue of excessive mobile use by allowing them to revisit happy memories of family outings (Leong et al., 2018). In order to minimise future mobile phone overuse, early screening and intervention programs for students with poor mental health and poor school adjustment might be beneficial (Lee et al., 2011). Application-based interventions encourage behaviours that limit the use of mobile devices by utilising the strong reinforcement of notifications and the demand for social validation (Mac Cárthaigh, 2020).

Self-efficacy is an essential tool for intervention. There is a correlation between a decrease in problematic smartphone use and the intervention condition's higher self-efficacy toward goal-directed smartphone use. A planned smartphone use is linked to fewer daily unlocks, which is linked to reduced problematic smartphone use (Keller et al., 2021).

Goal setting, problem solving, reviewing results and goals, providing feedback on behaviour and its outcomes, self-monitoring behaviour, social support, information about health consequences,

and behaviour practice and rehearsal are the most popular behaviour change strategies used in digital behaviour change interventions to reduce inactivity (Martín-Martín, 2021).

In comparison to the control group, a quick one-session mindfulness intervention can reduce problematic smartphone use and raise self-control and state mindfulness levels. The effectiveness of the mindfulness intervention in lowering problematic smartphone use can be fully mediated by self-control (Liu, 2022).

A lot of studies have been done to explore the impact of the excessive use of mobile phones. Overuse of mobile phones has been connected to insomnia and poor sleep patterns. Excessive usage of mobile phones for online chats and social networking sites may be more linked to depression than using them for gaming, movie watching, or internet browsing. In a study, it has been found that over five hours of daily mobile phone use is linked to insomnia and reduced sleep duration. An increased risk of depression is linked to using a mobile phone for online conversations and social networking sites for two hours or more each day (Tamura et al., 2017).

Addiction to mobile phones must be viewed as a dependent syndrome, and preventative actions must be implemented to lower the increased risk of psychological disorders in the younger generation. Today is the ideal moment to start taking preventative action against mobile phone addiction among students and public health. Everyone must acknowledge that relationships with mobile phones are unhealthy for everyone and can lead to "mobile phone mania" or "nomophobia," which are psychological disorders just as dangerous as drug addictions (Peraman & Parasuraman, 2016).

In a simultaneous statistical study over 450 occupational health and safety students, it has been urged to consider the impact that cell phones have on overall health and sleep quality as a trigger to employ certain intervention programs to enhance their overall health, sleep quality, and eventually, academic achievement (Eyvazlou et al., 2016).

The human body can be harmed by improper mobile phone use. Using a mobile device increases the chance of neoplasms, eye conditions, mental health issues, and headaches as compared to the one who does not use it (Cao et al., 2022). In another cross-sectional study, it has been found that several diseases can arise in the human body as a result of using mobile devices. The auditory nerve and other tissues close to the handset may be negatively impacted by exposure to radio frequency radiation waves. Tumours, auditory neuromas, and other possible issues are among these hazards (Mushroor et al., 2020).

Overuse of mobile phones is linked to reduced time spent in nature. Additionally, excessive mobile phone use is associated with decreased psychological well-being, mindfulness, and subjective well-being due to a decrease in the frequency of nature encounters (Wang et. al., 2021).

Anxiety, depression, loneliness, social anxiety, poor attention, and feelings of hopelessness or sadness are more common among students with severe mobile phone addiction (Mei et al., 2023). In 2021, Khayatan and others found that students who use their phones problematically are less healthy overall. And suggested that possible intervention should be made to improve their health and reduce this problematic overuse of phones (Khayatan et al., 2021). University students' mental health issues may be caused by a variety of factors, including the frequency and kind of their mobile phone use (Višnjić et al., 2018). A study that has been done among the university students in Jordan found that severe psychological discomfort and smartphone addiction were more likely to develop in women, those who believed that using a smartphone impairs their mental abilities, and those who experienced sleep problems and tiredness (Abuhamdah & Naser, 2023). In a cross-sectional study in 2022, Daniyal and others found that there is a strong correlation between excessive cell phone use and detrimental impacts on one's physical and mental health, and they advised that students be given more options for physical activity and alternatives to reduce their use of mobile phones (Daniyal et al., 2022). In another cross-sectional survey on 120 female medical students who use smartphones, potential health risks were mentioned in significant numbers. The pattern of their mobile phone usage involves dangerous behaviour. According to reports, the primary impacts of smartphone use are on memory, sleep, and attention, all of which may have an impact on academic achievement (Jamal et al., 2012).

Screen time can be decreased with simple digital solutions. Overuse of smartphones is more of a self-control issue than an addiction, and it is manageable with the correct approach and enough willpower (Zimmermann & Sobolev, 2023). Some people have been living in an "infosphere" of gadgets in recent years, using smartphones, wearables, and personal computers for work, social networking, and messaging. Without a doubt, technology makes our lives better in a number of ways. For instance, it would have been more difficult to get through the COVID-19 lockdowns and restrictions without it (Roffarello et al., 2023).

Due to technological advancements, mobile technology use has significantly increased, and worries over excessive use, dependence, or addiction to mobile phones have been raised globally. Exercise or psychological therapies are equally effective at lowering problematic cell phone use (Zhang et al., 2023). In order to avoid future detrimental psychosocial effects, early intervention and identification of individuals exhibiting problematic smartphone use symptoms may stop the emergence of addictive behaviours and maladaptive coping mechanisms (Wang et al., 2022).

Despite the fact that digital wellbeing apps are being used by people, they appreciated the concept of having a digital wellbeing assistant that can warn the users of any addictive behaviour. Roffarello & Russis (2019) found that applications for digital wellbeing are valued and helpful in certain situations, and they are thought to be insufficiently limiting and do not encourage the development of new habits; hence, they are ineffective in assisting users in altering their smartphone using habits.

1.2 Case Description

Smartphones have acquired centre stage in people's lives through information and communication technology with strengths in information, communication, education, and entertainment. Nevertheless, this has also brought complications in how the users, specifically university students, plan and regulate their time on screens. One of them is aimless scrolling; when using social networks or other applications, people involuntarily scroll through content without a clear purpose (Alter, 2017). Such behaviour results in considerable time waste and level of distraction and can have an undesirable influence on health (Vicente et al., 2024).

University students are more prone to scroll through the app aimlessly because smartphones' integration into students' lives cuts across education, social relationships, and personal uses. Some features, such as notifications, infinite content feeds, and application designs that promote addictive habits, worsen this behaviour.

The screen time feature in the iPhone currently shows some statistical data with minimal activity to reduce the excessive phone usage. It really falls short to motivate users not to overuse their phones and control their using behaviour. Rather, users themselves have to be self-reliant to control their usage pattern (Keller et al., 2021).

The purpose of this study is to assess how well Apple's Screen Time feature encourages optimal digital behaviours among university students. Overuse of smartphones has become an increasing concern because of its correlation with decreased productivity, mental exhaustion, and digital distraction, especially among students juggling social, academic, and personal obligations. With features like app limitations and downtime to assist users in self-regulation, Apple's Screen Time is a digital well-being tool that delivers insights into device usage.

By examining different user groups and their habits, motivations, and difficulties, this study explores the feature's practical use. The case study demonstrates the many ways in which university students use screen time and identifies how it affects their digital wellbeing and self-awareness.
In order to suggest specific modifications for encouraging substantial behavioural change in this group, it also investigates practical gaps, user perceptions, and design limitations.

1.3 Problem Statement

How can we better understand the user behaviour of university students regarding the iPhone screen time feature and what interventions can be made to reduce phone usage?

1.4.1 Research questions

1. How does the current screen time feature serve the purpose of regulating phone usage?
2. How do university students currently utilise iPhone screen time management features, and what factors influence their engagement with these tools?
3. What are the most common patterns of smartphone usage among university students, particularly in relation to non-essential activities (e.g., social media, entertainment)?
4. How do app limits and generalised reminders in screen time tools affect students' phone use?
5. How do students perceive the effectiveness of these tools in helping them recognise and manage their non-essential phone usage?
6. How can screen time features be designed to enhance students' awareness of phone usage patterns while minimising disruptions?
7. What design adjustments can be implied to maximise the user engagement to make it more interactive?
8. How can iPhone screen time tools be redesigned to support students in sustaining focus and maintaining productivity through reduced digital distractions?

1.5 Overview of the Report

This paper examines how university students interact with Apple's Screen Time features and proposes design changes to improve its effectiveness in fostering healthy usage of technology. Thus, it embraces a systematic way of dealing with the research questions and in coming up with the answers.

Chapter 1 introduces the background to the study, problem definition, as well as the research questions and objectives. It describes the difficulties of overreliance on smartphones and the capacities of screen time features to improve that. The chapter also covers the limitations of the study and the research questions that have been asked in the undertaking.

Chapter 2, the Literature Review, lays down the theoretical and empirical background of the study, focusing on areas like digital well-being, user behavior, persuasive design, gamification,

and the gap in tools. The study integrates the findings from prior research for demonstrating the possibilities of unavailable and contextually applicable time management solutions.

The Theory (Chapter 3) section defines the conceptual framework to be used in the study: self-determination theory, Fogg's behaviour model, and key principles of human-computer interaction. These theories help to get a glimpse of the users' requirements and other aspects of designing relevant interventions.

The methodology (Chapter 4) outlines the research procedure and methods of the study that form mixed-methods research that involves heuristic evaluation, questionnaires, interviews, and contextual inquiries. The ethical issues, the validity, and the reliability of these methods are discussed, and the limitations of them are explained too.

Analysis and Findings, which is chapter 5, provides a user review evaluation and uses capturing the blind spots of the existing Screen Time tools. This section also included the analysis of self-regulation and digital awareness that was supported by the tools.

Expanding on the above discoveries, Design Thinking (Chapter 6) shows how user-orientated approaches were used to develop new solutions. The outline for this chapter consists of five sections where empathising, defining, ideating, prototyping, and testing approaches to develop effective user tools are discussed.

The Discussion and Conclusion (Chapter 7) builds on the research questions and discusses how the findings relate to theory. It also discussed the implications of the contributions made by the research to the domain of digital well-being and provided concrete suggestions for the enhancement of screen time instruments.

Lastly, the Limitations and Future Work section (Chapter 8) describes the study's limitations and provides the plan for future work and stresses the importance of the development of more varied and substantial interventions for promoting mindful smartphone usage among university students.

This structured perspective helps build a clean, coherent, and interrelated account of the existing theoretical, methodological, and empirical work, which aims to advance the overarching conversation on digital well-being and screen time.

2. Literature Review

Doing a literature review is essential for a research project and an integral part of any research (Clark et al., 2021). A literature review summarises current information on a subject and outlines

the planned research's predicted addition to knowledge (Knopf, 2006). This should be a brief assessment of all relevant literature about the topic or issue under consideration (Cronin et al., 2008).

In general, literature reviews are created in one of three contexts: a) a standalone document, b) a first step in a broader research endeavour, or c) a component of a completed report (Knopf, 2006). In our review, we have examined and explained some of the existing literature and relevant fields of study in order to inform our methodological and analytical decisions later on, which comes under as a step in a larger research goal. This literature review examines the challenges of managing excessive screen time and creating awareness by providing a comprehensive overview of existing research on this topic. This review aims to analyse the factors behind excessive smartphone usage and possible interventions with the goal of developing a prototype solution that is effective and user-centred for managing overuse. The long-term intent is to design an experience to increase user awareness and encourage sustainable behavioural change.

2.1 Organization of the literature review

A comprehensive literature review collects information from several sources on a specific topic (Cronin et al., 2008). To present a clear and concise narrative of any work, there should be an organising strategy from the beginning that will guide the whole process of selecting and reviewing articles. For our work, we have combined a conceptual and methodological framework where the concepts and methods are discussed while reviewing previous work (Randolph, 2009). There are different types of literature reviews available, such as traditional reviews, systematic reviews, meta-analysis, and meta-synthesis (Cronin et al., 2008). Traditional review analyses and summarises material to form judgements on a certain issue. On the other hand, systematic reviews take a disciplined and defined approach to examining literature in a given topic area. Meta analysis and meta synthesis are used, respectively, for statistical quantitative and non-statistical qualitative research and provide analysis to improve understanding.

From the definitions, it shows that both systematic and traditional review methods are well suited for our project. However, we have decided to go with the traditional one. To explain the reason for this, we need to look at the core functionalities for both of the methods. The primary goal of a traditional review is to offer readers a thorough comprehension of existing knowledge and highlight the relevance of new research (Cronin et al., 2008). It includes a broader research topic and sources. A systematic review aims to give a comprehensive list of published and unpublished works on a certain topic, as opposed to traditional reviews. This type of review utilises strict criteria to discover, analyse, and synthesise all relevant literature on a specific issue, whereas traditional reviews summarise results from several research studies.

Flexibility in terms of the categorisation and screening of literature in relation to the interdisciplinary theme of screen time management was one of the few reasons for conducting this research using a traditional literature review instead of a systematic review. This review integrates interdisciplinary insights from human-computer interaction, psychology, and behavioural design perspectives, necessitating the inclusion of findings from diverse theoretical and empirical works without strict inclusion criteria. Unlike systematic reviews, a traditional review allows the questioning of emerging themes and theoretical frameworks, for example, SDT, gamification, and practical design insights. Moreover, it helps to recognise gaps and come up with innovative solutions, in accordance with the aim of the study, which is to create targeted and user-friendly screen time management tools. A traditional review offers much more flexibility with, as argued here, a broader, more abstract exploration keeping the time constraint in mind.

According to Cronin et al. (2008), a literature review should follow 5 steps: 1) Selecting a topic; 2) searching the literature; 3) gathering, reading, and analysing the literature. 4) Writing the review, and 5) References. In the following parts, the step-by-step review process for our research is described.

2.1.1 Topic Selection for review

It was the primary research questions that prompted the selection of the topic for the literature review, which is geared towards understanding the extent and effectiveness of tools aimed at managing screen time among university students. In particular, the focus was on the factors affecting the user's interaction with the tools and the tools impact on other unnecessary use of the phone. In this step, relevant themes available in the literature, which included excessive use of smartphones, self-control, and use of technology for behavioural change, were sought out. Because the students used the mobile for a long time, we consolidated these studies and provided explanations on all theories that related to awareness appeals, mobile usage patterns, and the screen time-controlling tools. The intention was to locate relevant literature that satisfied the aims of the research and, above, provide an orderly structure for the subsequent steps of the review process.

2.2 Literature search

a) Literature sources

A constructive literature review compiles information from a number of sources on a specific topic. (Cronin et al., 2008). Academic literature addresses theory through critical analysis of concepts; hence, papers in academic and research publications should constitute the heart of the literature study (Rowley & Slack, 2004). In this literature review, we have used several databases and online sources that provide scholarly articles, peer-reviewed journals, books, and web

information to identify related literature in our specific area. We have used Google as our search engine and AUB (Aalborg University Library) as our primary source of literature. Besides that, we also used the ProQuest database and Google Scholar to find academic and research literature. To sum up, we have used the following techniques by Rowley & Slack (2004):

a. library catalogues: locating books
b. search engines: locating web pages with keywords
c. online databases: providing access to journal articles, research articles, etc.

b) Keyword selection

Finding keywords is another important area in a literature review, as it provides a direction and goal to find necessary literature. Conceptual frameworks and mind mapping were suggested by Rowley & Slack (2004), who defined it as an efficient way of locating important ideas within a body of papers or a field of study. This provided us the starting point to think about the themes and eventually finalise our keywords for a literature search. To initiate the process, we have first looked at our research questions. From there, we have planned some areas that are relevant and started mapping them and finalising the actual one. This iterative process also allowed us to identify connections between different research areas and ensured that the reviewed literature was both comprehensive and relevant. Ultimately, this approach provided a clear roadmap for aligning the literature with our study objectives. In Figure 1 below, the visualisation of our mind and content mapping can be seen.

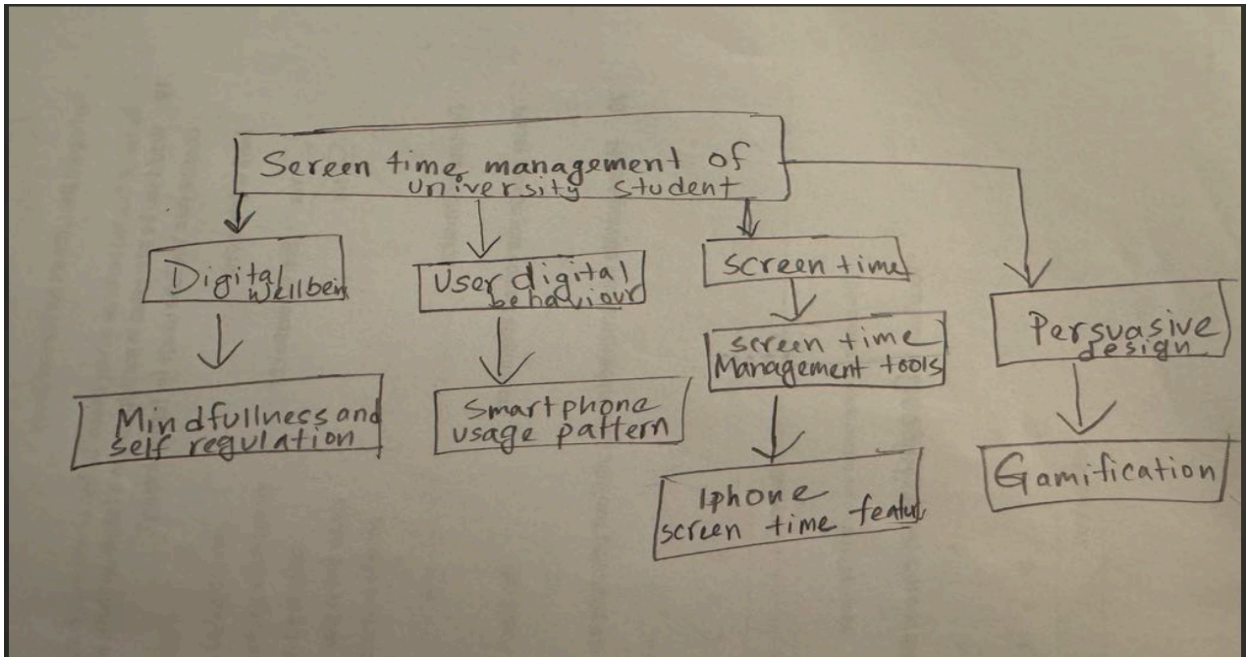


Figure 1: Content and mind mapping for literatures

c) Search strategy

Once the keyword and theme selection was done, we moved towards the next section of searching for literature on the previously mentioned sources. For the searching, firstly, we have used the quick and easy technique. It is also appropriate for a traditional type of review because it helps to include broader research using phrase operators and boolean operators. In terms of our case, we have searched for our key words with different synonyms and expressions and coupled them with AND, OR, and NOT operators. Figure 2 shows one of our many search strings.

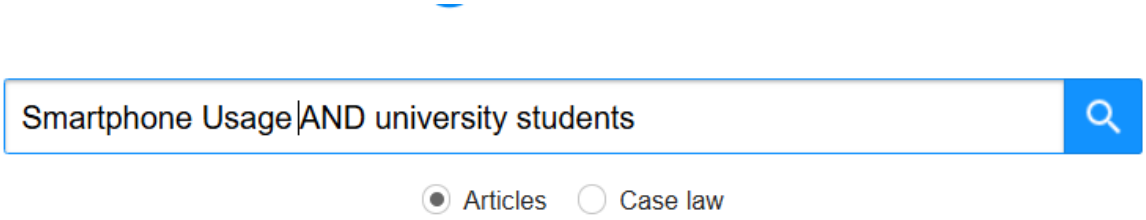


Figure 2: Search strategy

To search for relevant literature, an approach called snowballing has also been used simultaneously. Snowballing is mostly used in qualitative research. The technique starts by identifying relevant literature by choosing some relevant keywords in a search engine. After identifying a relevant article, we continue seeking literature in the references to find more literature. By using the snowball technique, we ensure that we will gather the most relevant articles and studies for this research.

d) **Synthesizing (**gathering, reading, and analysing the literature**)**

After searching for the literature, this is the phase to shortlist and minimise the numbers of the relevant literature. After the preliminary summary was finished, the articles were read again for a more thorough and critical analysis of the information. (Cronin et al., 2008). To do that, we have used the PQRS (preview, question, read, summarise) method proposed by Cohen (1990). First, we scanned all our literature and read the abstract and the conclusion to categorise them into different themes and concepts. Document scanning allows one to become familiar with the wide range of documents and how to organise documents with related themes (Rowley & Slack, 2004). Then we identify the purpose of the work, its major finding, and any suggestions made by the researchers. We looked into the literature, keeping our main topic in mind. Finally, we tried to summarise the article to create a better overview and provide more clarity to our research. The main goal of doing this was to ensure uniformity and focus, along with providing clear navigation and identification of the used materials. Additionally, we carefully evaluated the

relevance of each source as it is a crucial part as well, ensuring it contributed to stay aligned with the research objectives.

2.2.1 Introduction of literature review

As science and technology continue to advance and become increasingly interconnected in society, smart gadgets like computers, tablets, and mobile phones are becoming more and more commonplace in daily life, business, and education (Qi et al., 2023). It is important to recognise the function that screen time plays in people's lives in a culture where the trend is to spend an increasing number of hours looking at a screen, which takes on the role of providing access to connections and information (Oliveira, 2019).

There is growing concern about the negative consequences, well-being, and social behaviour of smartphone use as it gets increasingly integrated into daily life. The threat of addictive behaviours and negative health impacts is increased by the rising number of people using cellphones (Gower & Moreno, 2018; Neophytou et al., 2019). Our capacity to establish and sustain social bonds with others has increased due to technological advancement, which has made it possible for us to speak with people instantly. Research assessing the impacts of screen time during important developmental stages has received increased attention as a result of the widespread use of digital platforms over the last sixty years (Neophytou et al., 2019).

Given the widespread use of smart gadgets in this 21st century and the expanding accessibility of smartphones and the internet, screen time has gained prominence during the past ten years (Tiller, 2021). These days, a lot of users want to use their smartphones less in the hopes of increasing wellbeing and productivity (Zimmermann & Sobolev, 2023). In order to address these problems, screen time management solutions—like Apple's Screen Time feature—were introduced. These applications give users information about their use habits and allow them to set time limits for using mobile devices. A function called "Screen Time" is available for Apple devices, including iPads and iPhones. The feature can always be accessed via the settings (Use Screen Time on Your iPhone or iPad—Apple Support, 2024). Though these functions are readily available, it is still apparent how well these features work in decreasing smartphone addiction and enhancing user behavior (Zimmermann, 2021).

According to Deloitte’s 2019 Global Mobile Consumer Survey (n.d.), around 50 percent of smartphone users in developed countries claim to use their phones excessively. It is therefore not unexpected that a sizable segment of our survey participants believe they use their cellphones excessively. Even with the expanding array of solutions available to limit excessive consumption, overusers still don't seem to care about improving the way they use their smartphones. For example, just over 5% of smartphone users measure their screen time—much lower than the almost half of the users (48%) who identify as heavy users. It is possible that

concerns over excessive use of cellphones or screens in general have been exaggerated (Deloitte's 2019 Global Mobile Consumer Survey, n.d.). The purpose of this literature review is to assess the effectiveness of existing solutions targeted at restricting smartphone use and to give a thorough knowledge of the major factors influencing iPhone screen time consumption among university students. We will evaluate the benefits and drawbacks of the current digital tactics by examining the research on screen time, self-regulation techniques, and digital well-being. The knowledge gathered from this evaluation will serve as the foundation for developing more successful interventions aimed at encouraging students to use their phones in a healthy manner.
This section is organised around a number of major topics, such as how excessive screen time affects cognitive and academic performance, how well screen time management solutions work, and what behavioural and psychological variables lead to excessive smartphone usage. Furthermore, the effects of design tactics on digital well-being will be examined, including nudges and persuasive technologies, with the goal of enhancing user engagement with self-regulation tools.

2.2.2 Related Work

2.2.2.1 Digital well-being

Digital well-being refers to an individual's personal well-being in a social setting where digital media are prevalent. It defines three key concepts: “well-being, harms/benefits, and digital activities.” (Büchi, 2024). "Digital well-being" is the phrase used to describe how digital technologies affect an individual's ability to have a healthy life (Burr et al., 2020).

We are all somewhat dependent on our smartphones in this digital age. The ways in which we use our smartphones appear to mediate whether this addiction is detrimental. The truth about smartphone addiction is that individuals are addicted to the entertainment, knowledge, and interpersonal relationships that smartphones provide, not to the devices themselves (Emanuel et al., 2015). Furthermore, individuals will keep going above and beyond to establish connections, as smartphones offer a convenient, immediate means of remaining connected, entertained, and informed.
Social media creates a state where the sense of constant anticipation and connectivity leads to habitual use and emotional responses in users (Lupinacci, 2021). This continuous engagement results in mixed feelings, and they are a) excitement, b) anxiety, c) reassurance, d) fatigue, and e) responsibility. These experiences highlight the complex emotional reflections that have an influence on individuals' everyday lives.

Engagement, self-presentation, and entertainment on social networking sites are linked to higher well-being, while content consumption was linked to worse well-being (Liu et al., 2019). The study of Salehan & Negahban (2013) reveals that extensive use of social networking services (SNS) on mobile phones strongly indicates mobile addiction. Some factors, such as SNS network algorithm and user intensity, significantly influence app usage, highlighting potential public health implications. Medium and high users of social media are more likely to experience psychological health difficulties (Brand et al., 2024).

Using a smartphone while actively engaged, focused, and attentive mind or its application when in a state of split awareness and inattention appears to dictate its effects on life quality. While smartphone use in a highly conscious state is indicative of an active lifestyle where one is likely to feel capable and functioning as well as to feel good about their life, using a smartphone while oblivious is likely to indicate a lack of mindfulness. The lack of focus, stress, or other mental conditions that are linked to an addicted and careless mental state. Higher levels of negative feelings can occur along with these mental states, which the user attempts—most likely in vain—to counter by using their smartphones excessively and engaging in sensory feedback (Sela et al., 2022).

Thomée et al. (2007) concluded that high use of ICT, which includes frequent texting, online chatting, and internet surfing, is somewhat associated with symptoms of depression, stress, and sleep disturbance of young adults. This suggests that ICT has an impact on psychological impact on the said users. For example, smartphone addiction is associated with traits such as narcissism and neuroticism (Pearson & Hussain, 2016). Additionally, excessive usage of smartphones can lead to severe health problems such as pain in neck and body parts, hand dysfunction, and eye concerns in certain cases (Candussi et al., 2013; Demir et al., 2015; Hauksdóttir et al., 2024).

Inattention in everyday life has often derived from absent-minded smartphone use (Marty-Dugas et al., 2018). By encouraging more "intentional" or "mindful" use of social media and mobile devices, the industries like Apple, Facebook, and Google are progressively adding features that attempt to foster "digital well-being." The addition of these features—like Apple's Screen Time—frames these commercial platforms as offering a social good (Beattie & Daubs, 2020).

2.2.2.2 User digital Behavior and Smartphone Usage Patterns

Smartphones are portable electronic devices that give users access to a wide range of media, such as social media, games, music, and movies (Ryu et al., 2022). The way people use their phones is known as a use pattern (Kang et al., 2011). A mobile phone is considered a necessary part of contemporary life, and the globe has undergone significant change as a result of the ongoing advancement of mobile phone technology (Jung, 2014).
Smartphones are used for a variety of purposes, including productivity, entertainment, and gratification (Hiniker et al., 2016). According to the same study, users have two types of

incentives for using technology: instrumental and ritualistic. Instrumental applications of technology are goal-directed and intentional, whereas ritualistic uses are habitual and diversionary. Their findings conclude that to support instrumental goals, technologies prioritise anticipating user questions, creating a streamlined path to success, minimising user time, and maintaining a minimal and passive experience. To promote ritualistic goals, technologies prioritise delivering a diverse range of alternatives, an engaging user experience, and stimulation to encourage repeat visits.

Park (2019) stated that the smartphone, with its small size, ease of use, proliferation of free or low-cost apps, and continual connectivity, transforms our lives in ways that much exceed what we experienced with previous media. This additionally identified two types of dependence: functional dependence, which emphasises the smartphone's usefulness, and existential dependence, which involves an obsessive and often unconscious attachment to the smartphone. While the two categories of dependence overlap, those who experience existential dependence are more hesitant to acknowledge negative aspects.

This study by Zhang et al. (2014) suggests four types of smartphone usage motivations. These include coping motives (such as mood regulation and pastime), social motives (such as social relationships), enhancing motives (such as knowledge seeking and perceived enjoyment), and conformity motives (such as acceptance). It further explains that while information seeking and social relationships have no discernible effects on smartphone addiction, reported enjoyment, mood control, pastime, and conformity all have favourable effects.

A study done by Atas & Çelik (2013) on smartphone use among several different university students found that students spend around 5 hours daily on their phones, primarily at night, checking them 28 times a day on average. Whereas most used reasons are texting, social media, and browsing, with less frequent use for shopping. Smartphones are commonly used during free time or while waiting. The study highlights the importance of timing educational content and finding ways to integrate smartphones into learning effectively.

The results found by Alfawareh & Jusoh (2014) indicate that students use smartphones as a way to connect to online social networks and as a conventional mobile phone in addition to a classic computer. The findings also imply that the students failed to use smartphones as a tool to enhance education.

Research by Nam (2013) identified real-time communication, even in comparison to internet and social media use, is the most valued and frequently used feature; on the other hand, study-related functions are least utilized. Nonetheless, according to Kaysi et al. (2021), the most popular application kinds include texting, social networks, video editing, and games.

Aljomaa et al. (2016) found that 48% of students exhibited smartphone addiction, with overuse being the most prominent issue, followed by technological, psychological-social, preoccupation, and health dimensions. Males and unmarried students showed higher addiction levels, while those with more than 4 hours of daily use and lower income also reported significant impacts. Bachelor's degree students exhibited the highest addiction rates.

Smartphone addicts lack sufficient control over their smartphone learning plan and its process, and other apps on their phones frequently interrupt them when they are studying (Lee et al., 2015). The addiction among university students is a matter of concern nowadays in terms of their academic disruption, overuse for no academic purpose, and emotional dependency on phones (Fook et al., 2021). If used correctly, it can have a positive correlation on the academic performance of the students (Shakoor et al., 2021). However, there is an obvious need for strategies to manage and regulate meaningful phone usage in education settings (Fook et al., 2021).

2.2.2.3 User engagement with self-awareness and self-regulation

The idea of mindfulness as a condition, attribute, process, and intervention has been effectively applied in clinical health and psychological settings during the past 20 years, particularly in connection to stress management and general well-being (Vago & Silbersweig, 2012). The concept of awareness or mindfulness has been linked to both self-regulation of immediate and long-term aspirations as well as how we use digital media (Bayer et al., 2016). It is defined as a multifaceted construct of consciousness in digital communication that encompasses not just awareness of one's thoughts, feelings, and experiences in the time but also whether one is accepting, nonjudgmental, and nonreactive in how one responds to them (Bayer et al., 2016).

The research by Thatcher (2018) highlights that IT mindfulness can create a way for staying away from cognitive absorption, which focuses on immersive engagement with technology. IT mindfulness emphasises how active, thoughtful, and intentional interactions with IT systems are crucial in comparison to automatic or passive usage. It strongly describes the importance of being aware of how technology is being used, its impacts, and its potential for innovation. IT mindfulness, with the help of reflective engagement, helps users innovate with systems and adopt deeper, more structured usage practices. This, as a result, fosters more meaningful and purposeful interactions compared to purely absorbed engagement.

Smartphones nowadays have become inevitable; therefore, digital mindfulness in the sphere of smartphone usage is important (Abhari et al., 2021). This study by Regan et al. (2020) investigates how trait mindfulness is capable of reducing problematic smartphone usage by lowering risk variables such as boredom, impulsivity, and nomophobia. The findings indicate that increased mindfulness is connected with less problematic use and has a role to play in

lessening the impacts of nomophobia and boredom proneness. However, impulsiveness has the ability to undermine the effects of this protection. According to the study suggestions, digital mindfulness intervention can help in terms of promoting emotional and cognitive self-regulation, especially for people who use their smartphones impulsively.

The complexity of smartphone media was investigated by Parry et al. (2020) using multitasking and psychological well-being, and that research states that the overuse of somewhere correlates with negative effects like stress, lower productivity, and reduced life satisfaction. Additionally, it identifies patterns of use using participants from diverse groups and measures engagement with social media and entertainment apps and how self-monitoring tools and interventions that associate goal setting may improve awareness and reduce overuse. This study suggests that assessments of both media use and media multitasking are required to advance research in this domain. Such approaches will not only support the investigation of associations between media multitasking and cognitive control but will also aid in the assessment of related interventions, behavioural changes, and effects (Parry et al., 2020).

The study by Chou (2024) investigated the importance of self-regulation and IT mindfulness in reducing addictive technology use with the help of the case based on mobile gaming. It also indicates that individuals can control their technology usage in a better way by improving self-regulatory behaviors. The techniques include mindfulness practices, which may help reduce harmful cognitive and emotional preoccupations. The framework developed in the study provides future strategies for interventions aimed at fostering healthier technology engagement and helping users balance their digital lives. This can help us in our case because the addictiveness of the entertainment apps, particularly social media, has somewhat the same addictive features.

2.2.2.4 Screen time

The screen has taken the place of paper with the arrival of the digital age. The amount of time spent using a device with a screen is known as screen time. "Screen time" relates to any activity involving time in front of a screen, such as playing video games, watching television, or using a device such as a smartphone or a computer. The screen has long been associated with modernity, whether it is on a computer, smartphone, television, or video gaming console (Bharadwaj, 2021; Qi et al., 2023).
Screen time is the duration spent using a computer, smartphone, tablet, or other screen-equipped electronic device or watching a screen (Oxford English Dictionary, 2023).

While some argue that screen time is detrimental to healthy development, yet modern technology has become an integral part of daily life, making life easier and opening up previously

unimaginable opportunities (LeBlanc et al., 2017; Alrobai et al., 2016). Screens are ubiquitous in our culture, so it's crucial to recognise both the hazards and advantages of using them.

Concerns over the increasing amount of time students spend using screens have been raised regarding the effects on student's learning, growth, and wellbeing. Almost one-third of students in OECD (Organisation for Economic Co-operation and Development) nations become distracted when using digital devices in class, and 75 percent of students spend more than an hour on social media each day (OECD, 2024). There is a substantial association between excessive screen time and problematic smartphone use (Randjelovic et al., 2021). The amount of screen time (ST) during after-school hours is becoming a recognised risk factor for disease, regardless of its educational value (Sigman, 2012).
Mature students are more significantly affected negatively by the relationships between screen time and academic achievement than are younger students (Twenge & Campbell, 2018). This could be the case because the negative impacts of screen use on academic performance are amplified in students due to their more severe declines in psychological well-being. It could also be brought on by the varying degrees of screen access that various age groups have. While younger children's screen time is frequently more strictly regulated and watched, adolescents have more access to mobile phones, computers, and other displays (InnerDrive, 2024).
Twenge & Campbell (2018) found in their study that excessive screen users were far more likely to exhibit poor emotion control (losing composure, arguing excessively, being difficult to get along with), difficulties completing activities, less interest, and more difficulty forming relationships. As mentioned by Lavados-Romo et al. (2023), there is a negative relationship between screen time and quality of life in university students, and students who spent more time on screens had worse quality of life, particularly in social and psychological health categories.

There is several research that has been on the health effects and physical issues of university students in relation to their screen time. Hammoudi et al. (2021) attempted to understand smartphone screen time among university students in Lebanon and its relationship with insomnia, bedtime procrastination, and body mass index. Additionally, screen time exposure and headache were investigated by Montagni et al. (2016).
Most products and services are intended to be addictive. By "fighting" for the users' attention, those products hinder the user from concentrating and focusing on their present work (Pacherazova, 2019). Consuming too much on screens has become a worldwide problem among teenagers and students. To lower the percentage of non-essential uses, it is important to investigate the mix of intervention tracking techniques and other uses when controlling people's screen time (Qi et al., 2023).

2.2.2.5 Screen time management tools and design interventions

The integration of technology into our everyday lives has altered how we work and communicate while also increasing the amount of time we spend in front of screens. Many large organisations have begun to create and include screen time management features into their products in an effort to better inform users about how to take care of their digital health during the past few years. These tools are a crucial stage in the process since they raise users' awareness and support them in making behavioural changes (Pacherazova, 2019).
As smartphones become more common, worries about "screen time," or how much time people spend staring at their phones, are also growing. Numerous customers express worry about disruptive consumption, including the excessive use of smartphones. The issues around screen time have increased along with efforts to limit it as people spend more time using smartphones and tablets (Oeldorf-Hirsch & Chen, 2022; Zimmermann, 2021).

89% of smartphone interactions are started by people, not alerts or notifications, and that implies that the disruptiveness of cellphones stems from learnt user habits rather than technology (Heitmayer & Lahlou, 2021). This shows how self-regulation is important in terms of overuse of smartphones. There are some digital interventions that are available for helping people towards mindfulness and making them aware of their amount of use.
Rescue Time, Freedom, and Apple's Screen Time are a few examples of screen time management apps that help users stay focused on their work-related tasks while also keeping track of how much time they spend on laptops or smartphones (Olivieri, 2021). Personal device tracking is beneficial for a variety of reasons, including increased productivity, disciplined device usage, and reduced consumption (Rooksby et al., 2016).
There is a function on the iPhone that displays the amount of time users spend using it each day and each week. Students can see which applications they have spent the most time on and have a better understanding of how much time they spend on their phone by using this information. This gives a clear picture of the issue and, consequently, suggests an ideal spot for the solution (InnerDrive, 2024) Many digital technology organisations have included screen time tracking capabilities into their devices and applications, including Facebook, Google, and TikTok (Oeldorf-Hirsch & Chen, 2022; Zimmermann, 2021).

The research carried out by Zhang et al. (2022) developed and tested Chirp, a Twitter client with features designed to examine external supports (usage dashboards, nudges) and internal supports (tweet filters, content exhaustion alerts) for managing social media use. The findings suggest that internal support significantly enhanced users' sense of agency, while external support was deemed less relevant. The findings suggest that designs promoting user agency along with the traditional screen time tools may help to regulate the phone overuse better.

Apart from the systematic features provided by different smartphone companies, even though scarce, there are some digital interventions available that have been planned to reduce the targeted problematic overuse. Nonetheless, this research was hardly based on university students.

A smartphone app was developed by Lubans et al. (2014) to support the "ActiveTeen Leaders Avoiding Screen-time" (ATLAS) obesity prevention program, and the main aim was to promote physical activity and reduce screen time in adolescent boys. The app provided features that aligned with the program's goals, such as push notifications and tracking tools, but reported some issues that resulted in lesser engagement. The satisfaction was overall high for the ATLAS program. However, functionality and engagement were insufficient, and there is an evident need for additional features to boost usage.

Another app named “Happy Screen” was proposed by Pacherazova (2019), particularly from a design perspective. This study investigated the current screen time management tools and provided some design strategies that might be helpful for future work. It stated that visualising data in bright graphs itself is not effective in influencing user behaviour or device usage; rather, there should be other ways, such as disrupting the experiences of other apps that are designed to be addictive. Finally, it suggested that the current solution, which might fail in usability testing, can incorporate some ideas for this study to make these more usable.

2.2.2.6 iPhone Screen time management feature

The most prominent illustration is Apple's Screen Time function, which is compatible with all smartphones running iOS 12 or later. After the user activates the function, it keeps track of everything they do on their phone and generates comprehensive reports every day and every week. Users may also impose time limitations on how much time they spend on specific applications or the total amount of time they spend on their phones. The simplicity of Apple's Screen Time feature is demonstrated by the fact that it is integrated into the iOS software and only has to be enabled once in the device's settings. From that point on, it automatically records the amount of time spent on the phone and provides use notifications. With the help of this comprehensive, precise, and automatically generated data, users may monitor or even set screen time limits (Apple, 2018; Oeldorf-Hirsch & Chen, 2022).

The research by Oeldorf-Hirsch & Chen (2022) investigates the adoption of Apple's Screen Time feature using the Technology Acceptance Model (TAM), highlighting how mindfulness influences its perceived usefulness and ease of use. While mindfulness negatively predicts the feature's perceived usefulness, ease of use remains a significant factor in adoption. Findings from the study reveal that individuals with higher mindfulness often find screen time tools less necessary, and they feel the need for intervention is less. The study also emphasises designing intuitive and targeted tools that address varying user perceptions and designing for the users who are less mindful and require more self-regulation and external help. These insights contribute to understanding different types of user adoption behaviour and refining screen time management strategies to tailor them for users in need.

The work by Berr (2019) examines the role of Apple's Screen Time feature in regulating smartphone use and analyses this through the walkthrough method from user experience perspectives. It critiques how the feature promotes a self-regulation concept aligned more with corporate interests than user needs. It also presents that there is a clear gap between the way the screen time app should be and how it works currently. It emphasises the need for more sustainable and meaningful intervention, which is necessary to protect user attention.

2.2.2.7 Persuasive design and Gamification in Digital Interventions

Olivieri (2021) investigated the role of persuasive technologies in promoting *"tectonoetic awareness"*—a concept that highlights how different systems like screen-time management tools impact human cognition and eventually encourage reflective behaviours. Features of the mentioned tools, such as immediate feedback (e.g., notifications) and accumulated feedback (e.g., detailed reports), provide users with insights into their habits that, as a result, enable long-term behaviour change. However, Olivieri also raises an important ethical concern: while these systems may enhance self-recognition, they often undermine immediate user agency by subtly redirecting attention and decisions.

One more app named "The Wallpaper" was designed by Nwagu & Orji (2024), mainly focusing on persuasive design interventions. The main functions included: (1) When the user unlocks their phone, a leaf from the tree falls. The animated decrease ensures user awareness. (2) The leaves change colour as the user spends more time on their phone. This is a subtle shift that happens gradually during the day. (3) Using the smartphone's built-in accelerometer, users may regrow leaves by engaging in physical activity instead of using the phone. This study reported that the intervention decreased the usage of smartphones when distracted. However, perceived persuasiveness may not be associated with behaviour change.

There is some encouraging evidence that gamification is effective in a lot of cases (Cugelman, 2013). Additionally, it has some similarities with certain health behaviour modification programs. It is easy to see how gamification techniques can be applied to the current wave of digital motivation by taking account of flow and meaningful incentives, providing them with a way of social interaction, and above all, finding creative digital interventions that will both be captivating and entertaining (Cugelman, 2013).

There is no direct study targeting gamified elements in screen reduction. Nonetheless, one study done by Hariri & Stone (2024) investigated the design of triggered screen restriction (TSR), a unique behavioural intervention that uses negative reinforcement and gamification to encourage physical activity and less screen use. Participants who used the TSR framework reported better levels of activity, perceived competence, and app usability than those in the control condition.

These findings draw attention to the potential of gamified treatments to reduce sedentary behaviour and encourage healthier habits.

2.2.2.8 Gap of the literature

Altogether, while a lot of the studies examine persuasive technologies and reducing screen time, there are still many research voids when it comes to considering the persuasive aspects of design that iPhone's Screen Time incorporates. Although earlier research by Nwagu & Orji (2024) has suggested the use of personalization, mindfulness, and persuasive techniques for behavior change for the application of which the present research is proposing, the iOS ecosystem is rather uncharted9) underlines the efficiency of considering the mentioned approaches for interventions that do not expect users to change their preferred environment. However, the current tools of Screen Time in the iPhone do not capture the potential value of this principle; this suggests a gap in user-centered design and wise integration .

Furthermore, although combining qualitative and quantitative data was recommended as a means to improve user experiences (Lukoff et al., 2018), there is not enough evidence of using such a strategy in the context of screen time application and personalisation in the iOS environment . This gap indicates that more studies are required on how the perceptive personalised persuasive modes fused with mindfulness and autonomy-supportive elements could further engage and effectively influence users.
Still, scholars have paid little attention to several important factors, one of which appears to be the use of gamification to address the issue of screen time. Even though the use of gamification to encourage healthy behaviour change in related settings has been discussed (Cugelman, 2013), there is a lack of literature on gamification in reducing screen time, especially within the framework of Apple's Screen Time. Hariri & Stone (2024) indicated in their study that screen restriction frameworks with gamified features improved activity levels and the perceived competence of users of screen time; therefore, they recommended the direction provided by such solutions for screen time management.

Furthermore, a lot of the current research does not capture aspects of difficulty university students experience in managing time in front of screens and academic, social, and personal smartphone usage. The design solutions for this demographic entail a combination of HCI, self-regulation theories, and behavioural designs by factoring in its special needs.

3. Theory

In this section, we have introduced a number of theories we will use to guide and shape our research subject. As the main focus of this research are user interaction, user motivation, and

designing interventions of the screen time management function, the theories have been chosen to analyse these accordingly. There are overall two sections of theories: the first one is about the users, such as user interaction and motivation, and the second one is basically about the system and the interaction design, and these are modelled under the umbrella of human-computer interaction (HCI).
The first section serves as the means to understand the psychological and behavioural factors of the user, which drive students to become aware of their phone usage and adopt tools to regulate it. Additionally, once they are motivated, they actually go through the process and interact with the same.
The next part of the theory is focused on understanding the functionalities of the screen time features and how the interaction design theory makes us understand the processes. By applying interaction design theory, we can dissect how different elements, for instance, notifications, app usage limits, and user interfaces, are designed to guide user actions, making the processes of monitoring and reducing screen time more intuitive and user-friendly. This theory also helps us explore how effective these design elements are in shaping positive user experiences and encouraging sustained behaviour change. In addition to the knowledge gained from the literature research, all of these theories will aid in guiding the analysis.

3.1 Human-computer interaction

Human-computer interaction studies the development, assessment, and use of interactive computer systems for human use as well as the examination of the main phenomena that surround them (Sinha et al., 2010). The study of human-computer interaction (HCI) is at the nexus of computer science and technology and psychology and the social sciences, respectively (Caroll, 1997). As the technology evolved, HCI has shifted its core functionalities from only machine assessment to a more inclusive understanding from the context of user experience and recognising how the emotional responses to technology can improve overall satisfaction (Hasan & Galal-Edeen, 2017). This has broadened the scope of design to include the user’s emotional journey, highlighting the importance of empathy in system design. The well-established hypothesis that a happy or negative feeling may significantly alter the user experience, independent of the product's other usability indicators, led to the development of the definition of usability and the transition to user-centred design (Tosi, 2020).

In a general sense, user-centred design is defined as the use of the following principles: multidisciplinary approach, iterative design and assessment, and active user interaction for an accurate understanding of user and task needs (Vredenburg et al., 2002). The main goal of UCD is to design systems, services, or products that are appropriate for users' everyday lives, making sure that they are not just useful but also significant and appealing to those who will use them (Kujala, 2003). This highlights that user involvement is crucial for UCD, which allows designers to create tools that are both functional and relevant to real user experiences.

In user-centred design, the difference between usability and user experience is often discussed. Usability is described as the acceptability and ease of use of a system or product for certain categories of users performing specific activities in a specific context, and acceptability influences whether or not the product is used, while ease of use influences user performance and satisfaction (Lewis & Sauro, 2021). Whereas user experience (UX) is influenced by a user's internal state (predispositions, expectations, needs, motivation, mood, etc.), the features of the system that was designed (complexity, purpose, usability, functionality, etc.), and the context (or environment) in which the interaction takes place (relevance of the activity, voluntariness of use, organisational/social setting, etc.) (Hassenzahl & Tractinsky, 2006). UX in the context of a positive HCI focuses on how to produce exceptional quality experiences as opposed to only avoiding usability issues (Hassenzahl & Tractinsky, 2006).

The definition of a user and the best way to include them in the design process must be carefully considered because users are the ones who will utilize the finished product or artefact to complete a job or achieve an objective (Abras et al., 2004).
In the context of screen time management by the users, it is essential to meaningfully engage them in the design process, as their unique experiences will provide dynamic perspective in this research. By incorporating the experience gathered from the user, it will be easier to ensure better functionality and usability for the end product. By combining student views and viewpoints, designers can assure that the tool will solve specific difficulties linked to screen time, which in turn will better the overall user experience, hence increasing efficacy in encouraging healthy digital habits. Our research basically has two parts, which are users and the system, and these are core components of the HCD principles as well. For the user part, as we know that emotions and motivation are important elements of users, we have gone through the process of selecting to know these aspects, and these are all described in the following parts.

Before selecting theories that would guide research in terms of the psychological needs of the users, we have explored several other theories as well. Albert Bandura developed Social Learning Theory (SLT) in the 1960s, which later became known as Social Cognitive Theory (The Social Cognitive Theory, n.d.) . Human autonomy refers to the ability to govern and shape one's life by means of intention, self-regulation, and reflection. Social Cognitive Theory distinguishes three types of activity: direct personal control, indirect action (dependence on others), and social agency (collaboration), emphasising the growing relevance of shared effectiveness in a globally linked environment (Bandura, 2001). The purpose of SCT is to describe how humans manage their behaviour using control and reinforcement to accomplish goal-directed behaviour that can be sustained over time (The Social Cognitive Theory, n.d.). SCT has the elements that might help us to understand the underlying motivations of the user to regulate using the screen time feature. It could be relevant because it focuses on learning and behavioural change and describes this as an interplay between individual experience and social environment. For instance, in this context, the past interaction of the users with the technology,

their productivity expectations, and the influence of peers or social media can influence how the users utilize screen time management tools. SCT also takes into account how students learn and adjust to behaviours depending on social feedback, which can provide some dimension for understanding their use of such tools.

While SCT focuses on social and environmental communication to influence learning behaviour, it may not completely address the internal motivating factors that are crucial to understanding why students choose to minimise their phone usage autonomously (The Social Cognitive Theory, n.d.). In this context, our research focuses more on internal factors driving behaviour change, such as intrinsic motivation and the design of interventions (nudges) that subtly encourage self-regulation. The SCT theory emphasises past behaviour and external influences, but screen time management tools often aim to foster self-regulation and personal reflection, which may be better explored through frameworks like Self-Determination Theory (SDT) or the Fogg Behavior Model. These frameworks focus more on internal motivation and triggers rather than external reinforcement.

3.2 Self Determination Theory (SDT)

Figure 3 : Self determination theory (Toxboe, 2024)

In the field of information systems (IS), studies have focused on extrinsic motivation (reward, reputation, and image) and intrinsic motivation (enjoyment of helping others, enjoyment of learning, and sense of self-worth) to understand the motivations behind information use .
Self-determination theory is a framework that describes human motivation by the measurement of three basic psychological needs—autonomy, competence, and relatedness—and promotes self-regulation (Deci & Ryan, 2000). Initially, the self-determination theory was described as interpersonal events and structures (such as rewards, communication, and feedback) that promote feelings of competence during action and can increase intrinsic motivation by satisfying the psychological need for competence (Ryan & Deci, 2007). However, after more research has been

carried out, it has been explored that autonomy and relatedness also play crucial roles in this regard (Ryan & Deci, 2007).

Autonomy in SDT is defined as the feeling or state of an individual where they are in control of their actions and decisions. It incorporates the sense of ownership of individuals' choices and ability to engage in activities willingly, which aligns with their values and interests, and is an essential tool for intrinsic motivation (Deci & Ryan, 2000). Whereas competence is defined as the individual's need to feel effective and capable in their interaction with the environment. It encompasses seeking challenges that allow one to put their skill to work and the development of new abilities. When individuals' perception of competence is fulfilled, they are more likely to engage in activities facilitated by their intrinsic motivation and overall satisfaction (Deci & Ryan, 2000). Finally, relatedness derives from the need to connect with others and to feel a sense of belonging. It involves the desire for social interaction and relation with others. So, the feeling of relatedness makes individuals more intrinsically motivated to engage in activities that connect others, and cooperative behaviours are promoted (Deci & Ryan, 2000).

SDT differentiates between intrinsic and extrinsic motivation. Extrinsic motivation is described as doing something for a specific goal rather than only enjoyment (Ryan & Deci, 2007). Intrinsic motivation occurs when an individual engages in an activity purely for the enjoyment or satisfaction derived from the activity itself (Ryan & Deci, 2007) .
Nonetheless, even though there are some perspectives that view extrinsic motivation as totally non-autonomous, SDT differs in that extrinsic motivation can have varying degrees of autonomy (Ryan & Deci, 2007).

To explain the journey between extrinsic and intrinsic motivation, we need to look at the SDT paradigm from figure 3. The SDT paradigm includes six constructs, and these are motivation, external control, introduced regulation, identifiable regulation, integrated regulation, and intrinsic motivation (Ryan & Deci, 2007).

A lack of motivation to carry out the behaviour is referred to as *amotivation* (Lubans et al., 2013). External regulation involves engaging in the behaviour to satisfy an external demand. Extrinsically driven behaviour can be carried out by users with resistance, apathy, and resentment, or, contrary, with a willingness attitude that shows an internal acceptance of the worth of the task or usefulness (Ryan & Deci, 2000). Introjected regulation is concerned with avoiding feelings of guilt and shame and/or enhancing feelings of self-worth. More autonomous forms of motivation include identified, integrated, and intrinsic regulation. With identified regulation, the individual values the outcome as personally important. Individuals with integrated regulation believe that the behaviour aligns with their deeply held values and beliefs (Lubans et al., 2013). Individuals' extrinsically driven acts become more self-determined as they internalise and integrate into the self (Ryan & Deci, 2000).

Finally, intrinsic motivation is driven by enjoyment, fun, interest, and the inherent satisfaction of participating in the behaviour (Deci and Ryan, 2002). According to Ryan & Deci (2000), their research focused primarily on psychological needs—namely, the innate needs for competence, autonomy, and relatedness—and recognised that basic need satisfaction accrues in part from engaging in interesting activities. Screen time management tools are built around interactions between users and digital components, making it essential to understand interaction design within the context of self-regulation. Self- determined motivation in self-regulated learning is influenced by a variety of underlying beliefs, including perceived efficacy and intrinsic desire (Zimmerman, 2002).

The SDT elements are essential for self-regulation, and individuals who feel autonomous are more likely to be inclined to engage themselves in self-regulation strategies (Deci & Ryan, 2000). When users start perceiving themselves as competent enough and find connection or belonging to others, their intrinsic motivation is increased, and that leads to greater engagement and persistence on their task (Zimmerman, 2002). This can finally motivate them to intrinsically motivate them to use the tools to amplify their productivity and well-being (Zimmerman, 2002).

In conclusion, SDT provides a solid foundation to explore how these tools help users regulate their screen time and also provide a means of deeper intrinsic motivation for a sustainable behaviour change. Overall, SDT provides a strong perspective on the design and implementation of effective screen time management tools tailored to users psychological needs, which in turn foster intrinsic motivation.

All the presented themes of SDT—autonomy, competence, and relatedness stressing intrinsic motivation—respond well to the design of empowering features. For instance, customisable app limits respect the principle of autonomy while the details increase users' competence. However, SDT is most focused on intrinsic motivation and does not take extrinsic motivators into consideration, such as rewards and game elements, which are essential for maintaining motivation in the long run. This limitation is addressed by incorporating several interaction design theories that deal with proximal behavioural motivations in addition to SDT that targets inherent motivations.

3.3 Persuasive Design

Digital architecture, including software and the Internet, influences human behaviour through various design elements and interaction mechanisms. According to Lockton (2012), these are more than functional tools and serve as frameworks that can guide, nudge, or even create awareness to alter decisions and behaviours by creating special digital environments that regulate certain interactions. By thoughtfully designing different aspects such as interface layout,

interactivity, and personalised output, these platforms can boost their effectiveness and perhaps result in long-lasting behavioural change (Orji et al., 2018).
Persuasive technologies are one of the most notable aspects of digital architecture. This is described as systems that are designed explicitly to change attitudes and behaviours by incorporating psychological and motivational techniques (Fogg, 2002). This field includes applications across several spheres, namely health, education, and social networking, and utilises design principles that encourage user actions, such as adopting healthier habits or engaging deeply with the content (Cabrita et al., 2018). The tools of persuasive technology allow different strategies from simple prompts and reminders to complex gamification strategies that incentivise continued interaction (Raftopoulos, 2014).

As technology advances, the forms and motives of persuasive strategies are constantly evolving, which allows designers to create more sophisticated and personalised approaches to influence users (Bang & Ragnemalm, 2012). The Human-Computer Interaction (HCI) community has paid a lot of attention to personalising user interfaces and systems in general, which has increased interest in figuring out how to customize persuasive systems (Orji et al., 2018). With the new wave of artificial intelligence and machine learning, these technologies are evolving into more flexible tools that employ real-time data to offer personalized suggestions and interactive feedback, which in turn have a big influence on user behaviour.

The frameworks that are provided by persuasive design and digital architecture tools for understanding and influencing user behaviour in targeted ways are highly relatable to our case in discussion. We aim to integrate persuasive design elements that are beyond only functionalities and rather create a digital environment that will guide users subtly towards behavioural changes, for instance, reducing screen time, increasing mindful engagement, and adopting healthier digital habits. This aligns well with our which are to regulate positive behavior change and these can be achieved by utilizing prompts, feedback loops, and personalized suggestions (Lockton 2012; Fogg 2002).

In the following part, some theories related to persuasive design are explained.

3.4 Fogg behavior model

Figure 4: Fogg Behavior Model (Tan, 2024)

The Fogg Behaviour Model proposes that behaviour is influenced by the combination of three factors: motivation, ability, and trigger, each with their own subcomponents (Figure 4) (Fogg, 2009). According to the FBM, individuals must be motivated, capable, and prompted to engage in a desired behaviour (Fogg, 2009). The FBM links behaviour effectiveness to an individual's motivation and ability before a task, which may be influenced by a trigger intervention (de Toledo et al., 2018).

Motivation

The FBM suggests that motivation is mainly derived from three main components, and these are pleasure/pain, hope/fera, and social acceptance/rejection (Fogg, 2009). The first motivator basically focuses on immediate sensory-based responses that influence decisions. The hope/fear motivator is based on anticipated future outcomes and drives individuals toward behaviours that offer the promise of positive change (hope) or help them avoid negative outcomes (fear). The social acceptance/rejection factor comes from the innate desire of a human being for belongings and connection with others.

Ability

Ability is another essential part of FBM, which refers to the individual's capacity of performing desired behaviour, and that depends on various factors such as time, physical effort, mental energy, and others (Fogg, 2009). The model highlights that even a highly motivated person can fail if they don't have necessary skills. Simplifying things is one way for achieving ability (Fogg, 2009).

Triggers

Triggers, also known as prompts, are a critical element to facilitate the right behaviours at the right time (Fogg, 2009). Triggers can take the form of cues, reminders, or alerts that prompt individuals to take action. Fogg outlines different types of triggers based on the individual's

current level of motivation and ability, such as facilitators, signals, and sparks. Triggers are especially effective when carefully timed and tailored to the user's readiness for behaviour change. This model has been widely used in designing persuasive technologies, which are technologies designed to influence user behaviour. For example, the FBM has been used to create applications that encourage healthier lifestyles, such as diet and fitness apps, which has ensured that users have both the motivation and ability to interact with the tool while getting effective triggers to sustain behaviour change (Fogg, 2002).

Thus, FBM can be considered a useful approach for bringing structure to the perceived relationship between motivation, ability,, and triggers and the observed behaviour. The fact that reminds users of app limits is contextual for guaranteeing timely interventions. However, FBM's main area of concern seems to be short-term modification of behaviour, which could be insufficient in capturing the dynamics of habit in the long term. With the principles of sustained intrinsic motivation grounded in SDT, this study closes a gap between short-term behavioural shifts and long-term use of technological solutions.

3.5 Nudge theory

The concept of "Nudge Theory" is connected to behavioral economics and psychology, and it was first introduced by Richard Thaler and Cass Sunstein in 2008. The term "nudge" is described as any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their environment (Lin et al., 2017). This theory suggests that small and strategic modification in the choice architecture and the context in which the choices are presented have the ability to significantly influence behavior of people in a somewhat predictable way without restricting the freedom of the users (Thaler & Sunstein, 2008). To describe the choice architecture Thaler & Sunstein (2008) stated that a choice architecture has the responsibility for organizing the context in which people make decisions in their introduction to the term. Nowadays, users of the ubiquitous computer technology are continuously making both little and major decisions.

Over the last decade, HCI academics and practitioners have embraced the concept of nudging, which suggests that tiny modifications in the 'choice architecture' might predictably affect people's behaviors (Caraban et al., 2020). The main idea of this is to guide individuals towards better life choices by nudging them, rather than implementing or tracking their initial preferences (Bang & Ragnemalm, 2012).

Nudging relies heavily on choice architecture to guide human decision-making. Every day he engages with goods and services that were designed without considering basic human psychology principles, resulting in design failures in choice architecture, whereas nudging theory opposes these (Bang & Ragnemalm, 2012). This method argues that individuals lack the necessary information to successfully modify their behaviours, and the role of the design is to

assist them in documenting, evaluating, and reflecting on their actions (Caraban et al., 2020). So, this approach does not enforce behaviour changes instantly, but rather provides an assistive structure that helps users overcome biases or limitations in knowledge by guiding them towards beneficial behavior.

Nudge Theory could be relevant in our context due to its main concern being to gently guide users toward positive behavioural changes without heavy interventions or drastic alterations to their options. Since our project aims to encourage behavior change in a subtle and user-friendly way, nudge theory can offer an unauthoritative framework to keep users on track and help them establish a healthier This aligns well with our design focus, as it avoids overwhelming users with complex or demanding actions, instead encouraging them to engage and reflect on their choices.

Nudge Theory is implicitly designed with a focus on non-intrusive yet effective solutions that can help people become healthier. But the ethical aspects that may pose concerns for the builders of nudge-based designs are the interventions themselves, as the users may consider some of them as intrusive. This is a tension that is controlled by making the authors transparent and providing users with the power of choice regarding customisation, which is in line with SDT.

3.6 Gamification

Gamification enables system designers to accomplish goals by expanding upon well-established game-based strategies and a behavioural economics and psychology-based knowledge of human nature (Wood & Reiners, 2015). The main emphasis of this method is on behavioural economics and psychology and is essential in HCI because it taps into well-researched principles about how individuals interact with technology, aiming to create more positive and productive user experiences. The connection between HCI and gamification becomes more prevalent when the concept of UX is considered, as UX is not only focused in usability and ergonomics but also on factors like cognitive load, affective experience, and increasingly, user motivation (Tondello, 2016; Deterding et al., 2011).

Gamification has gained a lot of attention as a way to encourage positive trends in service use, such boosting user activity, social connection, or the caliber and productivity of tasks, and it has been a popular issue (Hamari, 2011). The use of game mechanics in non-gaming contexts to improve the procedures followed and the experience of individuals engaged is mainly referred to as "gamification" (Caponetto et al., 2014). This involves redesigning work processes with game mechanics to create an entertaining and pleasurable experience, rather than just converting everyday operations into games (Wood & Reiners, 2015).

In the design process of the game designer, these are mainly 3 elements: (a) mechanics, (b) dynamics, and (c) aesthetics (Hunicke et al., 2004). Game mechanics include points, badges, leaderboards, stats, levels, quests, countdowns, tasks, quests, missions, and other specific

guidelines and incentives, and these make up the majority of the aspects of the game that we notice right away (Kim, 2015). The second element, which is game dynamics, refers to the interplay between concrete game mechanisms and players at a more abstract level, including appointment, behavioural momentum, feedback, progress, time pressure, and specific powers for game avatars (Kim, 2015). The final element, aesthetics, relates to the well-designed experience required to impact a learner's propensity to adopt gamification because if the learners do not appreciate the experience, their overall satisfaction and engagement with the game may suffer (Kapp, 2012).

By incorporating the game design elements method, there are several frameworks for gamification in HCI available that were proposed by different researchers. However, Aparicio et al. (2012) proposed a framework linking both SDT and gamification. As we have already decided and described about SDT, this is the framework that is the most suitable one for us. The SDT proposed by Ryan & Deci (2000): activities that a person finds intriguing and engages in for the sheer enjoyment of doing so are known as intrinsically driven activities when autonomy, competence, and relatedness are met, and these can be achieved by gamified processes (Aparicio et al., 2012). There are four sections to the mentioned framework.

Identification of the main objective is the first step, which is a description of the rationale for gamification. Any task or job has a main goal that is clearly identifiable (Aparicio et al., 2012). Identifying the transversal objective or finding more factors that will make people interested in what the system aims to offer (Seaborn & Fels, 2015). Selection of game mechanics that align with aims and promote human motivation (autonomy, competence, and relatedness) according to their relationship to the ideas of self-determination (Aparicio et al., 2012).

An analysis of the effectiveness of gamification in terms of enjoyment, quality indicators, satisfaction, and service quality (Aparicio et al., 2012). This can be accomplished by having users complete surveys and tests with certain metrics or by having experts undertake a heuristic review based on the game mechanics and gamified procedures.It is also worth mentioning that despite being a widespread method in HCI, because of the flaws in the widely used "one size fits all" approach of traditional gamification principles, the use of gamification does not always provide the desired effects (Böckle et al., 2018). However, adaptive intervention can help the designer in this case.

Gamification, as mentioned above, is the practice of adding the stated incentive features to services for creating engaging experiences and improving behaviour (Hamari, 2011). Social media networking apps, which are Internet-based and emphasise robust IT infrastructure support, seem to be the foundation of several contemporary applications of gamification (Wood & Reiners, 2015). If we look at our context, the mentioned method is a promising strategy to enhance user engagement and positive behaviour by integrating incentive mechanics in our

system. Since, our platform requires engagement towards the screen time features, the use of gamified elements can help to build a more engaging experience.

The existing consumption patterns of ICT applications are looking forward to developing products within persuasive technology with the intent of promoting sustainable digital behaviour (Huber & Hilty, 2015). Current persuasive approaches tend to rest on the assumption that information inspires changes in behaviour and are based on rigid definitions of what constitutes "sustainable" behaviour. The breadth of the concept of gamification has allowed for a broader approach to design in that it has increased the amount of user-chosen aspirational goals that may still be in alignment with self-determination theory as well as increased the opportunities for social motivators such as competitive and cooperative elements to strengthen motivations. The relationship between persuasive design and gamification illustrates that bridged concepts will bring forth more engaging, user-centred solutions able to achieve sustained behaviour change. Gamification, along with the other discussed persuasive design tools, presents a solid theoretical ground for our design goal of this study.

Therefore, incorporating these theoretical frameworks offers a wide-angled and diverse understanding of the study topic. This is because by honouring a critical view of the strengths and limitations of the established methodology, this research presupposes a balanced approach to both the design and the assessment of screen time tools. The complementary nature of these theories means that the research is properly equipped for handling the multifaceted problems of raising users' awareness, involvement, and productivity. This discursive framework not only increases the scientific credibility of the study but also establishes the basis for generating new and practical approaches to digital wellbeing issues.

4. Methodology

This chapter outlines the overall method that was used in our study, with a focus on university students' engagement with the iPhone Screen Time tools. With the aim and design of the study, creating mixed-methods consisting of both qualitative and quantitative data, the findings are equally capable of providing detailed understanding, varieties of user behaviours, problems, and opportunities waiting for enhancements.
To set the methodological framework for the study, in this chapter we elaborated how the quantitative and qualitative approaches offered a rich insight into screen time behaviours and anchored useful recommendations for enhancement.

4.1 Research Design

We deployed a mixed-methods approach in order to collect data for our study to combine the strengths of both quantitative and qualitative research along with contextual inquiry, heuristic evaluation, and design thinking methodologies, providing a comprehensive understanding of university students' iPhone screen time behaviours. According to Bryman (2016), studies that blend qualitative and quantitative methods are defined as mixed methods. The author further included a concise phrase for research that combines quantitative and qualitative components into one topic, which is "mixed methods research."

To address our research questions, mixed methods research incorporates aspects of both qualitative and quantitative research. A combination of quantitative and qualitative methodologies might provide us with a more comprehensive understanding than either one alone (George, 2023). Researchers can address some of the difficulties arising from diversity and take logical views using mixed-methods projects, which offer both a challenge and an opportunity (Small, 2011).

The development of mixed methods research raises the appropriate question of how valuable mixed methods research is in comparison to pure quantitative or pure qualitative research (McKim, 2017).

The heuristic evaluation assessed the usability and effectiveness of existing screen time tools, identifying areas for improvement. Design thinking was utilized to ideate and prototype user-centered interventions, ensuring the solutions were both practical and innovative. This methodology provides a robust framework for understanding user behavior and developing actionable design improvements. The section outlines the research design, heuristic evaluation process, design thinking phases, participant recruitment, and data analysis techniques in detail.

The Reasons for Selecting These Methods

The methods described below were used to meet the research objectives of comprehending the iPhone screen-time habits of university students and identifying practical design improvement suggestions:

First, Quantitative Data: The survey aims to obtain broader data on iPhone screen time usage trends across a wider demographic to find patterns like the most frequently used features, average usage time, and typical issues. This survey will be used to gather quantitative data about students' current usage of iPhone screen time management tools, their perceptions of these tools, and the impact on their productivity and non-essential phone usage

Justification for Use:

According to Creswell & Clark (2018), surveys effectively gather information from a large number of respondents, providing statistical insights that are representative of the larger user population.

Quantitative data allows comparisons across demographic groupings or uses trends by providing quantifiable evidence to support results.

Second, Semi-structured Interviews to Gather Qualitative Data: We conducted interviews to acquire a better understanding of how consumers understand, motivate, and interact with screen time technologies. Additionally, this method provides participants freedom to voice their opinions while the discussion is directed by predetermined concepts.

Justification for Use:

According to Bryman (2016), semi-structured interviews work well for revealing hidden themes and capturing details of individual experiences. Through these interviews, participants may go into further detail about survey results, such as why they bypass app guidelines or which aspects are confusing to them.

Third, Contextual Inquiry: The goal of the contextual inquiry for user behaviour is to watch participants utilise time technologies in their natural settings. To better understand how and why people interact with certain features in addition to what they do.

Justification for Use:
According to Holtzblatt and Beyer (2017), contextual inquiry focuses on real-world behaviours and identifies differences between what users claim to do in interviews and what they really do in observations. It offers detailed contextual information, including natural elements that impact usage patterns.

Fourth, Heuristic Evaluation: The goal of the heuristic evaluation is to compare the efficacy and usability of the current Screen Time solutions to accepted usability guidelines to find areas for improvement and design problems (Nielsen, 1995).

Justification for Use:
According to Nielsen & Molich (1990), heuristic assessment is a methodical and economical approach to identifying usability problems without the need for intensive user testing. This method facilitates the conversion of user input into useful design suggestions.

Why Mixed-methods Is Appropriate for Our Research

Triangulation

Mixed-methods research enhances the validity and trustworthiness of findings through the comparison of quantitative data (survey) with qualitative insights (interview) (Creswell & Clark, 2018). Triangulation enhances the study's findings by ensuring that several viewpoints are taken into account (Bryman, 2016). Mixed-methods research reduces the biases seen in single-method techniques by combining several data sources (Tashakkori & Teddlie, 2010).

A Thorough Comprehension

The combination of survey data and behavioral insights from contextual inquiry and heuristic evaluation yields a comprehensive, broad picture of user behavior. According to Clark & Ivankova (2016), researchers can investigate a phenomenon's depth and breadth by using mixed methodologies. In contrast to surveys, which record generalizable patterns, qualitative techniques like semi-structured interviews reveal underlying reasons and obstacles, providing a more comprehensive view (Greene et al., 1989).

Design Process Iteration

Design thinking frameworks need repeated cycles of assessment and redesign, which mixed approaches facilitate (Kolko, 2010). While qualitative data informs subtle design modifications, quantitative data aids in prioritizing design improvements. Mixed methods enable continuous feedback cycles, allowing researchers to evaluate advances and iteratively adapt interventions (Johnson & Onwuegbuzie, 2004).

Addressing Complicated Situations

A mixed-method approach is the most effective way to comprehend the usability, psychological behaviors, and design difficulties associated with screen time consumption. While quantitative approaches measure the frequency and significance of these interactions, qualitative approaches offer insights into user experiences and contextual complexities (Yin, 2018). According to Greene & Caracelli (1997), mixed approaches work especially well when tackling complex research problems that involve the intersection of social, technical, and behavioral aspects.

Bridging Paradigms

Mixed methods provide a more thorough study design by bridging the positivist (quantitative) and constructivist (qualitative) paradigms (Tashakkori & Teddlie, 2010).

A number of different approaches may have been used to better understand the iPhone Screen Time patterns of university students. Although these approaches have special benefits, they are also limited in their ability to accomplish all of our research objectives. These are some possible approaches-

- *Longitudinal Studies:* The aim of Longitudinal study is to gather information from individuals over time in order to spot behavioral trends and changes. In longitudinal studies, certain factors are observed repeatedly over a long period of time, enabling

researchers to monitor changes and advancements. These investigations are especially useful for determining trends and causal links across time (Yin, 2018).

Why it could be effective: It gives information about how screen-time habits change over time.
monitors how user behavior is affected by interventions such as app limitations or downtime features (Yin, 2018).
Reasons for not selecting it: This study takes a lot of time and resources. An in-depth technique (such as surveys and interviews) was more feasible because our study focuses on current behavior and usability (Creswell & Clark, 2018).

- *Focus Group:* Focus group is a method to gather data where a number of people chosen and brought together by researchers to talk about the perspectives and experiences of participants on the research problem (Powell & Single, 1996).

Why it could be effective: It promotes conversation and engagement, which can provide information not obtained through one-on-one interviews and gives the chance to discover common problems or solutions (Bryman, 2016).
Reasons for not selecting it: According to Morgan (1997), interactions between groups have the potential to restrict individual points of view or cause smaller individuals to be overlooked by dominating voices.
And it is less effective than semi-structured interviews in gathering specific, personalized behavioral insights (Guest et al., 2017).

- *Ethnographic Research:* Ethnographic studies are qualitative research methodologies in which the researcher involves themselves in a particular social or cultural group to watch and analyze interactions, behaviors, and practices in their natural setting. It is the long-term, continuous observation of participants in their native surroundings. The goal of ethnography is to comprehend the meanings people provide to their surroundings and behaviors (Hammersley & Atkinson, 2019).

Why it could be effective: This method provides a deep and contextual knowledge of how students use Screen Time features in everyday situations and identifies cultural and environmental elements that affect screen-time habits (Hammersley & Atkinson, 2019).
Reasons for not selecting it: It is time-consuming and requires extended access to the lives of individuals. It could not be in line with ethical principles because observation is widespread (Creswell & Poth, 2018).

- *Diary Studies:* In diary studies, participants record their ideas, actions, or experiences throughout time, producing data that is current and representative of their daily life. According to Bolger et al. (2003), this approach records variations and trends that other

conventional approaches could overlook. In this method participants keep a journal in which they document their thoughts and actions around the use of screen time over a predetermined amount of time.

Why it could be effective: This method gives people' experiences with Screen Time tools directly, in real time and aids in identifying regular usage trends and irregularities (Bolger et al., 2003).

Reasons for not selecting it: Diary study mostly depends on participant accuracy and compliance, may result in data that is inconsistent or lacking because of participant boredom or forgetfulness (Zimmerman & Wieder, 1977).

- *Experimental Study:* Experimental studies are frequently carried out in controlled environments, entail adjusting one or more independent variables in order to assess their impact on dependent variables. The purpose of this approach is to prove that one variable causes another (Shadish et al., 2002).

Why it could be effective: The study compares behaviors before and after the intervention to provide quantifiable results and evaluates certain theories on the impact and usefulness of features such as app limits or outages (Campbell & Stanley, 1966).
Reasons for not selecting it: The limited impact of the study on the environment since actions in controlled settings might not be representative of those in the actual world (Shadish et al., 2002).

The chosen methods—survey, semi-structured interviews, contextual inquiry, and heuristic evaluation—were selected because they effectively address our research objectives of understanding both broad trends and individual behaviors of Screen Time.
Other methodological approaches—such as focus groups, longitudinal studies, or diary studies—were not chosen even though they may have offered insightful information due to practical limitations, ethical concerns, or their limited capacity to address our study's combined focus on behaviour and usability.

4.2 Limitations of Mixed-methods

Research using mixed techniques requires a lot of work. It takes a lot of time and work to gather, examine, and combine two different kinds of data into a single study output, therefore, multidisciplinary teams of researchers are more frequently involved than lone researchers. Mixed-methods research can therefore be substantially more expensive than individual investigations (George, 2023).

It can be quite difficult to know how to interpret contradictory outcomes from our research in a mixed methods study. Relying on interdisciplinary teams might cause coordination issues; researchers must be skilled in both qualitative and quantitative approaches (Bryman, 2016). It takes considerable preparation to successfully incorporate qualitative and quantitative components when designing a mixed-methods study. It might be difficult for researchers to choose which approach will be used first or how to combine the findings (Creswell & Clark, 2018). It might be difficult to know what to do next if there is any inconsistency between the quantitative and qualitative results or if we suspect confounding variables. (George, 2023).

It can also be challenging to develop ways to systematically compare the results since quantitative and qualitative data come in two very distinct formats. This puts your data at risk for bias throughout the interpretation step (George, 2023).

4.3 Heuristic evaluation

Usability testing has an international definition in ISO 9241 pt. 11 (ISO in 1998), which states that, “usability is that point in which a product can be used by specific users to accomplish specific goals in a specific context of use with effectiveness, efficiency, and satisfaction” (Sauro & Lewis, 2016).

Usability testing is the process of asking users of a product to perform specific tasks to measure the user's perception of ease of use, uptime, and experience (Niranjanamurthy et al., 2014). Usability testing is a technique to find difficulties and issues that need enhancement within devices (Wood et al., 2021). This also determines whether a product can be utilized by the target audience for the purposes for which it was designed (Lazar et al., 2017). Generality and portability is more important in a globally connected information system than complex additional features and high-end graphics approaches (Berners-Lee, 1989).

User experience (UX) refers to the interface, interaction, and experience of users using the products and services of an organization (Sharma & Tiwari, 2021). The advantages of usability testing is that this approach identifies user needs and tasks early in the design process, balances graphic design with functionality, offers clear evidence for design recommendations, and reduces costs by predicting and addressing potential issues (Niranjanamurthy et al., 2014).

There are several types of user testing, each with different criteria and requirements. For instance, in automatic testing, the product or systems are measured through different software programmes where the measures are already given. For our study, we have used heuristic evaluation, which is expert based usability testing.

4.4 Survey

According to Fritz Scheuren (2004), the term "survey" is most frequently used to refer to a technique for obtaining data from a sample of people. Typically, "sample" represents a small portion of the population under investigation.

The word survey, in its broadest sense, is the organized collection of data on a sample selected from a certain larger group of individuals (Schwarz et al., 1998). Survey methodology is the best tool for collecting quantitative data for our study because it allows us to collect data from a large sample in a methodical manner, which makes it possible to analyze patterns, trends, and relationships across various variables, including the frequency of screen usage, academic performance, and well-being. A survey is a type of data collection process where standardized procedures are employed to gather information, ensuring that each individual is asked the same inquiries in a manner that is more or less consistent (Scheuren, 2004).

The survey is the most effective technique to gather information about your users' demographics and points of view. Researchers can uncover comprehensive characteristics about their users and identify intriguing patterns by employing statistical tools on the results (Goodman et al., 2012). There are numerous methods of conducting surveys, including postal surveys, telephone interviews, face-to-face interviews, and internet surveys (Jenn, 2006). Web surveys offer a number of benefits over traditional survey methods (Fan & Yan, 2010). There are plenty of cases where particular groups and communities exist only online (Wright, 2005). Scientifically valid online surveys can be conducted in the most effective way (Fricker & Schonlau, 2002).

For our research, we have opted for a self-completed questionnaire. The instructions and queries of a self-administered questionnaire should be unambiguous, the questionnaire should be organized logically, and complex filtering should be avoided. The likelihood of respondents providing truthful responses is higher when they are not prompted by an interviewer (Jenn, 2006).

Advantages of the Survey method

Effectiveness in Data Collection: Once surveys are created with standardized and organized questions that facilitate the process, they provide a rapid and effective means of gathering data from huge populations (Scheuren, 2004). Surveys are very effective because they enable researchers to collect data from a large number of respondents quickly (Bryman, 2016). Particularly, online surveys may easily and affordably reach geographically scattered and different audiences (Fowler, 2014).

Application: Researchers can extrapolate findings to a broader population by using surveys to gather data from a representative sample (Groves et al., 2009). This strength is especially crucial

for research that wants to draw conclusions at the population level or comprehend big trends. Surveys offer information that can be applied to a broader population if the sample is carefully selected, increasing the validity of inferences and the validity of results made from survey data (Scheuren , 2004)

Diverse Data Collection Techniques: Researchers can choose the best method for their audience and budget by using surveys that can be sent by mail, phone, internet, or in-person interviews (Scheuren , 2004). Using surveys we can investigate both specific and exploratory findings by using surveys that support a variety of question forms, such as open-ended and closed-ended (likert scales, multiple choice) questions (Bryman, 2016).

Independence and confidentiality: Surveys that guarantee the privacy of respondents might lessen bias since honest answers are more likely to be given by participants, particularly when discussing delicate subjects, which increases the data's trustworthiness (Scheuren , 2004). When anonymity is guaranteed, respondents are frequently more inclined to answer honestly in surveys, which lowers the possibility of social desirability bias (Tourangeau et al., 2000). Because of this, surveys are especially helpful for discussing sensitive topics.

Affordability: Compared to other techniques like focus groups or interviews, which demand more resources for transcribing and facilitation, surveys—especially those conducted online—are more affordable (Groves et al., 2009). Surveys are comparatively less expensive than other data-gathering techniques, such as in-depth interviews, especially when they are used to reach a sizable and widely distributed sample (Scheuren , 2004)

The Limitations of Surveys

Quantitative data is frequently gathered using surveys, however they have some significant drawbacks:

Limited Depth: Although open-ended questions can provide more detail, they are not as commonly employed since it can be challenging to analyze qualitative replies. Because of their organized framework, surveys frequently fall short of capturing the depth and complexity of participants' experiences or motives (Bryman, 2016).

The Possibility of Misunderstanding: There is no chance to address any questions that are unclear if the interviewer is not there. Data may be inaccurate or untrustworthy as a result of participants misinterpreting questions (Fowler, 2014).

Non-Response Bias: Low response rates are a common problem for surveys, particularly those conducted online. Biased results may result from systematic differences between respondents and non-respondents (Groves et al., 2009).

Absence of Background: The situational or contextual aspects impacting participants' behaviors and opinions are frequently overlooked by surveys, which concentrate on numerical data (Creswell & Clark, 2018).

Lack of adaptability: A survey cannot be modified to examine new themes or problems that surface during data collecting once it has been distributed (Fowler, 2014).

4.4.1 Close-ended questionnaire

The core component of a survey is its questionnaire (Krosnick, 2018). A questionnaire is a set of inquiries that enables a diverse group to provide an organized description of individuals (Goodman et al., 2012).

One of the initial choices a researcher must make when creating a survey question is whether to make it open-ended (allowing respondents to answer in their own words) or closed-ended (requiring respondents to choose an answer from a predetermined list of options) (Krosnick, 2018). Even an enthusiastic participant when a longer questionnaire progresses participants lose their nerve eventually (Galesic & Bosnjak, 2009).

A closed-ended questionnaire limits respondents to selecting predefined response options from a provided list of alternatives. By employing a structured method, the range of possible replies is standardized, resulting in enhanced manageability of responses and improved comparability of data (Bryman, 2016).

The questionnaire was created to objectively investigate how university students use iPhone screen time management, with an emphasis on usage patterns, attitudes, and how well the platform controlled unnecessary phone use. In order to gather accurate information for thorough analysis, each segment of the questionnaire is in line with a certain research question. Demographic information, particular usage trends, reasons, and the perceived usefulness of screen time features are all included in the questions. This framework makes it possible to comprehend user involvement clearly and assists in identifying obstacles to efficient screen time management.

In the initial part of the questionnaire, we have included a part mentioning the aim of the survey, approximate time duration and confidentiality declaration. We have made use of different types of questions such as multiple choice, single choice questions, and Likert scale and made sure that the options provided for each question are comprehensive (Jenn, 2006).

Likert-scale questions on productivity and self-awareness examine user attitudes about screen time tools quantitatively by evaluating user perceptions and behavior change. In order to capture a variety of factors that impact screen time habits, the survey is divided into parts on usage

frequency, self-awareness, and perceived productivity. This allows for both a behavioral analysis and an investigation of design flaws in the current solutions.

When selecting questions, we have taken into account our research questions. The questions were carefully crafted to gather an extensive array of data on how university students utilize the iPhone's screen time. The questionnaire consisted of parts that covered demographic information, overall usage habits, interactions with the platform's features, and user satisfaction and feedback.

Since the introduction of electronic mail (e-mail) and the World Wide Web (Web or WWW), the Internet has expanded the field of surveying. Nowadays, it is now possible to provide a URL to a website that contains the survey instead of mailing a paper copy. Or, in an email survey, a questionnaire may be emailed to a respondent as an attachment (Fricker& Schonlau, 2002). The survey was circulated using several online channels, such as Reddit, Facebook, and WhatsApp groups, in order to reach a wide audience. The selection of these platforms was based on their significant and engaged user bases as well as their capacity to reach niche audiences that are iPhone users. For instance, on Reddit and Facebook, posts were made in groups dedicated to technology, media, and digital tools, while WhatsApp groups included community and university groups. The survey was administered online via Microsoft Forms, which allowed for easy dissemination and data collection. Additionally, there is also some disadvantage of collecting data through data that people sometimes do not feel motivated and that results in longer time for data collection (Reja et al., 2003).

Based on the article of Fricker & Schonlau (2002), here are the advantages of Online Survey

Quicker: Since online questionnaires are disseminated and completed digitally, eliminating the delays that come with postal mail, they allow for faster data collecting. Because surveys are sent to respondents immediately, researchers may get answers more rapidly, cutting down on the total amount of time needed to administer the survey.

Higher quality: By using standardized questions that minimize interpretational variance, surveys provide researchers the chance to improve the quality of their data. Data quality increases when online surveys have features like question branching and real-time validation because they reduce user error and enable researchers to get thorough, precise replies.

More affordable: Since digital surveys eliminate the need for paper, printing, and shipping, they are incredibly economical. Because replies are automatically recorded electronically, they also save money on data input, which is especially advantageous for big samples.

Simple: Respondents may complete online surveys on a variety of devices at their convenience, making the process simpler. Additionally, researchers may easily conduct and monitor surveys from a distance, and automated data input makes it possible to integrate replies seamlessly,

which minimises labour and error in the data gathering process.

Moreover, we also had a very limited time. To speed up the process and gather a substantial amount of data, we have circulated some printed copies and posters with QR codes of our Microsoft form questionnaire and distributed them in different sections of university campuses. After collecting data from there, we have input them in the web form and analysed them later.

4.4 Interview

The goal of qualitative research is to offer comprehensive insights and comprehension of problems in real life (Moser & Korstjens, 2017). Qualitative interviews are a flexible and effective method for capturing the voices and how individuals perceive their experiences (Rabionet, 2011). Qualitative data collection technique through interview is beneficial in a variety of methodological approaches. Many research problems can easily be addressed by using qualitative interviews (McGrath et al., 2018).

Qualitative Component: Semi-structured interviews were conducted to obtain deeper insights into how students interact with these tools, their suggestions for improvements, and how subtle nudges can be designed to promote healthier phone usage.

4.4.1 Semi-structured interview

The semi-structured interview uses a combination of open-ended and closed-ended enquiries, frequently with additional queries on how or why (Adams, 2015). Semi-structured interviews are becoming more and more common in research. Through qualitative interviews, researchers may delve deeply into topics specific to the respondents' experiences and gain an understanding of how various phenomena of interest are experienced and interpreted (McGrath et al., 2018).

Typically, semi-structured is considered an in-depth interview; instead of using a list of closed questions, the interviewer will guide the conversation with subjects and open-ended enquiries (Allmark et al., 2009). One of the main advantages of semi-structured interviews is that they allow for concentration while allowing the interviewer to freely explore relevant concepts that may arise throughout the interview (Adeoye‐Olatunde & Olenik, 2021).

Advantages of Semi-structured Interview

A combination of open-ended and closed-ended questions are permitted in semi-structured interviews, allowing interviewers to delve deeply into subjects while pursuing them with follow-up enquiries for further information. This adaptability is especially helpful when investigating unfamiliar or challenging topics (Adams, 2015).

Semi structured interviews involve asking the respondent prepared questions while at the same time allowing the respondent to provide more information on other issues of concern during the interview. This flexibility aids in the discovery of latent patterns of participants' thinking and feeling (Bryman, 2016).

Semi-structured interviews allow interviewers to record respondents' autonomous thoughts without being influenced by group dynamics, which is sometimes a drawback of focus groups (Adams, 2015). Further questions developed from the initial questions may be directed to the participant in an effort to gain better insight to the topic of discussion (Cohen et al., 2017).

Semi-structured interviews allow participants to give their opinions freely This is because Unlike structured interviews where the questions are rigid that participants are forced to answer the questions in the manner prescribed by the researcher; semi-structured; interviews enable the participants to be more frank when responding to questions (Gill et al., 2008).

According to Adams (2015) The semi-structured interview method works well when discussing delicate or private subjects, since people may be more forthcoming and truthful in one-on-one interviews than in a group context. The interviewer can go into unexpected but significant topics that come up throughout the discussion, enabling a deeper comprehension of the topic.

This approach affords rich quality data exploring aspects of the participants' feelings, intentions, and the events they have undergone. It allows participants to explain, expound on their responses, thus gaining a better grasp of multimodal events. (Kallio et al., 2016).

Disadvantages of Semi-structured Interview

Semi-structured interviews take a lot of time to conduct, including preparation, interviewing, and data analysis. Especially when contrasted with more standardized techniques like surveys, this procedure can be time-consuming (Adams, 2015). Semi-structured interviews may require a reasonable amount of time, and even more, if the interviewer has the opportunities to ask additional questions to the participants. Semi structured interviews are time consuming, and require a lot of effort in conducting, transcribing and analyzing data collected from the interviews (Bryman, 2016). Given the open-ended or naturalistic nature of the data it suggests the use of thematic or qualitative analysis which can be but is also cumbersome and time consuming (Cohen et al., 2017).

In order to follow the discussion and yet obtain important information, interviewers must be very skilled, sensitive, and educated about the subject (Adams, 2015). Newcomers in the interviewing profession may have challenging times trying to find the middle ground between order and freedom. According to DiCicco-Bloom & Crabtree (2006), the quality of the data collected is based on the interviewer's skills of asking questions, following them up, and keeping off any leading questions that can bias the participant's response.

Some of them are based on simple observations and/or questionnaires completed on cam by a limited number of participants. The data collected from the semi-structured interviews and coded in great detail, and with attention paid to the context might not be very translatable to broader populations of patients (Gill et al., 2008). Semi-structured interviews are usually done with lower sample numbers due to the time and resources necessary, which may restrict the capacity to generalize findings to a wider population (Adams, 2015).

According to Adams (2015) it can be challenging to analyze data from semi-structured interviews since the replies are open-ended and require careful coding and theming, which can increase the research's complexity and time requirements.

4.5 Contextual Inquiry

Contextual inquiry is an anthropological field study method that entails closely observing and interviewing a limited number of users to obtain a comprehensive picture of their work practices and behaviors (Salazar, 2024). Contextual inquiry includes observing and analysing work processes in their natural environments, which has various advantages over traditional approaches like interviews and surveys (Karen & Sandra, 2017). This method is an important approach toward knowing who people truly are and how they operate a product or system daily (Holtzblatt & Beyer, 2014).

Whereas, traditional qualitative methods like surveys and interviews often depend on users' recollection and description of past processes, which may result in the omission of critical insights such as users' reasoning, motivation, and mental models, ultimately providing researchers with only a superficial understanding of the user experience (Salazar, 2024). Users can better describe their actions and thoughts during task engagement, making contextual inquiry a more successful way for obtaining richer and more relevant insights than self-reported data or lab-based research methodologies (Salazar, 2024). The strength of this technique is that it identifies unexpected, habitual, and low-level elements such as disruptions, superstitious habits, and illogical procedures that affect user experience (Salazar, 2024).

Strengths of Contextual Inquiry

Practical Perspectives: Contextual inquiry reveals information that respondents might miss or find challenging to express in surveys or interviews. It provides contextualized and genuine insights by capturing how participants complete activities in their real-world settings (Holtzblatt & Beyer, 2017).

Consider Unconscious Requirements: Contextual inquiry enables researchers to see interactions and activities that participants might not be aware of, exposing possibilities and problems that

are hidden (Kuniavsky, 2003).

The User-Centric Approach: It places a strong emphasis on working together with participants to make sure the results are based on practical applications and user requirements (Holtzblatt & Beyer, 2017).

Flexibility: The method enables researchers to make dynamic adjustments to questions or observations in response to participant replies and activities (Rogers et al., 2011).

Weaknesses of Contextual Inquiry

Contextual inquiry has some drawbacks despite its advantages:
Time-consuming: Large-scale studies cannot benefit from contextual inquiries since they take a lot of time and effort to conduct and analyze (Holtzblatt & Beyer, 2017).
Minimal Sample Sizes: Contextual inquiry usually involves fewer participants due to the method's intensive character, which may restrict the findings' generalizability (Rogers et al., 2011).

The intrusiveness: Participants' typical behaviors may be disturbed or they may become self-conscious when observed in their usual settings, which might have an impact on the findings (Kuniavsky, 2003).

Relies on Researcher Proficiency: The researcher's capacity for successful observation, interaction, and data interpretation is critical to the success of contextual inquiry. Untrained researchers could contribute bias or miss crucial facts (Rogers et al., 2011).

Four grounding principles of Contextual Inquiry

The method of contextual inquiry is based on four grounding principles: Context, partnership, interpretation and focus. Each one of the principles defines a different aspect of an interaction with the participant to learn about their work (Beyer & Holtzblatt, 1999).

- *Context:* As the name suggests, this is the most fundamental requirement for a contextual inquiry (Beyer & Holtzblatt, 1999). The context guides the researcher to go around and observe the participants in their natural environment, where they usually use the product or system (Salazar, 2024).
- *Partnership:* The aim of the partnership is to make the researcher understand the work of the participant (Beyer & Holtzblatt, 1999). In traditional interviews, the interviewer holds much more authority than the participants. However, in this type of inquiry, the whole session and the content of discussions should not be controlled by researchers; rather, both parties should have the whole session, and the content of discussions should not be

controlled by researchers. The two parties should have the possibility of directing their discussion towards the goal (Salazar, 2024).

- *Interpretation:* In order to understand the meaning of the activities and the structure of the user's work, it is not enough to observe and return the observations and interpretations (Beyer & Holtzblatt, 1999). A comprehensive and consistent interpretation of all major aspects of the work, supported by user feedback, should be developed by researchers (Salazar, 2024).
- *Focus:* Focus instructs the interviewer on what to look for that fits with the project goal. (Beyer & Holtzblatt, 1999). Researchers should be well versed with the purpose of the inquiry (Salazar, 2024).

There are different models to use for doing contextual inquiry such as the Master apprentice model, post work interview, and artifact walkthrough. For our research we have used the Artifact walkthrough.

Artifact walkthrough is arguably the most prevalent method for exploring user data. This typically means asking either an individual or a group of individuals to recreate a certain process for the researchers, utilizing artifacts from the real process to refresh their recollections (Raven & Flanders, 1996).

To guide our artifact walkthrough we have essentially followed Raven & Flanders (1996) steps and procedure.

Work among researchers to identify key users

As researchers, we have taken the decision by talking among ourselves how and where we might get the participants who use iPhone's screen time. Following our semi structured interview we wanted to explore how users manage their Screen time features to know their actual interaction with the screen time. This includes understanding their typical behaviors and workflows while using the system which will help us explore and evaluate their usage and feedback regarding usability of the screen time.

Arrange visits

Firstly, we got the interview participants from the survey, where they provided their contact who are interested in the interview, later we asked them in the interview if they want to participate for further study, thus, we got 4 participants for our contextual inquiry.

For contextual inquiry, we interviewed participants from semi structured interviews. Participants 3, 4, 6 and 8 from Table 1, agreed to participate for contextual inquiry.

Set the focus for the visit

One strategy for setting focus that works at Digital is to have a meeting of the individuals participating (Raven & Flanders, 1996). One person from our group has been the facilitator of the inquiries and talked with the participants about the purpose of the inquiry. Before going into the actual inquiry, we brainstormed questions to set the direction as a part of our preparation.

The questions were open-ended and were all written in notes first. We identified a series of questions to understand their behaviors, workflows, and how they experienced the platform.

After that, we combined the questions into two segments (tasks), for task 1 we asked the participants to walk us through the screen time report.

Conduct the visit

For conducting the inquiries, we have taken advantage of Zoom, accessed through our university mail, to ensure an uninterrupted session. We have chosen the inquiries to be online because of the convenience of the participants. To ensure the context of the inquiry, we have asked them to perform different tasks in the Screen Time. We have taken an artifact walkthrough that has three parts, like most other contextual inquiry processes (Raven & Flanders, 1996).

- **An introduction**

We have started the initial part of the inquiry by introducing ourselves. This included briefly describing who we are and what the purpose of the inquiry and the research were. We also made it clear that they were the experts and whatever they would do was correct, as they were in complete control of the inquiry. Additionally, we informed them that the inquiry was slightly different from the traditional interviews and that we would strictly make inquiries by observing how they use Screen time generally and perform the tasks, keeping our focus in mind. Finally, we obtained consent from them in terms of recording the videos and using the data for our research purposes.

- **An inquiry about the work**

The inquiry about the work is the step where the different relevant Inquiry strategies vary the most (Raven & Flanders, 1996). For our inquiry technique, we observed the participant while they were using "Screen Time", and we asked them questions regarding their previous use of the artifact and the strategies they generally follow while *reviewing the report*, setting specific features like *App Limit*. We have used our previously brainstormed open ended questions to ensure the *Focus.* of the inquiry remains intact. This allowed us to know many underlying information regarding the users strategies regarding our focus area. We have continuously asked them what they were doing and whether their expectations aligned with the current system. Almost all the users were talking freely and they shared plenty of information about their typical

usage of Screen Time which was important to establish *a partnership*. Our sessions typically lasted 30-40 minutes for this part. As there are 4 people in the team and to ensure comfort of a participant we divided ourselves into two teams and conducted the interview. Even though we were recording, one of us asked questions during the interview and the other one took the notes as it is recommended by Raven & Flanders (1996).

- **A summary of the shared understanding**

Once we were done with the inquiry, that was the time where we wrapped up the whole inquiry from our part. We have talked about our learnings gathered throughout the inquiry. This also included the note taker clearing the doubts and assumptions. Finally, we asked them to add anything if we have something in our notes.

Analyze the information from the visit

Analyzing the data gathered from the actual inquiry is necessary for ensuring *Interpretation.* We have thoroughly gone through the data and notes gathered from the information and analyzed them to find the interpretation. The whole procedure and the result have been described in the following chapter.

4.6 Validity and Reliability

Since obstacles to validity and reliability can never be totally eliminated, their impacts can be minimized by paying close attention to these factors throughout the course of a study (Cohen et al., 2017).
It is important to judge the quality of study if the results are to be put into practice and used to further study (Noble & Smith, 2015). The application of concepts like reliability, validity, and generalisability usually connected to quantitative research and relating these to qualitative research is often complex (Noble & Smith, 2015). As our research is a combination of both qualitative and quantitative studies, we will discuss validity and reliability for both types of studies.

Validity

Validity can be defined as the degree to which the results obtained in the study represent the phenomenon being investigated in the study and can be generalized in the similar settings (Patino & Ferreira, 2018).

Triangulation: We applied the convergent parallel design approach, which enabled data collection and analysis from both qualitative (semi-structured interviews and contextual inquiry) and quantitative (survey) sources. This approach enabled validation and enhancement of the believability of the discoveries made (Creswell & Clark, 2018).

Participant Validation: All data collected during contextual investigations were deemed accurate by the participants as they validated the observations and insights made (Noble & Smith, 2015).

Researcher Discussion: This procedure is common in mixed-methods research where data and results are descriptively and interpretively analyzed, codes are reconciled, and biases are controlled by presenting findings to members of the cross-disciplinary research team (Bryman, 2016)

Diverse Sampling: Subjects were chosen in terms of their age, academic major, and the amount of time they spend in front of computer screens. This diversity enhanced the possibility of generalising those findings to other populations (Yin, 2018).

Prototype Testing: By including new users during the prototype testing in addition to the individuals that were interviewed initially, we were able to consider generalisable insights that included multiple user behaviors and preferences for external validity.

Reliability

A key element of quality is Reliability which depicts the degree to which measurements which are made by an investigator, scientist or researcher are accurate and stable, comparable, and repeatable when the research study is repeated under the similar circumstances (Moss, 1994). Reliability in our study was ensured by procedural consistency and procedure documentation.

Standardized Data Collection: Surveys were developed with standardized and clear questions while CI was guided by specific agreed upon observation and notation techniques. This reduced variation in data collection processes and made it easy to compare the different participants that were involved (Fowler, 2014).

Consistency in Analysis: Thematic analysis was conducted with reference to an agreed coding manual so as to enhance the inter-observer reliability in as far as the themes and sub-themes were concerned. This approach also reduced subjectivity of the results as well as agreement about the data (Nowell et al., 2017).

Transparent Documentation: Every stage of the survey design, interview, and analysis was carefully recorded. It enables other future researchers to begin from the same point where this study was conducted and under similar circumstances (Noble & Smith, 2015).

Convergent Parallel Design: Combining the quantitative and the qualitative data and analysing them independently yet arriving at similar conclusions, we established the credibility of the data obtained from the different sources (Creswell & Clark, 2018).

The high level of validity and reliability shown throughout the study is therefore a demonstration that the results are trustworthy, reproducible, and generalisable to practice settings. This approach refined not only the quantitative data but also the qualitative results, promoting the advancement of the study of user behaviour and the efficiency of the Screen Time tool.

4.7 Ethical and Legal Considerations

We tried to follow and maintain ethical and legal aspects that come along with the research, which involve humans throughout our whole research. Both of our data collection methods involved collecting data from the population sample. In our quantitative study, we have added a small description of the purpose and procedures of the study before the actual questions related to the study focus.

Similarly, in the semi-structured interview and the contextual inquiry, there was a small narration of how and why the data will be collected. Additionally, we made them aware of the way we were going to use their data. We also informed them about their role and rights in this. We have guaranteed confidentiality and anonymity by anonymising and securely storing data that complies with the rules of General Data Protection Regulations (GDPR). We have taken clear and concise consent from the participants. We maintained the protocol for handling sensitive information with awareness and transparency. Finally, we aim to communicate our findings with the participants for acknowledgements.

Ethical standards

Ethical issues regarding the balance of power and the possibility for change in respondents' personal activities and decisions following the interview are addressed, as well as the idea of really informed consent is challenged. (Husband, 2020)

Informed Consent

Before the interview starts, we will obtain informed permission from the participants. We will also let them know about the goals of the research, the subjects that will be covered, and any possible effects on their time or feelings (Allmark et al., 2009). Additionally, there are no penalties for participants who withdraw at any moment.

Confidentiality and Privacy

We will let them know that all information will be securely saved and that their personal data will be anonymized, because protecting participants' privacy is so important. Additionally, confidentiality will be upheld during data storage, dissemination, and transcribing. As a result, we must guarantee the confidentiality of all replies, identify participants using fictitious names, and exclude any personally identifiable information from reports (Husband, 2020).

Minimizing Harm
We must create a setting that is welcoming for participants, as it is necessary to prevent emotional or psychological harm during the interview process (Allmark et al., 2009). If they feel upset or uneasy, we must offer a break or discontinue the interview.

Power Imbalance
In order to prevent pressuring participants into disclosing more than they would like to, we will remain impartial and refrain from asking probing questions. We will give participants the freedom to lead the conversation and concentrate on subjects they find interesting.

Transparency and Feedback
We will make sure participants are aware of the consequences of their involvement and provide them with transparency on the usage of their data when the study is finished. Giving them feedback after the interview might encourage their participation in the study (Husband, 2020).
We also make sure the participants understand exactly how the information will be examined and shared.

5. Analysis and Findings

The analysis chapter conducts a detailed assessment of university students, utilising iPhone Screen Time management toolkit, employing mixed-methodology questionnaire survey of respondents, semi-structured interviews, heuristic evaluation, and context inquiries. Based on the above methodologies, the findings are grouped to reflect on the user behavior and experience, issues and the efficiency of the tools.

This chapter thus makes it clear that while the iPhone Screen Time tools can be quite useful in managing overuse behaviors, they are only partially useful. It combines the quantitative and qualitative data to give a more comprehensive insight into users' needs and shed light on the tangible steps toward increasing the tool efficiency and usage.

5.1 Participants

Survey
112 university students in all took part in the survey, which investigated iPhone screen time management features and how they affected students' personal and academic life. The target demographic was made up of engaged university students who owned and used iPhones, making them a suitable sample for investigating productivity and digital well-being. Convenience

sampling was used, making it possible to recruit students easily through social media platforms and printed QR code posters across the universities.

Respondents' gender, academic level, and daily iPhone usage were among the demographic data gathered. Potential variations in screen-time behaviours among demographic groups were examined using this data.

Semi-structured interviews

Eight participants were chosen through a purposive sample of survey respondents for in-depth, semi-structured interviews as part of the qualitative component. Participants were divided into three groups—low, moderate, and high—according to how much screen time they used in order to capture a wide variety of user experiences. This classification enhanced the study by enabling a comparative examination of screen time habits at various usage intensity levels.

Each group's participants were invited to go into further detail about their experiences, reasons for using the screen time tools, and opinions about them. This allowed them to shed light on how different screen time levels affected their use of the tools.

This sample size was chosen to ensure a variety of viewpoints while preserving data management by achieving a balance between data quality and the needs of practical analysis.

Complementing the survey results, these qualitative data, which were grouped by user level to emphasize various needs and perspectives, provided a nuanced understanding of students' motives and difficulties in limiting screen usage.

Contextual Inquiry

The contextual inquiry has been conducted after the interview to understand the user based on certain tasks on Screen time.

5.1.1 Data Collection Tools

A structured survey conducted using Microsoft Forms for quantitative data and a semi-structured interview guide for qualitative insights were the two main data collection strategies we used for our study to thoroughly investigate university students' use of iPhone screen time management tools. These resources made it possible to use a mixed-methods approach for our study, documenting general trends and specific individual experiences with screen time management.

1. Survey (Microsoft Forms):

Microsoft Forms was used to administer the structured survey, making it easier to distribute and gather responses from a sizable sample. Microsoft Forms is a free web-based platform and can be used on any devices without having any accounts. Microsoft forms offer preliminary visualizations and summary statistics, which are essential for obtaining an easy overview of the

data. Besides, the data collected from Microsoft forms automatically give the options of seeing the data in the Google Sheets, which facilitate efficient data analysis and management. Google sheets eased the initial data cleansing process.
By providing a shared link, Microsoft Forms made it possible for participants to view and complete the survey on a variety of devices. The survey's layout had sections on:

Demographics: In this section, participants' gender, levels of education, and daily iPhone usage were collected. Analysis of screen time habits across demographic groups was made possible by this data.

Using a Screen Time Management Tool: Students were asked about how often they used certain iPhone screen time capabilities (including App Limits, Downtime, and Screen Time Reports), why they used them, and how often they used them.

Behavioral patterns and perceptions: This section examined self-reported participation in unnecessary activities, awareness of use trends, and opinions of how well screen time tools work to reduce distractions and boost output. Respondents' opinions about the usefulness of self-awareness elements, visual reports, and reminders in screen time tools have been evaluated via Likert-scale items.

2. Semi-structured interview guide

To obtain detailed qualitative insights from a sample of 8 participants chosen according to their screen time consumption levels (low, moderate, and high), a semi-structured interview guide was created. Open-ended questions from the interview guide included subjects like:

Detailed Use of Screen Time Features: The purpose of the questions was to learn how participants used particular technologies and under what conditions they found them useful or difficult.

Motivations and Perceived Effectiveness: Participants were questioned on the reasons for their use of screen time management tools as well as the perceived value of these resources in preventing distractions and promoting academic focus.

Obstacles and Recommendations for Enhancement: This segment examined any challenges that participants had with the instruments and their recommendations for possible enhancements or new functionalities.

The conversational flexibility provided by the semi-structured format made it possible to ask follow-up questions and get more in-depth information depending on each respondent's unique response (Adams, 2015)

Based on Adams (2015), the key steps we followed conducting semi-structured interviews are

Choosing Interview Participants and Setting Up Interviews

Participants for our study were chosen using a purposive selection technique in order to collect a variety of viewpoints relevant to our research goals. People who met certain requirements from the survey related to the study's aim, such being users of iPhone screen time, made up the target group. After being identified, respondents received an introduction letter sent through email outlining the purpose of the study, the value of their participation, and confidentiality guarantees. Participants' availability was taken into consideration while scheduling appointments, which encouraged their voluntary and supportive participation in the study.

Creating the Interview Guide and Forming the Questions

To guide the inquiry and provide room for follow-up questions, a semi-structured interview guide was created. Both closed-ended and open-ended questions were provided in the guide:

Closed-ended Questions: These were included to rapidly collect baseline answers and provide background information for future in-depth investigations. For example, participants were asked direct questions on how often they used the screen time tool.

Open-ended Questions: By encouraging participants to expound, these questions provided a window into their own perspectives and experiences. In order to get respondents to think more thoroughly about their attitudes and actions, probing questions like "Can you describe the benefits you've noticed from using these tools?" were employed.

The queries were systematically ordered, starting with generic, insensitive inquiries to establish confidence. To make sure participants felt comfortable sharing criticisms, more delicate questions—like those about possible flaws in the tools—were positioned at the end.

Conducting the interview

Each interview started with a brief summary that explained the goals of the study and the confidentiality statements. The interviewer used a conversational style, promoting sincerity and rearranging the questions according to the conversation's flow. A digital recorder was utilized to capture the whole conversation after participants gave their consent to be recorded. In order to ensure that important words and non-verbal clues were recorded, thorough notes were collected during interviews that were not recorded. The semi structured interview approach's adaptability enhanced the depth of insights obtained by enabling the interviewer to explore unexpected subjects when appropriate (Adams, 2015).

Data analysis

To find recurrent themes and patterns in the interview responses, a *thematic analysis* was carried out after the data was collected. Example quotes were chosen to give specific instances of

participants' experiences, and key topics were arranged according to the research questions. This method supported a nuanced assessment of screen time tool usage by allowing the integration of qualitative data into coherent conclusions (Adams, 2015).

Reporting the findings

The findings were presented with a summary of the topics and a selection of statements from the participants that concisely reflected shared experiences or original ideas. This method provided a deeper knowledge of how users engage with screen time control programs by highlighting broad trends while also illustrating the intricacy of individual perspectives.

Table 1 : Participants Profile

Participants	**Occupation**	**Gender**	**Level**
Participant 1	Thesis student	Male	High
Participant 2	3rd semester student	Female	Moderate
Participant 3	2nd semester student	Male	Low
Participant 4	1st semester student	Male	Low
Participant 5	1st semester student	Male	Moderate
Participant 6	3rd semester student	Female	Low
Participant 7	Thesis student	Female	Moderate
Participant 8	Thesis student	Male	High

5.2 Heuristic Analysis

We have followed the book ‘Usability Inspection Method, 1994’ edited by Jakob Nielsen and Robert L. Mack to understand the usability inspection method and its proper application. Nielsen's 10 Usability Heuristics served as the framework for our heuristic analysis of the iPhone Screen Time Management tool. The user interface (UI) and user experience will be the basis for reviewing each heuristic.

Step-1:

5.2.1 Heuristic Principle Applications

Table 2: Heuristic Principle Application

Heuristics	Principles Applied
Visibility of System Status	Yes
Match Between the System and the Real World	Yes
User Control and Freedom	Yes
Consistency and Standards	Yes
Error Prevention	Yes
Recognition Rather than Recall	Yes
Flexibility and Efficiency of Use	Yes

Aesthetic and Minimalist Design	Yes
Help Users Recognize, Diagnose, and Recover from Errors	Yes
Help and Documentation	Yes

So, we have found all the heuristics to be applied to which are aligned to our review. Two of our group members work on the evaluation to identify the issues.

Deciding the Evaluators and discussing the process

It is ideal to have more than one person to participate in a heuristic evaluation (Nielsen, 1995). It was determined that two of our group members would carry out the evaluation. In this stage, we looked at each of the chosen heuristics separately. To ensure that we both understood the evaluation process, we had a fundamental understanding of the heuristics between us. In order to practice, we completed a sample evaluation with pen and paper. The interface of the iPhone Screen Time Management tool and the typical activities that users engage in were observed.

Selecting a specific process to conduct the evaluation

In this step, we systematically evaluated our observation using the Nielsen Norman (1995) groups heuristics workbook. As a result, we can find precise and clean data regarding our observations.

Defining the scope

To narrow down the evaluation we have defined our tasks. We decided what to observe. How long to observe and what we are looking for.

Step-2

Understanding the subject

Firstly we observed the iPhone Screen Time Management tool common activities; how it interacts with users, how users can get involved with the interface and how it works as an application.

Looking for Issue

In this phase we looked for the issues that Screen Time deals with the users. We figure out how users interact with Screen Time to manage. We, being a user, found what a general user might face using the interface.

Here is a sample workbook to show how we have done the evaluation:

5.2.2 Evaluation Workbook

Table 3: Heuristics Evaluation Workbook

Heuristics	Issues	Recommendations
Visibility of System Status	It's not well communicative	The design could have been more communicative regarding its state
	The tool may be less able to notify users immediately when they surpass their restrictions if there are no real-time updates.	Immediate notification with real time updates might be implied
Match Between the System and the Real World	Simple terms like "Daily Average," "App Limits," and "Downtime" are used in the Ui. These phrases fit the user's mental models	N/A

	for screen time management.	
	Yes, it uses real world words and familiar phrases and also the logo that people can connect mostly.	N/A
User Control and Freedom	Although the tool lets users establish limitations, there is not much room to change them in case something goes wrong (for example, setting app limits too low by accident).	More flexible and clear choice might be established.
	Although it is available, the option to temporarily disregard or alter limitations is not very noticeable, and users may not find it easy to adjust or reverse the limits they have established	
Consistency and Standards	Yes, the common signs, logos and other things are conventional and consistent.	N/A
	The tool's consistent icons, motions, and design patterns align to iOS design standards. The language	N/A

	and modes of engagement match with other elements of the iPhone..	
Error Prevention	Insufficient recommendations or cautions when limiting screen time or setting ineffective limitations.	Notification with consequences might be implied
	There are no obvious notifications altering users to the consequences when they completely disable Screen Time.	
Recognition rather than recall	A large portion of the Screen Time tool's functions are easy to locate and don't require users to commit specific procedures to memory.	N/A
	If it's not about deep customization it actually helps users in-context	In case of deep customization the design might need some adjustment
Flexibility and Efficiency of Use	Some ideas can be formed to speed up the user experience	To speed up the process of establishing restrictions based on past usage trends, some automation could be included.

	Advanced users have limited options for changing settings.	
Aesthetic and Minimalist Design	The design of the tools is simple and tidy	N/A
	The data visualize and charts are straightforward.	N/A
Help Users Recognize, Diagnose, and Recover from Errors	Lack of thorough instructions for limit adjustments and inadequate errors recovery alternatives.	
	There are no comprehensive error warnings or instructions provided by the tool when users set improper limitations or disable key features.	context-sensitive, real-time warnings that identify and notify users when they have disabled or set in conflict restrictions might be implemented.
Help and Documentation	Yes it is easy to search the ‘help’ but,	
	Absence of thorough, easily available assistance documentation.	A comprehensive and easily accessible help documentation can be added

Step-3

Synthesizing Identified Issues

We had another discussion after completing the individual assessment. Affinity diagramming was used to synthesize the problems. Using a whiteboard, we managed to identify the areas that we both saw and agreed upon. On the whiteboard, we discussed the problems we encountered with the design and drew our conclusions. After that, we completed the evaluation by summarizing the problems.

Exception

We did not notice any significant differences.

5.2.3 Summary of Heuristic Evaluation

1. **Visibility of System Status**

The visibility of system status is a fundamental concept of user interface design that shows the need of always providing users with the most up-to-date information about a system's operation. Alerting users about their actions and the content they are reading is crucial. Users should always receive quick and relevant feedback from the system to keep them up to date about the system activities.

By dividing screen time into categories such as social networking, entertainment, and productivity, the iPhone Screen Time feature provides users with an in-depth understanding of their weekly and daily usage patterns. Instead of getting constant notifications on consumption milestones or overuse warnings, users must manually open the app to monitor updates, so real-time feedback is not constantly available. The tool may be less able to notify users immediately when they surpass their restrictions if there are no real-time updates.

2. Match Between System and the Real World

A fundamental element of user interface design is the concept of a match between the system and the actual world, which emphasizes the need of designing interfaces that complement the user's cognitive image and the tasks they are used to completing in real life. Instead of utilising system-oriented terminology, the system should communicate with users in their native language, using words, ideas, and concepts that they recognise.

Simple terms like "Daily Average," "App Limits," and "Downtime" are used in the UI. These phrases fit users' mental models for screen time management and are easy to understand. For this heuristic, no major problems were identified.

3. User Control and Freedom

The user control and freedom principle in user interface design is concerned with allowing humans to move around and interact with systems in ways that are appropriate for their needs and aims. This concept highlights the need of allowing people to explore and interact with interfaces without feeling constrained or contained. It is frequently related with Jakob Nielsen's (1995) usability criteria. Users often make mistakes and desire a simple "emergency exit" to get out of an unfavourable situation without having to go through a lengthy procedure.

Despite allowing users to set limitations, the tool does not provide for much flexibility in case something goes wrong (e.g., accidentally setting app limits too low). While it is possible, users may find it difficult to change or undo the limits they have set, and the option to temporarily ignore or modify limitations is not evident. Insufficient flexibility and confusing choices for temporarily avoiding enforced limits.

4. Consistency and Standards

In considering a component of UI design, Uniformity and Standards emphasizes the need of maintaining coherence and uniformity throughout a system or application. To enhance usability and user experience, this notion emphasizes the benefits of adhering to recognized patterns and standards. It is frequently linked to the usability heuristics developed by Jakob Nielsen. The meaning of certain phrases, circumstances, or behaviors shouldn't be unclear to users.

The tool's consistent icons, motions, and design patterns align to iOS design standards. The language and modes of engagement match with other elements of the iPhone. No significant problems with consistency.

5. Error Prevention

Reduce the issues' potential to negatively affect the app's user experience. One of the fundamental concepts of user interface design is "error prevention." This concept helps to keep

the issue from occurring. A thoughtful design that stops an issue before it starts is even better than having effective error messages.

Although certain safeguards are in place (such as default daily limitations and notifications when limits are approaching), more should be done to stop users from inadvertently setting limits that are too tight or relaxed. Insufficient recommendations or cautions when limiting screen time or setting ineffective limitations. There is one significant issue which has been identified: that if anyone wants to turn off the screen-time for some time, all of the previously recorded data will be removed completely when they turn on the feature again. However, there is no instruction indicating this while anyone tries to turn off their screen time feature.

6. Recognition Rather Than Recall

Recognition and recall differ in how many clues are used to aid memory retrieval; recall uses fewer cues than recognition. The reason recognition is easier than recall is that it involves more cues. These cues increase the activation of the answer, spread activation to related material in memory, and increase the likelihood that you will choose it. This explains why multiple-choice questions are easier than open-ended enquiries that require the respondent to think of an answer (Budiu, 2024). Objects, actions, and options should be highlighted to minimize the user's memory load.

Much of the Screen Time tool's operations are simple to find and don't require users to memorize particular processes. Although the basic dashboard provides a useful summary, users who do not use the tool on a regular basis may find it difficult to access detailed settings or customisations because doing so requires multiple steps. Accessing extensive customising options may require multiple steps and is not always obvious immediately away. Additionally, when a user wants to check their daily activity, they have shown an overview of their weekly activities as well. Nonetheless, this is not documented well and the users are forced to remember that this is an overview of a daily activity in relation to their weekly usage pattern.

7. Flexibility and Efficiency of Use

Since the new users initially don’t form a mental model of how a system operates, they frequently need assistance and clear, obvious options. For instance, novice users mostly rely on step-by-step instructions or menus with clear labels, but more seasoned users learn keyboard shortcuts or touchscreen movements to accomplish the same operation. Expert users may still employ the slower, more methodical approaches, of course, but they would not gain anything from doing so. Instead, they tackle the task more quickly, but with less guidance. We call these alternate, quicker ways of performing common task accelerators.

A system that prioritizes easy learning for new users would slow down repeat users since it probably contains far more step-by-step guidance than a repeat user would require. It may be required to make additional clicks to help consumers through a wizard the first time, but they are unnecessary for subsequent repetitions.However, if a system was designed solely for professional users, it would likely be quite hard to understand. In contrast to going through a series of menus to initiate the same operation, using keyboard combinations or a touch gesture is quicker, but it also puts more strain on the user's memory. It would be equivalent to completely forgoing a graphical user interface (GUI) in favour of a command-line one if you relied entirely on them. Therefore, creating a flexible and effective system involves two distinct steps: various approaches to complete the same task based on personal preferences and accelerators that speed up skilled users rather than slowing down novices. For the skilled user, accelerators can frequently speed up interactions that are invisible to the novice (Laubheimer, 2024).

Although the Screen Time tool is simple, more experienced users may find it lacking in deeper insights or the ability to more easily manage numerous settings (organising app limits by day or category, for example). To speed up the process of establishing restrictions based on past usage trends, some automation could be included. Advanced users have limited options for changing settings. One thing worth mentioning is that, even though the feature shows the

8. Aesthetic and Minimalist Design

As per this heuristic, a minimalist design aims to simplify interfaces by eliminating superfluous components or content that does not facilitate user tasks. It does this by minimizing the amount of "noise" an interface has in order to highlight important information (Fessenden, 2022). Information that is rarely needed or unnecessary shouldn't be included in dialogues.

The design of the tool is simple and tidy. The presentation of all important information is free of unnecessary distraction. The data visualizations and charts are straightforward. No significant problems were found.

9. Help Users Recognize, Diagnose, and Recover from Errors

Error messages should accurately describe the issue, offer a remedy, and be written in simple language (no codes). Good error messages should be professional, simple to comprehend (in human-readable language), accurate, offer helpful advice, be easily observable, take less time to resolve, and instruct users (Gorasia, 2021).

There are no comprehensive error warnings or instructions provided by the tool when users set improper limitations or disable key features. A user is simply blocked if they attempt to go over their limit; there are no particular suggestions for changing the restriction or managing the circumstance more skillfully. Lack of thorough instructions for limit adjustments and inadequate error recovery alternatives.

10. Help and Documentation

An essential component of the user experience is help and documentation. Though rarely fun they are frequently required. Users do not like reading in general, and they dislike reading instructions in particular. However, any interaction issue also presents a learning opportunity for the user, which gives the designer the chance to influence information and expand the user's mental model in ways that would not have occurred in the absence of the interaction's catalyst. When users require assistance, it is necessary to be prepared because giving them pertinent information will help them achieve their goal. Proactive assistance for users should be supplemented with a documentation repository that they can access when necessary (Joyce, 2023). Although it is preferable if the system can be used without documentation, assistance and documentation could be required.

Short tooltips offer some basic assistance and explanations through the Screen Time tool, but users who wish to go deeper into features will find minimal detailed documentation. It's not always easy to get assistance. Absence of thorough, easily available assistance documentation.

5.3 Survey Analysis

Statistical Analysis

After the initial data cleaning in the Google Sheets, the dataset was imported into SPSS (Statistical Package for the Social Sciences) for descriptive statistical analysis. SPSS is a powerful data management and analysis tool. This software is used to perform descriptive statistics, such as frequency and mean calculations, as well as complex analysis, such as cross tabulations and standard deviation calculations. This comprehensive analysis provides detailed information about survey responses and makes it easy to identify patterns and trends.

Questionnaire Data Preparation

Once the data collection phase was complete, responses were exported to Google Sheets for initial processing. In Google Sheets, the data set is checked to detect and process missing or partially filled responses, which are cleaned to maintain data integrity. Common data entry errors like typos and inconsistent answers have been fixed here. To ensure consistency, a basic format has been implemented, including standardising text entry and ensuring that numeric data is maintained in consistent formats. The dataset was then coded for statistical analysis with categorical variables assigned numerical values.

Data Coding in SPSS

The next phase in preparing the survey data for analysis was coding it in SPSS (Statistical Package for the Social Sciences). This step involved transforming the cleaned dataset into a structured format that SPSS could efficiently process for statistical analysis. The coding phase included the following detailed activities:

The next step in preparing the survey data for analysis was performed in SPSS. This step involves transforming the extracted data into a structure format ready for statistical analysis in SPSS. The coding phase included the following activities:

1. Importing the Dataset into SPSS

The cleansed dataset was imported into SPSS. This ensured that all the cleaned and formatted data from Google Sheets was transitioned into the software. Although the length of the variable names was checked to ensure that they met the requirements of SPSS, e.g. to avoid special spaces or characters.

2. Defining Variables

Each survey question was assigned a unique variable name in SPSS to describe the collected data. Example: *Gender* is coded as Gender.

The variables were clearly defined and labelled to guide the interpretation during the analysis.

3. Assigning Value Labels

The categorical data were converted into numerical codes to represent different categories so that SPSS could process the data accurately. Such as:

- Gender: 1 = Male, 2 = Female, 3 = Other.
- Education Level: 1 = Undergraduate, 2 = Graduate, 3 = PhD.
- Likert scale responses were calculated as follows:
- Strongly Agree = 1, Disagree = 2, Neutral= 3, Agree = 4, Strongly Agree = 5.

4. Setting Measurement Levels

For each variable, the measurement level was defined in SPSS as either:

- **Nominal** (e.g., Gender, Screen Time Tool Usage)
- **Ordinal** (e.g., Likert Scale Responses)

For each variable, the measurement level in SPSS was defined as follows:

- Nominal (e.g. gender, Screen Time Tools Usage)
- Ordinal (e.g. Likert Scale Responses)

By coding the data in SPSS, the survey responses were converted into a structured and analysable format. This successful process ensured that the variables were well understood, the data would be maintained, and the data was ready for in-depth analyses to answer the research questions.

Demographic Information

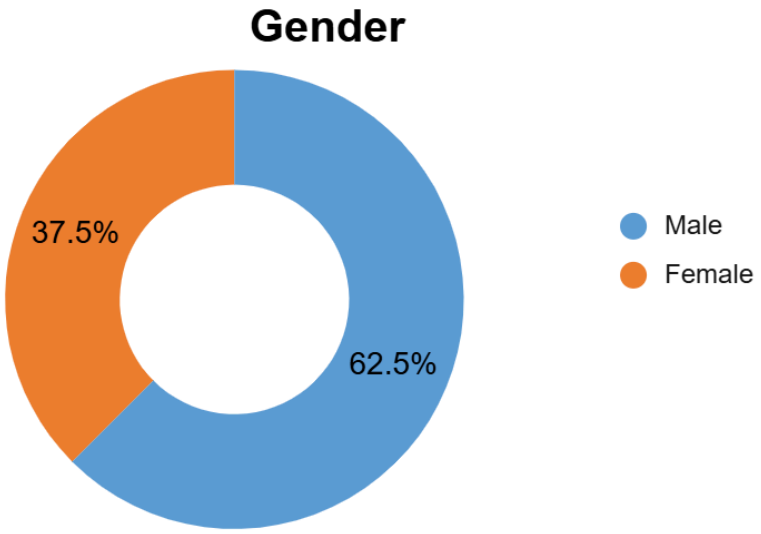


Figure 5: Gender distribution

According to figure 5, the majority of participants were male (62.5%), with females accounting for 37.5%.

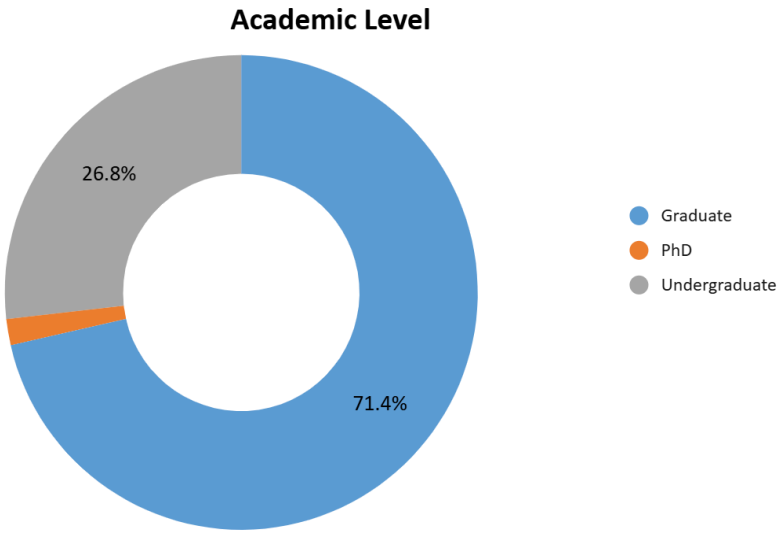


Figure 6: Academic Level

Figure 6, shows that 71.4% of respondents were graduate students, followed by undergraduate students (26.8%) and PhD students (1.8%). This distribution suggests that the sample is heavily skewed towards people who are likely to experience higher workload, which may impact their reliance on productivity tools.

Current Usage of iPhone Screen Time Management Features

Table 4: iPhone uses on a daily basis

Responses	Frequency	Percent	Cumulative Percent
Less than 2 hours	7	6.3%	6.3%
2 - 4 hours	17	15.2%	21.4%
4 - 6 hours	52	46.4%	67.9%
More than 6 hours	36	32.1%	100.0%

Total	112	100.0%	

Table 4, mentioned that over 46.4% of respondents use their phone for more than four hours a day, and 32.1% use their phone for more than six hours. The excessive screen time consumption indicates that there is a great need for features that can effectively control unnecessary activities and promote the adoption of healthy habits. Heavy usage may also indicate the addictive nature of applications such as social media and messaging.

User Level

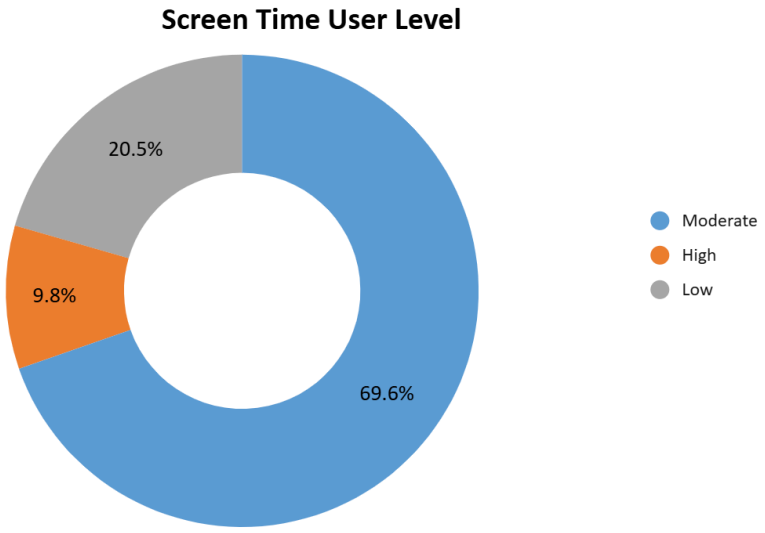


Figure 7: Screen Time Tools User Level

Figure 7, shows that nearly (69.6%) indicates moderate engagement, while many users are engaging with these tools, their consistent and effective use remains limited. Only 9.8% report a high level of engagement, indicating that many users are still not taking full advantage of these features.

Screen Time Tools Usage

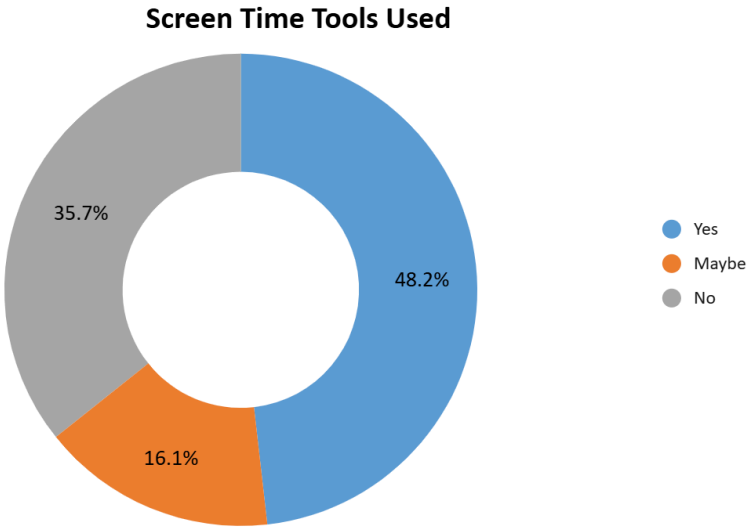


Figure 8: Screen Time tools used

Figure 8, shows that almost half (48.2%) of respondents said they used screen time tools, but a significant minority (35.7%) do not. This indicates barriers such as lack of awareness, perceived complexity, or doubts about its usefulness. Addressing these barriers through better integration of features and advertising campaigns could improve usage rates. Specifically, the 16.1% who selected "maybe" might be addressing the users who are aware of the tools but are unsure about their usefulness.

Table 5: Screen Time features used by the participants

Features Used	**Responses**	**Percent**	**Percent of Cases**
App Limits	28	18.1%	25.0%
Downtime	11	7.1%	9.8%
Always Allowed Apps	14	9.0%	12.5%
Screen Distance	11	7.1%	9.8%

Content & Privacy Restrictions	11	7.1%	9.8%
Screen Time Report	39	25.2%	34.8%
None of them	41	26.5%	36.6%
Total	155	100.0%	138.4%

Table 5, shows that a significant 26.5% of respondents said they don't use Screen Time features. The most popular features among users were Screen time reports (25.2%) and App limits (18.1%). Limited use of features like Downtime (7.1%) and Always Allowed Apps (9.0%) may be due to lack of awareness or perceived insignificance.

Table 6: Motivation factors to use Screen time

Features Used	**Responses**	**Percent**	**Percent of Cases**
Productivity Improve	50	29.1%	44.6%
Manage Distractions	50	29.1%	44.6%
Academic Obligations	17	9.9%	15.2%
Social & Peer Pressure	5	2.9%	4.5%
Stress and Improve well-being	38	22.1%	33.9%
No Motivation	12	7.0%	10.7%

Total	172	100.0%	153.6%

Table 6, shows that the productivity improvement and Manage distractions (29.1%) are the top motivation factors. Stress and improved well-being (22.1%) was also significant, suggesting mental health benefits of screen time. Interestingly, social pressure and academic obligations were less motivating.

Frequency of Report Checking

Table 7: Frequency of report checking

Responses	Frequency	Percent	Cumulative Percent
Daily	14	12.5%	12.5%
Weekly	34	30.4%	42.9%
Monthly	5	4.5%	47.3%
Rarely	38	33.9%	81.3%
Never	21	18.8%	100.0%
Total	112	100.0%	

Table 7, shows that almost half of respondents (52.7%) check their screen time reports only rarely or never, indicating limited usefulness or relevance. A review of daily and weekly reports (42.9%) suggests moderate to high levels of engagement, but also indicates that the information provided may not be robust enough to encourage consistent use.

Adjusting Screen Time Limits

Table 8: Adjusting screen time limits

Responses	Frequency	Percent	Cumulative Percent
Daily	6	5.4%	5.4%
Weekly	23	20.5%	25.9%
Occasionally	28	25.0%	50.9%
Rarely	30	26.8%	77.7%
Never	25	22.3%	100.0%
Total	112	100.0%	

Table 8, mentioned that almost half (49.1%) of respondents said they rarely or never change screen time, while only 5.4% made daily adjustments. Which suggests that many users either set limits once and forget about them or do not engage deeply enough with the features. In addition, frequent changes may also indicate a lack of confidence in the effectiveness of the process or being influenced by frequent changes.

Phone Usages Patterns

Table 9: Top activities used by the Participants

Top Activities	Frequency	Percent	Cumulative Percent
Social Media	70	62.5%	62.5%
Messaging	25	22.3%	84.8%

Entertainment	9	8.0%	92.8%
Browsing	5	4.5%	97.3%
Gaming	2	1.8%	99.1%
Educational	1	0.9%	100.0%
Total	112	100.0%	

Table 9 shows that social media dominated respondents' phone use (62.5%), followed by text messaging (22.3%) and entertainment (8.0%). These findings are consistent with broader trends showing that social media is a major driver of screen time. While news may be considered semi-important for communication, social media and entertainment contribute significantly to non-essential use.

Table 10: Time Spent on Non-essential Activities

Responses	**Frequency**	**Percent**	**Cumulative Percent**
Less than 1 hours	5	4.5%	4.5%
1 - 2 hours	29	25.9%	30.4%
2 - 4 hours	47	42.0%	72.3%
4 - 6 hours	22	19.6%	92.0%

More than 6 hours	9	8.0%	100.0%
Total	112	100.0%	

More than 27% of participants reported spending more than four hours a day on non-essential activities, and 42% spent 2 to 4 hours as shown in table 11. This shows the great challenge of finding a balance between productivity and leisure. Despite widespread awareness of overconsumption, reflected in follow-up questions, participants found it difficult to effectively moderate their habits, underscoring the need for more effective tools.

Table 11: Overuse of Non-essential Activities

Responses	**Frequency**	**Percent**	**Cumulative Percent**
Yes	80	71.4%	71.4%
Maybe	16	14.3%	85.7%
No	16	14.3%	100.0%
Total	112	100.0%	

We ask the respondents if they spend too much time on non-essential activities or not. Table 11, shows a large majority (71.4%) admitted to overusing non-essential apps, indicating high self-awareness. However, this awareness does not necessarily lead to action, as the following questions about reminders and adherence to limits shows.

Table12: Attention to Reminders

Responses	Frequency	Percent	Cumulative Percent
Yes	32	28.6%	28.6%
Maybe	32	27.7%	56.3%
No	49	43.8%	100.0%
Total	112	100.0%	

Table 12, shows that nearly 44% of respondents said they did not notice reminders, while only 28.6% said they did. This points to a critical problem with the design or delivery of reminders, as they do not effectively capture users' attention.

Table 13: Action After Receiving Screen Time Reminder

Responses	Frequency	Percent	Cumulative Percent
Never	21	18.8%	18.8%
Rarely	38	33.9%	52.7%
Sometimes	40	35.7%	88.4%
Often	8	7.1%	95.5%

Always	5	4.5%	100.0%
Total	112	100.0%	

Table 13, shows that only 11.6% of respondents responded to a reminder often and 52.7% rarely or never. This limited follow-up suggests that reminders may lack relevance, timing, or actionable content.

Table 14: Awareness of iPhone Usage after using Screen Time tools

Responses	**Frequency**	**Percent**	**Cumulative Percent**
Not aware at all	21	18.8%	18.8%
Slightly aware	36	32.1%	50.9%
Moderately aware	47	42.0%	92.9%
Very aware	5	4.5%	97.3%
Extremely aware	3	2.7%	100%
Total	112	100.0%	

While 42% reported moderate awareness, 50.9% reported slightly aware or not aware at all, as shown in table 14. This suggests that the tools provide some information, but are not comprehensive or engaging enough to fully inform users about their habits.

Table 15: Time Limit reminders on Controlling iPhone Usage

Responses	Frequency	Percent	Cumulative Percent
Yes	42	37.5%	37.5%
Maybe	47	42.0%	79.5%
No	23	20.0%	100.0%
Total	112	100.0%	

While 37.5% of respondents agreed that the time limits help, 42% were unsure, and 20% said they were not, as mentioned in table 15. This uncertainty suggests that the feature has potential, but its current implementation may not be impactful or adaptive.

Table 16: Reminders on Exceeding Time Limits

Responses	Frequency	Percent	Cumulative Percent
Yes	66	58.9%	58.9%
No	46	41.1%	100.0%
Total	112	100.0%	

Table 16 shows that 58.9% reported receiving reminders, while 41.1% do not, likely due to not setting limits or turning off notifications.

Table 17: Ignoring Time Limits

Responses	Frequency	Percent	Cumulative Percent
Never	10	8.9%	8.9%
Rarely	13	11.6%	20.5%
Sometimes	34	30.4%	50.9%
Often	36	32.1%	83.0%
Always	19	17.0%	100.0%
Total	112	100.0%	

Table 17, shows that nearly half (49.1%) admitted that they often or always ignore time limits, which indicates that this feature is not significant enough to cause behavior change.

Table 18: Effectiveness of the Reminders

Responses	Frequency	Percent	Cumulative Percent
Very ineffective	14	12.5%	12.5%
Somewhat ineffective	15	13.4%	25.9%
Neither effective nor	36	32.1%	58.0%

ineffective			
Somewhat effective	36	32.1%	90.2%
Very effective	11	9.8%	100%
Total	112	100.0%	

Table 18, mentioned that while 32.1% rated them as somewhat effective, 45.5% rated them as neutral or ineffective. These mixed reviews suggest that reminders are helpful for some, but not universally accepted.

Cross- Tabulation

Cross-tabulation helped us identify the association between two nominal variables, because it gives a matrix format that can display the frequency distribution of the specified variables with an option to compare between the groups. Co-occurring with statistical tests such as the Chi-Square tests, the Chi-Square test is used to enable the analyst to gain information as to if any observed difference between two groups is statistically significant or not (Babbie, 2020; McHugh, 2013).

Gender and Daily Time Spent on Non-Essential Activities

The Pearson Chi-Square test provided a value of 2.917 (df= 4, p = .572), indicating no statistically significant association between gender and the amount of time spent on non-essential activities daily.

Gender does not appear to play a significant role in influencing the time spent on non-essential activities, suggesting similar usage patterns across genders.

Academic Level and Motivational Factors for Using Screen Time Features

1. Productivity Improvement

   The Pearson Chi-Square test provided a value of 2.678 (df= 2, p = .262), indicating no significant relationship between academic level and motivation to improve productivity.

Motivation to use Screen Time features for productivity improvement is consistent across different academic levels.

2. Managing Distractions

   The Pearson Chi-Square test yielded a value of 5.629 (df= 2, p = .060), approaching significance (p <.10). The likelihood ratio test indicates a stronger relationship (p = .039), suggesting a potential association.

   There may be a difference in how academic levels influence the motivation to use Screen Time features for managing distractions.

3. Academic Obligations

   The Pearson Chi-Square test yielded a value of 1.026 (df= 2, p = .599), indicating no significant relationship between academic level and academic obligations as a motivator.

   Academic obligations are not significantly associated with the motivation to use Screen Time features across different academic levels.

4. Social and Peer Pressure

   The Pearson Chi-Square test yielded a value of 9.909 (df= 2, p = .262), indicating a statistically significant association between academic level and motivation related to social and peer pressure.

   Academic level significantly influences the motivation to use Screen Time features due to social or peer pressure, with potential variations in social dynamics among different levels.

5. Stress and Improving Well-Being

   The Pearson Chi-Square test yielded a value of 3.972 (df= 2, p = .137), indicating no significant relationship between academic level and stress and well-being improvement as motivators.

   Stress and well-being improvement motivations are consistent across academic levels.

6. No Motivation

   The Pearson Chi-Square test yielded a value of .498 (df= 2, p = .780), indicating no significant relationship between academic level and lack of motivation to use Screen Time features.

Academic level does not appear to influence the absence of motivation to use Screen Time features.

Perception & Effectiveness of Screen Time

Table 19: Screen time features helps to aware phone usage

Responses	Frequency	Percent	Cumulative Percent
Strongly disagree	5	4.5%	4.5%
Disagree	10	8.9%	13.4%
Neutral	40	35.7%	49.1%
Agree	45	40.2%	89.3%
Strongly agree	12	10.7%	100%
Total	112	100.0%	

Table 19, shows that the majority of respondents (50.9%) agreed that the tools help raise awareness, although 35.7% were neutral. This shows that while the tools serve their intended purpose, there is room for improvement in the way data is presented to make it more actionable and engaging.

Table 20: Screen time features on recognize non-essentials activities

Responses	Frequency	Percent	Cumulative Percent

Strongly disagree	4	3.6%	3.6%
Disagree	8	7.1%	10.7%
Neutral	30	26.8%	37.5%
Agree	57	50.9%	88.4%
Strongly agree	13	11.6%	100%
Total	112	100.0%	

Table 20, shows that around 62.5% agreed that the screen time tools helped identify non-essential activities, but 26.8% neutral indicated that some participants did not consider it a significant benefit. Bridging the gap between recognition and behaviour change remains a critical challenge.

Table 21: App limits & Downtime to manage phone usage

Responses	**Frequency**	**Percent**	**Cumulative Percent**
Strongly disagree	9	8.0%	8.0%
Disagree	24	21.4%	29.5%
Neutral	47	42.0%	71.4%
Agree	21	18.8%	90.2%

Strongly agree	11	9.8%	100.0%
Total	112	100.0%	

Table 21, shows that a significant portion (63.4%) disagreed or remained neutral, indicating limited active engagement. This lack of adoption may be due to complexity, inconvenience, or low perceived utility.

Table 22: Screen time on staying productive

Responses	**Frequency**	**Percent**	**Cumulative Percent**
Strongly disagree	6	5.4%	5.4%
Disagree	11	9.8%	15.2%
Neutral	51	45.5%	60.7%
Agree	34	30.4%	91.1%
Strongly agree	10	8.9%	100%
Total	112	100.0%	

Table 22, shows that while 30.4% agree with screen time helping them to stay productive by limiting distractions, 45.5% are neutral. This shows a moderate impact on productivity, but highlights the potential for improvement.

There is average use of Screen Time tools with slightly more than half the respondents using them (48.2%). However, a third (35.7%) of the participants said they never used these tools, and 16.1% said they were unsure, which might indicate their unawareness or perceived uselessness. Among these, Screen Time Reports and App Limits were the most used, which demonstrated that users desire for controlling their usage. The potential issues with such features as Downtime – 7.1%, Always Allowed Apps – 9.0% allowed us to think that these features are not utilized by users because they can contradict with their expectations or can be considered as difficult to set up.

Motivations to use Screen Time were primarily based on its importance for increasing productivity (29.1%) and distracting prevention (29.1%), followed by academic duties (9.9%) and social expectations (2.9%). This suggests that users assign these tools a more need-to-use status like personal usefulness as against socially or academically necessity. The response percentage of 69.6% indicates that while the users acknowledge the many benefits of these tools, they are constrained from effectively utilizing them.

The data also shows the regularity of smartphone usage, in which 78.3% of participants use their smartphones for more than 4 hours a day. Social media (62.5%), Messaging application (22.3%) is the second most used while entertainment (8.0%) is the least used internet activity according to the respondent's usage.

These findings align with global trends indicating that young adults give much of their time to social platforms due to high interaction (Spocket, n.d.). As we have seen, messaging apps which are primarily meant for the functional purpose of passing messages also lead to more overall screen time and thus more overall phone usage, which makes this all the more complicated.

The acknowledgement by 71.4% of participants that they spend too much time on non-essential activities demonstrates high self-awareness of overuse. However, this recognition does not seem to translate into meaningful behaviour change, as indicated by the limited use of App Limits and the high rate of ignoring reminders.

Additionally, screen time tools moderately raise awareness, with 50.9% reporting moderate to high awareness of usage patterns. However, 42% reported being only slightly aware or not aware at all. Similarly, while 62.5% agreed that the tools help recognise non-essential usage, 26.8% remained neutral, indicating that the tools do not consistently deliver insights that resonate with users.

The infrequent checking of Screen Time Reports (52.7% rarely or never check them) suggests that these insights are either not engaging enough or fail to provide actionable takeaways. Participants who actively check reports might find value in the data provided, but those who rarely engage might view these tools as passive trackers rather than enablers of change.

While 58.9% of respondents reported receiving reminders for exceeding limits, 49.1% admitted to often or always ignoring them. Only 32.1% found reminders somewhat effective, while 45.5% rated them as neutral or ineffective. Additionally, only 11.6% of respondents acted on reminders frequently, highlighting a disconnect between the tool's intent and user response.

The mixed results suggest that reminders, in their current form, fail to capture users' attention or influence behavior meaningfully. They may be perceived as generic, poorly timed, or lacking actionable context. For example, receiving a reminder without a clear alternative (e.g., "Take a break and hydrate" or "Switch to your reading app") might diminish their impact. Similarly, reminders delivered during critical activities, such as coursework or social interactions, may be seen as disruptive rather than helpful.

Perceptions of Screen Time tools are mixed, with 40.2% agreeing they increase awareness and 30.4% agreeing they help productivity. However, a significant portion (35.7% and 45.5%, respectively) expressed neutrality, suggesting that many users view these tools as moderately effective at best. Moreover, limited active use of App Limits and Downtime (63.4% were neutral or disagreed) highlights a gap in tool adoption.

These findings suggest that while students recognize the potential of Screen Time tools, they may not find them compelling enough to drive significant behavior change. Tools like App Limits may feel restrictive or lack flexibility, and Downtime might not align with users' schedules or needs. The perceived moderate impact on productivity highlights the need to integrate features that align better with students' academic and personal goals.

5.4 Interview Analysis

Qualitative Data Preparation

The qualitative data, consisting of semi structured interviews conducted via Zoom for recording purposes, underwent a preparation process that prioritized the creation of precise and error free transcripts for the purpose of thematic analysis. The process consisted of the following steps:

1. Transcription: The process of converting spoken language into written form. The Zoom audio was imported into MAXQDA for transcription. The interviews were transcribed using MAXQDA's transcription tools to create initial transcripts.
2. Review and Editing: Every transcript received a thorough review and editing process to guarantee precision. This entailed simultaneously listening to the recordings and reviewing the transcripts in order to rectify any transcription inaccuracies, such as misunderstood words or unfinished sentences.

3. Formatting: The transcripts were uniformly prepared to simplify analysis. This involved standardizing the arrangement of the text, explicitly identifying the speakers, and documenting any nonverbal signals or notable pauses.
4. Cleaning: Separate or meaningless information, such as talks unrelated to the topic or remarks containing background noise, were eliminated from the transcripts to concentrate on the pertinent content for thematic analysis.

Thematic analysis was deployed for the interview data analysis.

5.4.1 Thematic Analysis

The qualitative method known as thematic analysis is a systematic and adaptable strategy that is especially helpful for analyzing detailed social factors used to identify, evaluate, and interpret themes—meaningful patterns—in a collection of data (Braun & Clarke, 2006).

Strengths of Thematic Analysis

Thematic analysis is one of the broad qualitative research methodologies that offer many advantages in the process of data analysis and interpretation. Its strengths are as follows:

Flexibility

Thematic analysis can be conducted with variable types of qualitative data, including interviews, focus groups, and open-ended survey answers. It is flexible whether the approach is inductive (data-driven) or deductive (theory-driven), depending on the purpose of the investigation.

It is not anchored to any specific theoretical framework, allowing researchers to study data without restrictions and tailor their analysis to specific objectives (Nowell et al., 2017).

Accessibility

Thematic analysis is relatively straightforward and does not require extensive training or specialized software, making it accessible to researchers of varying experience levels.

It is easy to understand for both researchers and readers, facilitating the communication of findings to non-specialist audiences (Castleberry & Nolen, 2018).

Practical and Applied Insights

Thematic analysis is especially useful when research aims to derive actionable recommendations, such as improving products, services, or systems based on participant contributions. It helps researchers pinpoint areas for intervention and improvement. It connects findings to real-life applications, which can be valuable in fields like healthcare, education, and technology design (Terry et al., 2017).

Transparency

Thematic analysis employs a systematic, step-by-step process—such as data familiarization, coding, and theme identification—that ensures transparency and rigor in the research. It provides an audit trail that supports the reliability and reproducibility of the analysis (Nowell et al., 2017).

Applicable to Small or Large Data

Thematic analysis is suitable for small, focused data sets (e.g., in-depth interviews with few participants) as well as larger, more diverse qualitative data sets, making it highly scalable (Clarke & Braun, 2014).

It easily adapts to different research contexts and data volumes, offering flexibility for various project sizes (Vaismoradi et al., 2013).

Integration with Various Methods

Thematic analysis can be combined with quantitative data or other qualitative methods to gain a more holistic understanding of the research topic. It is often employed in mixed-method studies. (Vaismoradi et al., 2013).

Depth of Understanding

Thematic analysis offers a rich, comprehensive, and detailed description of participants' experiences and viewpoints by finding and analyzing patterns or themes in the data (Braun & Clarke, 2006).

It provides insights into participants' common and distinct experiences by capturing the variety of viewpoints included in the data (Clarke & Braun, 2014).

Weaknesses of Thematic Analysis

While thematic analysis is a highly versatile and widely utilized qualitative research method, it does come with its limitations.

Subjectivity and Bias

Thematic analysis relies significantly on the researcher’s interpretation, which may introduce subjectivity and bias into the analysis (Braun & Clarke, 2006). Researchers may unintentionally prioritize some data over others, influencing the themes that emerge. As Nowell et al. (2017) point out, this subjectivity can be amplified by the absence of a clear theoretical framework, requiring researchers to make numerous judgment calls during the coding and theme development stages.

Lack of Established Guidelines

Although Braun & Clarke (2006) provided a popular framework, there is no universal set of guidelines for conducting thematic analysis. This results in variability in how researchers approach and report their analyses (Castleberry & Nolen, 2018). The absence of standardization

complicates the comparison or replication of studies, potentially undermining the method's reliability (Vaismoradi et al., 2013).

Time-Consuming Process

Thematic analysis can be time-intensive, particularly when working with extensive data sets. Each phase—familiarization, coding, and theme development—requires substantial effort and time to ensure accuracy (Terry et al., 2017). This poses a challenge for researchers with limited time or resources, especially in studies with numerous participants or complex data sets.

Potential Loss of Context

By focusing on patterns across data, thematic analysis may overlook nuanced contextual information (Clarke & Braun, 2014). Individual participant voices or unique insights can be overshadowed by dominant themes. Castleberry & Nolen (2018) highlight that overemphasis on patterns can result in a superficial understanding of the data.

Difficulty in Defining Themes

It can be challenging to develop themes that are both distinct and comprehensive. Nowell et al. (2017) suggest that themes may overlap or fail to capture the richness of the data fully, leading to issues with clarity and validity. Balancing broad themes with specific sub-themes can make the results harder to interpret (Vaismoradi et al., 2013).

Limited Generalizability

As a qualitative method, thematic analysis relies on non-random samples, limiting its applicability to broader populations (Braun & Clarke, 2013). Findings are often context-specific and cannot easily be generalized to other settings or populations (Castleberry & Nolen, 2018).

Dependence on Researcher Expertise

Conducting thematic analysis requires a high level of skill in qualitative research to ensure rigor and trustworthiness. Inexperienced researchers may struggle with coding, theme development, or maintaining consistency (Nowell et al., 2017). This reliance on expertise can lead to varying quality across studies.

Challenges in Reporting

Presenting thematic analysis findings clearly and effectively can be difficult, especially when dealing with complex themes and large data sets. According to Terry et al. (2017), researchers often face challenges in demonstrating how themes were derived from the data.

Why We Chose Deductive Approach of Thematic Analysis

In the case of a **deductive approach**, the thematic analysis is informed by pre-existing theories, frameworks, or research questions. The method, therefore, becomes more applicable when studies have a focus or expectation. Here is I deployed deductive approach in our research:

1. Alignment with Research Objectives

The deductive approach allows analysis to be based on specific research objectives or hypotheses. Since our study has some predefined questions like motivations, challenges, and features of Screen Time, the deductive approach helped the focus of analysis on these aspects.

Braun & Clarke (2006) argued that the deductive approach is ideally applied in focused investigations in which themes emerge based on prior knowledge or frameworks.

2. Efficient Use of Existing Knowledge

Deductive analysis is based on the development of codes and themes from already developed theories or literature. If your research is based on previous findings and conceptual frameworks, this assures consistency with established knowledge (Fereday & Muir-Cochrane, 2006).

3. Time Efficiency

A deductive approach saves time since the codes or themes are predefined in contrast to the inductive approach, which is exploratory (Nowell et al., 2017). It concentrates on information related to our study goals and reduces the possibility of deviating from our research questions, ensuring a simplified analysis process.

4. Applicability to Real-World Problems

Deductive thematic analysis is suitable for applied research that aims to address the solution to a particular problem or evaluation of some existing intervention. Since our study assesses Screen Time tools and offers recommendations for their improvement, the nature of our research study is applied (Fereday & Muir-Cochrane, 2006).

5. Clear Reporting

The deductive approach results in structured findings linked to our research questions, making it easy to present the findings to stakeholders or through academic publications (Braun & Clarke, 2013).

Deductive-developed themes are more likely to be in harmony with aims of our study, thus tend to involve less afterwards adjustment.

Why Not Inductive?

While the **inductive approach** is valuable for exploratory studies, it is not be the best fit for our research for the following reasons:

Exploratory Nature

Inductive analysis starts from the raw data with the goal of generating new insight or theory, without prior ideas. Since our research already defined research questions or theoretical underpinning, it might be a waste to add complexity using inductive analysis (Thomas, 2006).

Risk of Divergence

Inductive coding can result in a number of diverse themes that may not relate directly to your research questions and thus requires extra work to reorient the findings back to the research questions (Nowell et al., 2017).

Time-Intensive

The open-ended nature of inductive analysis requires more time to explore and categorize emerging themes, which may not align with the structured goals of your research (Braun & Clarke, 2006).

Lack of Framework Validation

Inductive analysis does not explicitly prove or affirm existing frameworks or theories. For a study that aims at addition or criticism of established knowledge, deductive analysis is therefore more fitting (Fereday & Muir-Cochrane, 2006).

The deductive approach would set our analysis to keep the focus of our predefined research objectives, build on previous theoretical frameworks, and ensure clarity in actionable insights. In contrast, inductive analysis might be helpful for developing new theories, yet it may cause deviations from our specific goals and result in inefficiencies in answering applied research questions.

Here is a discussion of why these alternative approach of analyzing qualitative methods were not selected for our study:

Content Analysis

Content analysis is applied to quantify qualitative data by counting the frequency of certain words, phrases, or themes. It is particularly effective for structured datasets or large-scale text analyses (Elo & Kyngäs, 2008).

Limitation for Our Study: Although it provides a systematic and replicable approach, content

analysis lacks the depth and richness required to explore nuanced motivations, experiences, and challenges expressed in semi-structured interview data. Content analysis does not prioritize interpretative insights, which our research requires.

Narrative Analysis

Narrative analysis is designed to examine how people construct and communicate their personal stories, focusing on the structure, content, and meaning of narratives (Riessman, 2008).

Limitation for Our Study: Our research does not explore participants' life stories or interpret their experiences through narratives. Instead, it investigates participants' task-oriented behaviors and directly expresses opinions. As our data is based on pre-structured tasks and research questions, narrative analysis is less relevant.

Grounded Theory

Grounded theory is particularly useful for developing new theories from data through an iterative process of coding and constant comparison. It is especially valuable in exploratory research when there is no pre-established framework.

Limitation for Our Study: Grounded theory was not chosen because our research is guided by predefined research questions and themes derived from existing frameworks. The flexibility required for allowing theories to emerge directly from the data is inconsistent with the deductive nature of our analysis (Charmaz, 2006).

Discourse Analysis

Discourse analysis looks at how people use language in social or cultural contexts to create meaning (Gee, 2014). It focuses on how individuals express their thoughts, convictions, and behaviors via written or spoken language.

Limitation for Our Study: Discourse analysis places more emphasis on language usage and structure than on the topics or content of the material. This approach is less in line with our goals because our study seeks to uncover themes on screen time utilization rather than participant language methods (Fairclough, 2003).

Semi-structured Interviews

We collected the data through semi-structured interviews with 8 participants, the participants were divided into three usage groups—low, moderate, and high Screen Time users. After collecting the interview data, we transcribed the data through MAXQDA, later we coded based

on our purposes and finally analyzed following Braun & Clarke's (2006) six-step thematic analysis process.

After the transcripts followed the process of being cleaned and formatted, they were prepared for thematic analysis. The preparation steps included:

1. Data Familiarization: The first step refers to the process of being familiarized with or gaining a thorough understanding of data. We thoroughly examined the transcripts on several occasions to gain a comprehensive understanding of the content and to uncover initial themes and trends.
2. Preliminary programming: Initial codes were allocated to substantial sections of the text. The codes contained fundamental concepts, ideas, and repeating themes that arose from the interviews.
3. Code Organization: The initial codes were classified into more comprehensive groups or topics. The implementation of the thematic coding system enabled the development of a hierarchical framework comprising themes and subthemes, hence permitting a more comprehensive evaluation.

Step 1. Familiarization with the Data

We reviewed the interview transcript to understand participants' perspectives and interaction with iPhone Screen Time tools and identify patterns. We categorized the participants into 3 groups based on their level of usage of Screen time. Participants 3, 4 and 6 were considered Low level users, 2, 5 and 7 were considered Moderate users and 1 and 8 were considered as High users of Screen Time.

- The reasons for their use of iPhone screen time tools.
- The features participants use
- Barriers or challenges to using tools effectively.
- Benefits of the screen time on increasing productivity and decreasing screen time.
- Recommendations for changes.

Step 2. Generating initial codes

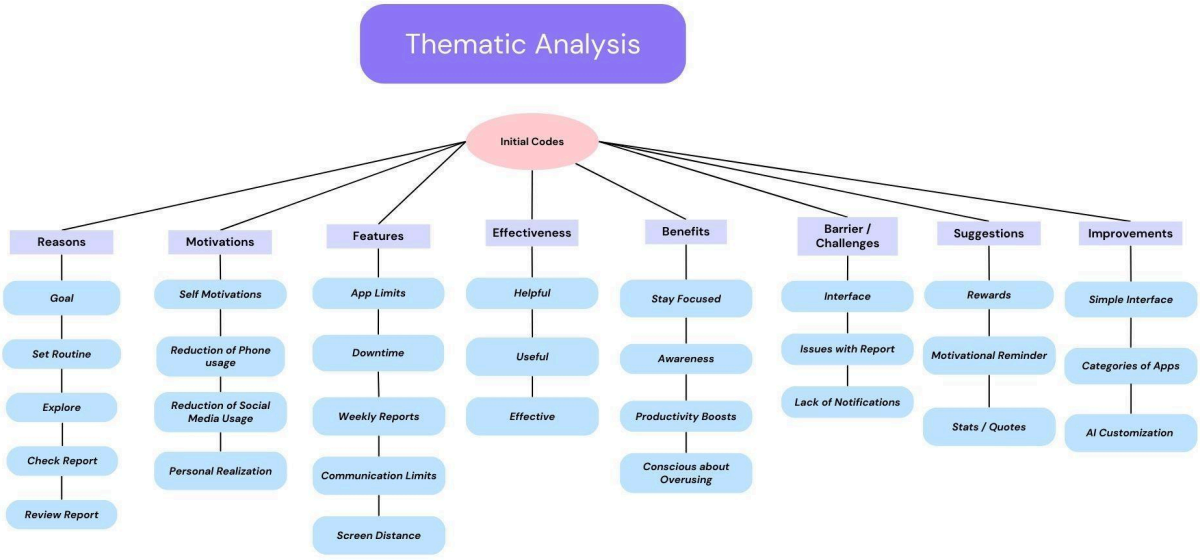


Figure 9: Initial Codes

Reasons participants talked about the reasons why they started to use screen time. For example, participant 1 (high level user) wanted to *explore* the features, participant 4 (low level user), his *goal* was to reduce the time spent on social media, participant 6 (low level user) to set the night *routine*.

Motivations Here the participants talked about the motivating factors using the screen time. Participant 2 ((low level user) got *motivated* by her husband to use the screen time. Where participant 8 (high level user) *motivated himself* to use screen time to minimize the consumption of social media usage, also participant 3 (low level user) thinks the screen time helps to *reduce* screen time in terms of being more productive. Participant 7 (moderate user), *realizing* that she needed screen time during her thesis and also to be more socialized.

Features within the screen time app limit is the most used feature among the participants. Participant 2 (moderate user) uses *app limit, always allowed* and *screen distance*. The other two moderate users, participants 5 and 7, also use *app limit*, but participant 5 uses *downtime* and checks the *report* as well. Participants 3 and 6 (low-level users) also use *app limit*, while the other low-level user (participant 4) uses the *weekly report* on the screen time. *The app limit* is also used by the both high-level users (participants 1 and 8), participant 8 also uses the *communication limit*.

Effectiveness in terms of the effectiveness of the screen time, participant 1 said, it *helped* him to

identify the most used apps, participant 6 said it *helps* her to manage distractions, and according to participant 3 it *helps* him to reduce unnecessary activities, where participant 8 thinks the screen time is *useful* for each and everyone to live in a structured way of life. When we asked participant 5 how effective it is, he gave *7 out of 10*. Participant 2 said it is *effective* when she only scrolls Facebook during her leisure times.

Benefits here participants shared the insights of how they benefited using the screen time. Participant 7 said when she uses the screen time she can stay more *focused* during her study. In terms of the awareness of the phone usage, participants 2 and 7 both said that they are *aware* about their phone usage and habits. Participant 2 said now she feels that she is more *concerned* about her phone usage than before, that she is *conscious* about *overusing* the phone for non essential purposes and the screen time is good for *boosting her productivity*, where participant 7 knows how long she is going to use her phone. Participant 6 said now she is *aware* of how much she spends time on social media and she was seeking temporary *productivity boosts* using the screen time. She is also *conscious* about the impact of *overusing* the phone.
Participant 1 is *conscious* about his overusing phone for non essential purposes. Participant 8 said he is *conscious* about his phone usage and now knows his limit.

Barriers/ Challenges In terms of *interface,* participant 6 found the user interface is quite difficult to navigate, she gave us an example, she found the term Downtime quite confusing, it took 1520 minutes for her to figure it out. Participant 3 said the interface can be more productive and attractive. Participant 1 said there is no clear guidance to *navigate features*, he had to figure it out. He also finds *lack in notification*.
Participant 6 had some problem with *understanding the report*, whether it is a weekly or daily report, it took a long time for her.

Suggestions when we asked about the suggestions to the participants, participant 5 talked about the *rewarding*.
Participants 1 said that there should be something else that could motivate us, where participant 7 said the notification should contain *motivation* that highlights the impact of productivity. Participant 3 also suggested that *motivational reminders* can be included. Participant 4 suggested the screen time should provide *statistics or scientific quotes or motivational quotes* as notification after exceeding the limit.

Improvements the participants also talked about some improvements, participants 1 and 6 said about the *simplification of the interface*. Participant 3 said the screen time should separate or *categorise* the productive apps and unproductive (social media) apps. Participant 8 said it should have *AI* that can help users to customize.

Step 3. Searching for themes

After reviewing the initial codes, we have pre identified topics based on our research questions. The given themes appropriately characterize the various aspects, behaviors and interactions participants engage in with the Screen time.

Theme A: Reasons for Using Screen Time
From our semi structured interview, participants gave us insights regarding the reasons for using the Screen time.

SubThemes:
Goal Setting: A participant wanted to reduce needless phone use, and boost productivity.
Exploration: The users wanted to explore features and were interested in those features.
Routine Establishment: A Screen Time user sets sleep routines.
Report Review: The weekly reports detail a variety of insights on the usage of the app.

Interview Transcript	Codes
"*I started to explore it and what the features are, I tried to know the features and everything*"	Exploration
"*I start doing the screen timing to set the night routine so that everything closes at 12 AM in my phone, and then I try to sleep.*"	Set Routine
"*my big goal is to reduce the time, like, the social media from, like, Facebook and Instagram and WhatsApp*"	Goal
"*So, weekly, I would like to review my usage and create a phone. So I'd like to use screen time to review that for my personal usage.*"	Review Report

Figure 10: Sub Themes

Interpretation:
Participants were driven towards the idea of productivity, curiosity, and establishing healthier phone usage habits. Reports of app usage played a large part in understanding how they changed their behavior.

Theme B: Motivation to Use Screen Time
The motivations behind using the Screen time have been shared by the participants.
SubThemes:

Self Motivation: Internal drive to control phone usage.
Reduction of Phone Usage: Desire to reduce overall screen time.
Reduction of Social Media Usage: A specific focus on limiting social media consumption.
Personal Realization: Participants recognized how excessive phone use affected productivity and wellbeing.

Interview Transcript	Codes
"to use this feature screen time, the thing that motivates me is, is it harming my productivity or not?"	Self-Motivation
"So I think using the screen time to deduct your screen time and be more productive helps you to be more on your life more than on your social or electronics lives."	Reduction of Phone Usage
"I should know how to minimize the consumption of social media and those things"	Reduction of Social Media Usage
"I realized that I need the screen time, when I felt like it's too much for me to play on the phone. And, also, when I started my thesis, so and then I decided, okay. Stop. I think I need the screen time to reduce and then to monitor how long I have been using my phone"	Personal Realization

Figure 11: Sub Themes

Interpretation:
Participants were motivated by both internal and external factors. While some were intrinsically driven, others were influenced by external prompts like family encouragement or academic deadlines.

Theme C: Features Used in Screen Time
Participants talked about features they use in Screen time.
SubThemes:
App Limit: This feature was widely used by the participants in order to restrict access to specific apps.
Downtime: The downtime feature blocks applications from a particular time interval.
Communication Limit: Used to apply inbound and outbound calls.
Screen Distance: It helps to ensure that phone usage is safer.

Reports: Screen time and app usage were provided in weekly summaries.

Interview Transcript	Codes
"this is my average use of the app. So I use this option, like, app limit" "I also use the limitation, like, at least 20 minutes."	App Limit
"Screen Time helped me to identify the app which one is the most used one. then I decided to put it in downtime" "Downtime, Sometimes I do that when I have, like, through the weekdays, not the weekend."	Downtime
"Actually, I've been using it recently, Communication limits."	Communication Limit
"So it's more into the reports, the report says, I could see that, I'm spending this much time on this app." "I use, like it's just reminding that you have used the app, like, almost 2 hours. Also, for Instagram."	Reports
"So I always try to use the screen distance particularly at night so that it will prevent me to not placing my phone not too close to my eyes."	Screen Distance

Figure 12: Sub Themes

Interpretation:
Core features like app limits and downtime were used by participants. They were considered essential tools to manage usage. Apart from these features, some participants used other features like screen distance, communication limit.

Theme D: Effectiveness of Screen Time

SubThemes:
Helpful: Screen Time helped to reveal the most used apps.
Useful: It allowed the participants to watch and alter phone habits.
Effective: Some people found the feature useful, but the success varied based on personal motivation.

Interview Transcript	Codes
"Screen Time helped me to identify the app which one is the most used"	Helpful
"it's useful for each and everyone. Because we want to live in a structured way."	Useful
"It's effective because, when I have no work, I am on the phone and rather than using YouTube or other things or browsing things, I always put my eyes on Facebook and without doing nothing." *"How effective is it? On a scale of 10, I'll give it a 7."*	Effective

Figure 13: Sub Themes

Interpretation:
In general, screen time was perceived as helpful and useful. Specifically, its effectiveness was limited by participants' willingness to obey notifications and prevent side stepping app limits.

Theme E: Benefits of Using Screen Time

SubThemes:
Focus Maintenance: Screen time helping the participants focus on academic or work tasks.
Awareness: Awareness of a bad screen time habit.
Productivity Boosts: A better time management was experienced by the participants.
Consciousness About Overusing: They learned to be more aware of which apps to spend time on, and which to avoid.

Interview Transcript	Codes
"When I use the screen time, I can focus more on finishing, especially my thesis, So it's helping me to decide and also helping me scheduling the time."	Focus Maintenance
"I think it reminds us in a very positive way so that we can control our time in a specific field, and I think it's good." *"now I feel that, yeah, I'm more concerned about what is going on."* *"I'm aware of that. And, of course, I want to minimize that."*	Awareness
"I can watch my last weeks. Think about how much time I spend on social media, and then it can actually inspire me to use it more."	Productivity Boosts
"Yeah. I'm conscious about overusing."	Consciousness About Overusing:

Figure 14: Sub Themes

Interpretation:

Participants reported that the app was beneficial, such as improving focus, increasing productivity, and earlier awareness of the times they spent on their phone.

Theme F: Barriers and Challenges

SubThemes:

Interface Issues: Confusing terms like "Downtime," and a difficult to navigate interface.
Report Confusion: Unaware of reports as daily vs weekly data.
Lack of clear guidance: Participants discovered there were no clear instructions, no onboarding.

Interview Transcript	Codes
"the interface or the structure of the thing is quite confusing. Like, when you even that now clear these things like Downtime, So I had to also spend 15 to 20 minutes to figure out how to do that."	Interface Issues
"I had some problems understanding the reports. If it's, like, weekly or it's, like, daily. So, yeah, it took me a lot of time to understand it in one go."	Report Confusion
"There is no clear guidance"	Lack of Clear Guidance:

Figure 15: Sub Themes

Interpretation:
This limited the effectiveness of the tool because participants had difficulty using the tool, did not understand notifications and did not receive enough guidance.

Theme G: Suggestions

SubThemes:
Reward System: They suggested adding progress based rewards.
Motivational Reminders: Better engagement results could have been driven through customized, motivational notifications.
Statistics/Quotes: Including motivational quotes or statistics relevant to the user could increase user experience.

Interview Transcript	Codes
"it can somehow give me the report that my screen time is down to 6% from last week in that reminder. Then it can be a rewarding thing. I used less last time than last week. So then in your mind, you'll be thinking that let's then stop using this, social media from now. They could include this type of thing."	Reward System
"I think there's supposed to be something else that could motivate us as a user to control this thing because screen time"	Motivational Reminders
"it should be provided Any statistics or scientific statistics or motivational quotes the post notification after exceeding the limit, not in the meantime. And then after the post notification, there's a screen time to tell you that you have exceeded the limit."	Statistics/Quotes

Figure 16: Sub Themes

Interpretation:
Participants mention the need for a more engaging (reward) and supportive system, where motivational components (statistics or quotes) are customized for individual behavior.

Theme H: Proposed Improvements

SubThemes:
AI Customization: Applications of AI for personalized recommendations and reminders.
Simplified Interface: An easier way to navigate and instructions that are easier to understand.
App Categorization: Differentiating apps that are productive from apps that are non productive is one of the first steps and a difficult principle to follow.

Interview Transcript	Codes
"it should have some artificial intelligence, so it will be easier for us, you can minimize or you can customize yourself"	AI Customization
"it will be a little bit easier, then they put it into 2 columns, like, it's daily, and this is, weekly, this is monthly, when it will be easier to, look at the things."	Simplified Interface
"They also can track the apps that you use on a regular basis. Like, though, they have to, like, separate the things which are productive apps and which are not. Like the study apps, if a person uses a study app for a long time, it's good. They have to track it, differentiate it by saying that this is a study tool he's using on his phone, and this is a work tool he's using on phone like the Microsoft Teams. I use it for a long time."	App Categorization

Figure 17: Sub Themes

Interpretation:

The participants suggested improving usability by recommending with the help of AI, simplifying navigation and managing apps.

Step 4. Reviewing Themes

It is crucial to make sure our themes appropriately reflect the facts now that we have recognized and we will define them in the next step. We accomplished this by going over the interview transcripts again and methodically comparing our themes and sub-themes with the data to ensure their coherence and applicability.

- Throughout this procedure, we investigated whether
- The data that each theme represents is accurately captured.

All of the topics and sub-themes were redundant, insufficient, or overlapping.

Final Review Conclusion:

- Minor adjustments were made to improve sub-theme associated and explain overlaps after themes were checked for validity.
- The data was examined carefully to check that no important codes or concepts were missed.
- At each stage all the themes were confirmed to accurately and clearly reflect the participants' experiences, difficulties and recommendations.

This process provided us with a strong basis for the next part of analysis in that our themes are both applicable and true to the facts.

Step 5. Defining Themes

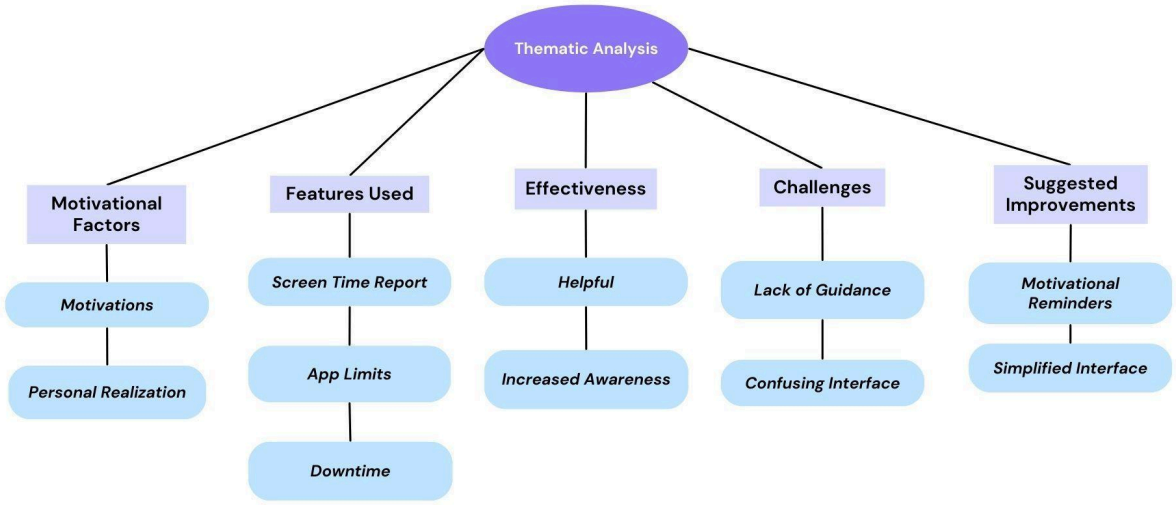


Figure 18: Defining Themes

In this step, we refined and clearly defined these themes and subthemes such that they matched the research questions and the participant responses. The final themes are presented below:

1. Motivational Factors
This theme contextualizes the motive and reasons for participating in Screen Time tools.
Motivations: Factors inside and outside of participants that cause them to monitor and lower their screen usage.
Personal Realization: They admitted to how their phone use was preventing them from being productive and being healthy.

2. Features Used
This theme focuses on how participants utilized these specially dedicated Screen Time features to manage their phone usage.
Screen Time Report: To review weekly and day to day app usage statistics.
App Limits: It controls how much time we spend on certain apps.

Downtime: Setting up routines by blocking access to apps during hours in a day.

3. Effectiveness
The theme on which this research focuses is participants' perceptions of the effectiveness of Screen Time tools in achieving their goals.
Helpful: The tool could identify what apps were used frequently, and how they used the screen.
Increased Awareness: Participants realized which apps they spent more or less time on and how they used their screens.

4. Challenges
The barriers and frustrations that participants experienced while using Screen Time tools are addressed in this theme.
Lack of Guidance: Participants commented that there was little guidance, or no guidance at all, as to how to navigate menu items or features.
Confusing Interface: It turned out to be hard to understand or even unclear on the surface like "Downtime."

5. Suggested Improvements
The content for this theme consists of recommendations Screen Time participants have for improving the functionality and usability of Screen Time.
Motivational Reminders: Participants suggested personalized and motivational notifications to help use healthier habits.
Simplified Interface: Optimizing the interface to make the user experience more friendly and intuitive.

We derive these themes which offer structured understanding of Screen Time tool interactions, including reasons for implementing the tools, usage behaviors, perceived effects, challenges, and recommendations for improvement. Each theme directly addresses the research objectives and offers actionable insights for enhancing the tool's design and user experience.

5.5 Contextual Inquiry Analysis

Table 23: Contextual Inquiry Analysis

Participants	Task	Observation	Verbal Feedback	Evaluation
1	Walk-through screen time	Good, she was comfortable to	She said she found a monthly	She could not find the specific date (7

	report, go to a specific day.	find the report . She did not know that the graphs (report) were clickable.	report.	Dec) on the first attempt, later she could.
	Setting App Limit	When the notification of app limit appeared, she pressed Okay.	She thinks it is fine.	She followed the steps, she tried several times with Facebook, but it did not work (unknown reason), then we asked her to do that with Youtube.
2	Walk-through screen time report, go to a specific day.	Searched to find the screen time, but could not find it in the first attempt.	He suggested that, pie chart would be good instead of a bar chart to highlight the report. And there should be a search bar to search specific week/day.	Explained his daily usage. Homepage— he thought it was about his report of last week, but it was the daily average. He was good when asked to go on a specific day.
	Setting App Limit	He did well to set the app limit, successfully completing the task.	He always skips the limit. He always ignores the limit for the day.	He always searches for the specific app instead of scrolling.
3	Walk-through screen time report, go to a specific day.	He searched in the search bar to find the screen time. He could not find the daily activity report. He easily found the day when we asked to get to a specific day.	He suggested that it could have been better if the daily report were in the homepage. And there should be an option that directly gets him to a specific day.	He did not know where screen time was. He needed instruction to find the daily activity report. He explained the homepage. He was swapping and dragging the screen to complete

				the task.
	Setting App Limit	He did well to set the app limit, and successfully completed the task. Pressed Okay to exit.	It would be great if there's a shortcut that you limit the app, like, from the notification bar, you can set that.	He was confident enough to complete the task, and explained well.
4	Walk-through screen time report, go to a specific day.	He searched to find screen time. When we asked to go to the weekly report, he was good to find it and explained. It was okay when we asked him to go on a specific day.	It was fine for him that he searched. The names (M T W) of the day are confusing at first glance. Later it is okay. It would be better if screen time was in front regarding the navigating issues.	He was confused by the report, it's not transparent at the first glance, when he carefully observes then it is understandable.
	Setting App Limit	Steps to set the app limit were okay, he was fast. When he got the notification while using the app, (app limit), he was reading the options.	They need to make some changes, like the current one is not motivating him.	He thinks there is room for improvement, in terms of motivating factors, for example, introduction to the award system.

As part of the contextual inquiry (Table 23) , four participants completed certain activities (tasks) regarding reviewing Screen time *Report* and one of the key features of Screen time *App limi*t. In order to pinpoint usability issues, user trends, and areas for design enhancement, each activity was followed by tasks we assigned, our observations, participants' verbal feedback, and our evaluation insights.

Key Insights

Navigational Challenges: For the first task, we asked participants to access the Screen time report and get us on a specific day. 3 out of 4 participants searched to find the Screen time. Because participants (except participant 1) were initially confused where the screen time is located. Eventually they all found the reports and explained the report.

Suggestions:

- A search bar should be added to search specific week/day. (Participant 2)
- There should be an option that directly gets users to a specific day. (Participant 3)
- Use of pie charts instead of bar charts in the report for easier data interpretation. (Participant 2)
- Should provide a shortcut to the app limit through the notification bar. (Participant 3)
- Add motivating components to notifications (e.g., reward-based system) to improve them. (Participant 4)

Summary of the evaluation

The contextual inquiry revealed key areas for improvement, such as simplifying navigation, improving data visualization, and enhancing motivational features. Despite initial challenges, participants adapted well after familiarization. These findings provide actionable insights for enhancing the system's usability and engagement potential.

The study also highlighted a recurring theme of participants struggling with initial orientation, suggesting the need for more intuitive onboarding processes. A redesigned user interface with clear prompts and visual aids could help reduce the cognitive load on beginners.

In terms of motivation, implementing a reward system or progress-tracking features could create a more compelling user experience. These recommendations aim to transform the Screen time management experience into a proactive and user-centered solution.

5.6 Findings

The findings chapter provides a detailed overview of the perceived usability, functionality and engagement issues related to the use of iPhone Screen Time. From heuristic evaluation, the surveys, interviews (semi-structured) that were coded and categorized thematically, contextual inquiries, certain significant findings regarding the ways users engage with the Screen Time features, and the usefulness of these tools, and possible improvement directions are mentioned in the chapter.

Additionally, the findings emphasise the necessity of increasing usability, motivation, and customisation for enhancing the effectiveness of the Screen Time tool to support digital

well-being. Thus, in order to meet these challenges, the tool can be optimised for matching the needs of users and providing them with proper stimuli to maintain sustainable behaviour changes.

5.6.1 Heuristic Findings

Towards the analysis of the strengths and challenges of the iPhone Screen Time Management tool, the heuristic analysis was conducted based on Jakob Nielsen's 10 Usability Heuristics. The design complies with the guidelines for developing applications in the iOS environment, an uncomplicated interface, and suitable features that help users to prevent extra mental processing. Nevertheless, significant problems were revealed: no real-time adjustment of parameters; low extensibility of the settings; weak error control and correction; and ineffective help and references. Those restrictions negatively influence the user involvement and effectiveness of this tool in controlling digital behaviours. Suggestions for the improvement of the current solution concern the provision of real-time notification services, the improvement of customisation capabilities and services, the improvement and usage of error recovery and prevention systems and services, as well as the improvement of the documentation services provided to users. These changes would greatly improve the utilisation of the tool and help users in their pursuit of digital wellbeing.

5.6.2 Survey Results

- 48.2% of respondents use the iPhone's Screen Time features, while 35.7% do not due to lack of awareness or perceived difficulty.

- The most commonly used features are:
    1. Screen Time Report: 25.2%
    2. App Limits: 18.1%
    3. Down Time: 7.1%
    4. Always Allowed Apps: 9.0%

- The main motivations for using Screen Time features are Productivity improvement and Distraction management, both cited by 44.6% of respondents.
- 46.4% of students reported using their phone between 4 and 6 hours a day, while 32.1% reported using their phone more than 6 hours a day.
- Social media apps and messaging were identified as the primary contributors to non-essential screen time.
- The students said that the screen time report enhances their phone usage awareness, but only 25.2% of them employ it.

- 18.1% of students use app limits to manage their phone usage, but the limits are often ignored or bypassed.

- Time Limit Reminders were sometimes (30.4%), often (32.1%), and always (17.0%) ignored by students.

- Regarding the usage of digital tools, students reported that they are best suitable when it comes to raising awareness, which is not enough to change people's behaviour.

5.6.3 Interview Thematic Findings

We used thematic analysis to analyse qualitative data and look at identifying trends, important problems, and areas for development. Our study presents the results of a thematic analysis of semi-structured interviews regarding usage of iPhone screen time tools by participants. The purpose of this study was to understand why people use Screen Time, hassles with Screen Time, and Screen Time's experiences by people who use Screen Time like Review Reports, App Limit, and Downtime.

Motivational Factors to Use Screen time

The reasons and elements that motivate the participants to use screen time tools fit well with this theme.

Motivations: Factors that influence participants to monitor their screen usage and reduce.

Personal Realization: Some of the participants did admit that using the phone too much comes at a cost of productivity and wellbeing.

The Features Used by The Participants

Specific Screen Time features that participants used to control their phone usage are highlighted in this theme.

Screen Time Report: It is used to look over the weekly and, at times, daily usage statistics of the app.

App Limits: App limits to set how much time should be spent on a specified app.

Downtime: Limiting access to apps during certain hours to create a routine.

Effectiveness of Current Screen Time Features

This theme explores participants' perceptions of the success of screen time tools to help them reach their objectives.

Helpful: It helped in identifying frequently used apps and in controlling the use of the screen.

Increased Awareness: The participants became more mindful of their usage patterns and screen time habits.

Challenges faced by The Participants

The theme is considering the barriers and frustrations reported by participants when using Screen Time tools.

Lack of Guidance: The lack of clear instructions or tutorials for navigating features also emerged as a noted shortcoming among the participants.

Confusing Interface: It also found the interface and usage terminology, such as 'Downtime,' unclear or difficult to understand.

Suggested Improvements

This theme includes participants suggestions on how to improve the functionality and usability of Screen Time.

Motivational Reminders: Participants suggested personalized and motivational notifications to encourage better usage habits.

Simplified Interface: Improving the interface to make it more user friendly and intuitive.

However, overall data from thematic analysis indicates that while awareness of screen time increases productivity, usability issues reduce overall effectiveness because of unclear instructions and a rather complex interface. These results seem encouraging because the research supports the idea that digital behaviors are essential for the intervention to be successful in a user-centered and personalized practice.

5.6.4 Contextual Inquiry Findings

The contextual investigation showed that there is a wide range of usability and engagement issues concerning the iPhone Screen Time, specifically, tasks related to viewing reports and setting app usage limits. Consistent complaints were the need to navigate: a feature might be in the Screen Time report, but it was difficult finding it there or pinpointing certain dates. Some recommendations were to add a search bar, providing links to certain dates and using pie charts instead of bars.

Participants mentioned the lack of motivational features and also that there were no shortcuts to change the app limits, for example, by means of the notification bar. Some of them are to make the structure clearer, work on the data presentation, and address the issue of motivation with elements such as reward or progress bars. It is particularly stressed here that a new design of the tool should be driven by the users and be aimed at improving its usability to help in regulating electronic use.

Therefore, the findings from this study form the basis for developing practical interventions that would help readdress the issues of concern in screen time management tools. They give clear directions about where to go next, listing some significant areas that need to be focused,

including the necessity of preferring the ideas of personalisation, the need to provide much detail and call people to action, and avoiding intrusive tips. Thus, more attention should be paid to what steps should be taken to translate these insights into realistic and user-orientated interventions that would meet users' needs and help them develop healthier use of social technologies. This move from analysis to the design of solutions is designed to develop tools that are not only novel but also highly consistent with the activities, requirements, and preferences of the user to ensure that the tools are indeed realistic and functional enough to facilitate more positive use of the digital environment.

6. Design Thinking

In its simplest understanding, design is the task of imagining and developing ways to solve certain issues or requirements. According to Buchanan's article (1992), design entails problem-solving in what is termed wicked problems for which there is no clear solution. In a situation where users deliberately or unwittingly engage with a product or service, design acts as a mediator for and fulfills the users' demonstrable requirements and functional specifications to provide convenient, meaningful, and, if possible, fun interfaces (Norman, 1988). The essence of design is to take intangible concepts to the physical world where the users can engage with them without hindrance. According to Norman & Draper (1986), the design of these systems promotes usability and, at the same time, satisfaction and behaviour of the users.

Furthermore, there is the addition of emotional and psychological perspective to the face of design because users do not only interact with systems in a functional way but experientially as well. A good design guarantees that design elements resonate with the user's expectations to enhance the understanding and make the process smooth to meet the user's purpose or need. This way, it is possible to consider the design as an effective instrument for stimulating users' needs fulfillment and having an impact on innovation and change.

The basis of our research is a user-orientated approach that emphasises the consideration of people's genuine requirements, preferences, and actions. Such research, also known as human-centred design, aims to make sure that a product and service can be utilised efficiently by users, is more fulfilling to the users, satisfying, and in effect more effective than others (Landry 2020). In this way, the human-centric approach to research works to find the drives and preferences of users deep down at their core.

In this regard, a number of methodologies and theories can be used, including design-based research, participatory research, and design thinking. All of them provide specifics on how to incorporate users' perspectives into the design process. To serve the purpose of the article, we

limited ourselves to the usage of a single methodology, namely design thinking, as this approach provides a more rigid yet free-form framework for creating new value propositions and solutions. Although the sections below expand further on design thinking, it is important to mention two other approaches that can be quite inspiring for the user-centred investigation.

Design-based research (DBR) is a methodology established by educators to improve the impact and transfer of education research into practice (Anderson & Shattuck, 2012). DBR is cyclic and utilitarian, and researchers and nonresearchers may be involved in developing, implementing, and refining interventions in educational contexts. Wang & Hannafin (2005) defined DBR as the integration of systematic inquiry of learning environments with the design and implementation of improvements in real-world contexts in multiple cycles of testing and improvement. This approach is particularly appropriate for marginalising how technology can facilitate learning by matching tools with the aims of instruction. This model is marked by its cyclic nature of problem analysis, design, implementation, and reflection phases, and those involve formative adjustments to the nature of the intervention as well as the overall theoretical framework of the methodology (Barab & Squire, 2004). In this way, DBR guarantees ecological validity, which makes the identified outcomes really helpful for practitioners.

Compared to DBR, where the researchers committed to creating a learning environment in the workplace over the years, our study needed timely and specific information from specific users through interviews, questionnaires, and feedback on prototypes. This made Design Thinking a more suitable choice, as it is formulated to deal with user needs in technologically advanced environments, always encouraging back-and-forth ideation and solution advancement via rapid concept creation and testing.

Participatory Design (PD) is a user-centred approach that actively involves stakeholders, particularly end users, in the design process to ensure the outcomes meet their needs and expectations. Originating in Scandinavia during the 1970s, PD emerged as a democratic method in workplace systems design, emphasising collaboration and shared ownership between users and designers (Simonsen & Robertson, 2013). According to Muller & Kuhn (1993), the core of PD lies in its commitment to empowering users by giving them a voice throughout the design lifecycle, enabling them to influence decisions that directly impact them. This approach fosters inclusivity and ensures that the resulting design solutions are both functional and meaningful to the intended audience.

Participatory Design (PD) is an approach that focuses on users, and the latter are engaged in the design process to guarantee that the results correspond to their requirements. Born from research practice and inaugurated during the mid-1970s in Scandinavia, PD aimed clearly at techniques in systems design, more especially in workplaces that focused on the democratisation of ownership and use among system users and designers (Simonsen & Robertson, 2013). To Muller & Kuhn

(1993), PD is rooted in the idea of enfranchising the users to have a say in product design at each of the design phases to make or affect decisions that concern them. This approach makes the solutions to design problems more inclusive and guarantees the returned solutions will be meaningful to the target end users. This type of research encourages designers to collaborate directly with users in real environments to gain insights into actions and technologies. This inclusive approach promotes a variety of perspectives, ensuring fair participation of users, designers, and stakeholders in generating collaborative design concepts, regardless of their professional training or personal experiences.

PD uses multiple feedback and co-design loops with multiple running or focus group-like settings as well as collaborative prototyping cycles to integrate both the idiographic user knowledge with the documentational design expertise (Spinuzzi, 2005). Thus, PD minimises the chance of designing unsuitable artefacts through the inclusion of user information at several points of the design cycle, in addition to increasing user satisfaction with the final design (Bødker et al., 2004). On account of the focus on participation, it can be suited well for interventions in which user enablement and negotiation are crucial.

However, the identified strength of Participatory Design was not sufficient enough for our research, and for some reasons. While PD particularly benefits from developing strong constructive relationships and co-creation, it is not always practical due to the time and user engagement that are needed for such relationships. Classic usability is also ambiguous to the specifics of our studies; however, it needed a methodology that would enable users' direct involvement while at the same time allowing a fast and uncoordinated move from one iteration to another, especially during the later prototype stage. That is where Design Thinking helped to find the balance for retaining the user's involvement during some phases, which are defined while at the same time granting more freedom during ideation and prototyping. While PD frames and mobilises collective designs, Design Thinking allows for a more efficient process better aligned with our study aims regarding limiting screen time.

Design thinking is a general term for an analytic and creative process that involves a person in opportunities to experiment, create and prototype models, get feedback, and remodel (Razzouk & Shute, 2012). Design thinking is a technique that uses a solution-based approach to issue resolution (Dam, 2024). It is especially beneficial when dealing with complicated challenges that are ill-defined or unknown—because it allows the designer to grasp the human needs involved, reframe the problem in human-centric ways, generate multiple ideas during brainstorming sessions, and take a hands-on approach to prototyping and testing. The five stages of design thinking help to address difficult challenges in any organisation, nation, and throughout the world.

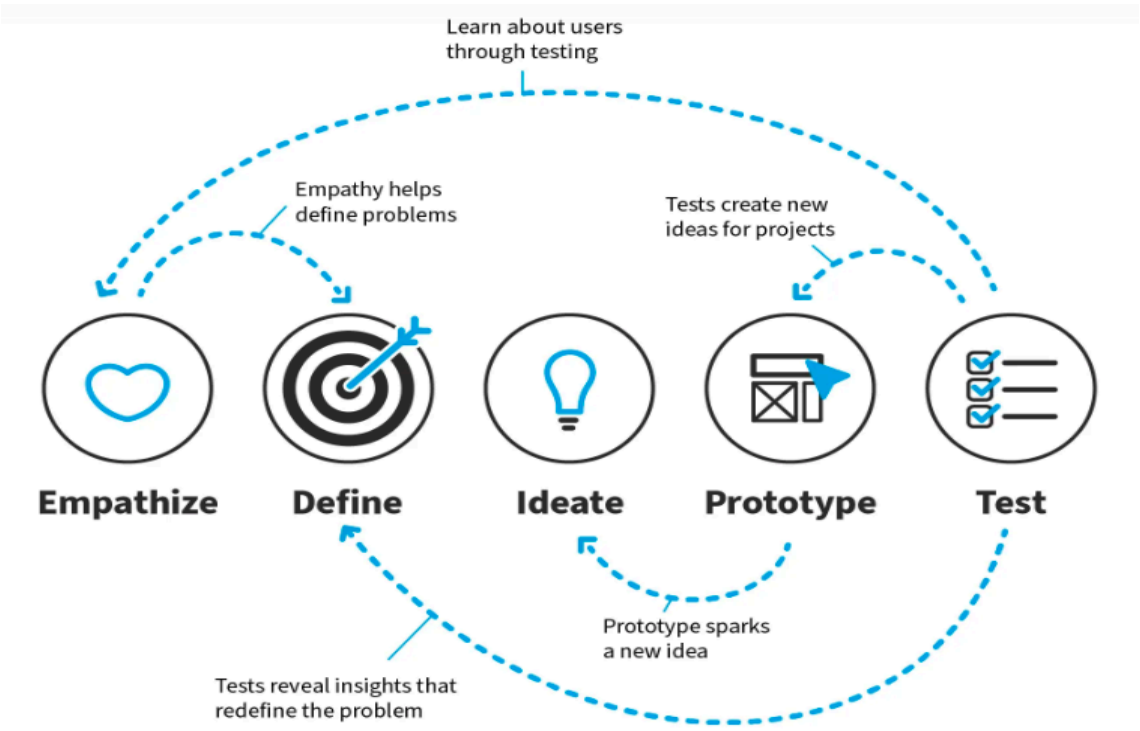


Figure 19: Design Thinking Framework (*What Is Design Thinking?*, 2024)

It consists of five key phases: empathise, define, imagine, prototype, and test, but these steps are not strictly linear as shown in figure 19. Even though there are 5 stages in a design thinking process, one of the main benefits of the five-stage model is that knowledge acquired in the latter stages of the process can inform repeats of earlier stages (Dam, 2024). This is because of the iterative nature of the model. Information is continually used to inform the understanding of the problem and solution spaces and to redefine the problem itself. This creates a perpetual loop in which the designers continue to gain new insights, develop new ways to view the product (or service) and its possible uses and develop a far more profound understanding of their real users and the problems they face.

Despite the practical guidelines that it offers to solve a challenging problem, design thinking has its drawbacks, and here, in the case of designing a screen time management tool, the following ones are critical: The commitment to utilising methods that derive from human experience—like empathy mapping and user testing—might lead to a bias towards users who are easy to access and listen to, thereby ignoring the rest of the user spectrum or even quiet majorities (Brown, 2009; Norman, 2013). Second, due to the inherent cyclic nature of design thinking, it results in extending timelines by first creating and then constantly refining prototypes till the project bifurcates the objectives into smaller goals.

When using design thinking to enhance iPhone's Screen Time in this particular study, the evaluation of user input was quite limited and therefore subjective, thereby not encompassing the

whole range of behaviours and motivations. Moreover, the five stages, including Empathise, Define, Ideate, Prototype, and Test, support creativity, but they don't focus on technical possibility and slight expansion that could lead to generating ideal solutions in the actual technological environment (Kolko, 2010).

From a theoretical point of view, design thinking does not take psychological or sociocultural aspects that govern the use of products into much consideration. For instance, it synchronises well with the motivation theories such as Self-Determination Theory by Ryan and Deci (2000) and Fogg's Behaviour Model (2002); however, it may not have the enough level of detail to address multifaceted, sustainable behaviour change such as fighting smartphone addiction. Third, it may not give as much importance to quantitative information, which reduces the richness of support for the given recommendations (Cross, 2001).

Nevertheless, design thinking is still a very strong strategy for encouraging the innovation and use of user-orientated approaches. Reducing the limitations of the process entails supplementing the process with strong theoretical principles and cross-disciplinary knowledge in order that the designs are not just easy to understand and use, but also plausible at the technological and psychological levels.

In the following parts, the stages of design thinking are described along with the methods and approaches that will help us understand the user needs and a design solution for the discussed problem.

6.1 Empathize

Empathising is the very first step in the process where researchers start to know their users, along with their needs and pain points. Design thinking can not begin without a solid understanding of the people for whom the team is developing. To acquire those insights, design thinkers must empathise with people and understand their requirements, ideas, emotions, and motivations (Mortensen, 2020). This is the phase when the researcher or designer aspires to comprehend user tasks and motivations authentically (Dam, 2024). At this stage, the designer tries not to judge but to put themselves in the user's shoes to truly understand their situation. This helps to discover the explicit and implicit needs of the user. This step is mostly done by user observations in a physical environment where the user will potentially use the end product.

To empathise with consumers, it is essential to adopt the beginner's perspective (Mortensen, 2020). When observing, designers should constantly try to leave their own preconceptions and experiences behind. They need to regularly and intentionally remind themselves to adopt a

beginner's attitude. It is useful for empathising to remind oneself not to judge what you witness but to question everything—even if the fact is known.

In this step, the user is the main focus. To come across the users, we have applied various methods, for example, surveys, user interviews, and contextual enquiries of the regular users to understand their communication with the said feature. We have documented all the findings from the analysis above. However, particularly in the empathy phase, we have gone through the gathered data, analysis, and the result of those to understand the users experience with the current solution properly. Firstly, we have created three personas and empathy maps to highlight the pain points of the users.

6.1.1 Persona

Designing a product or IT solution begins with the empathy phase, according to the design thinking methodology. This gives us some information about the users and the real issue. They are a useful tool for keeping the user's perspective in mind as we proceed through the design thinking process. As a user-centred design methodology, personas are employed. There are particular techniques used in IT system development to explain the system's interaction and navigation. The scenario changes when personas are used for product development, and the interaction with the product takes the lead. In this case, if the process is acted out as a kind of role-playing, it will be easier to understand how people engage with the product.

Additionally, a particular might not be subject to the same documentation standards as in systems development (Nielsen, 2019). The persona addresses the problems that could arise when a product is being designed. This approach is also used to prevent misunderstandings about the users and to offer everyone involved in the project a clear picture of who they are. We convey our comprehension of the users through personas. Personas are a design tool, and understanding and reducing data is the aim of the entire process (Nielsen, 2019 p. 10).

The entire process, from the first data gathering to the active use to the ongoing persona development, is covered in ten steps (Nielsen, 2019).

1. Data collection
2. Formulation of a hypothesis
3. The hypothesis is accepted by all.
4. A figure is determined
5. Description of the Personas
6. Preparing scenarios
7. The organisation provides acceptance.
8. Dissemination of knowledge

9. Everyone prepares the scenarios
10. Continuous adjustments.

1. **Collecting the data of the users.**

We did a survey on more than *100* users and interviewed *8* users and 4 participants for contextual inquiry to get an overview of the users experience of the screen time feature. We have put a question about how frequently they use the feature. Among all of our users, *11 percent* are high-end users, *78 percent* are medium-end users, and *28 percent* are low-end users. We ended up interviewing 2 high-end users and 3 of both medium- and low-end users.

2. **Formulation of a Hypothesis**

From our analysis of our survey and interview data, we have come up with the idea that users are generally confused about the interface. They don't find the interface interactive and user-friendly. Our data supports that the users think that the screen time is a feature of a lot of unclear data and a lack of nudges that might have helped the user to control the screen time. We thought about *a user who is not that involved with the feature and does not use it so much.* So, he knows less about the system and interface. We thought about another *user who uses the system but not regularly.* Sometimes he checks the features and tries to discover what might help him if he uses this. The last one we thought about is *a regular user of screen time and knows its pros and cons* as he checks its data and tries to control his use.

3. **The acceptance of the hypothesis**

While doing heuristic evaluation of the screen time feature, we also noticed the similar kind of issues in the interface and interactions. During the time of the evaluation two of us did an experimental test of the feature and tried to understand the problems from the perspective of the user. Therefore, our hypothesis of the issues began from there. So, finally all of our members discussed and decided that the hypothesis we have thought about is confirmed for the next step.

4. **A figure is determined:**

So, based on our hypothesis, we have decided that we will work on three personas. Which are high, medium, and low end users.

5. **Description of the Personas**

Persona 1
Sara The Multitasking Genius

Sara Hensen is a 26-year-old master's student. She is doing her master's in Computer Science and Engineering. She is also working for a company as a software developer. So, as a part of her work and study, she has to use digital devices a lot throughout the day. To stay connected with her office work and also study materials, her smartphone plays an important role in her life. All the important emails she gets she checks mostly on her mobile phone. To herself, a smartphone is not only a device to communicate. She uses her phone to maintain and track all her tasks and materials. Other daily uses are common like every other smartphone user.

Attitude towards digital solutions:
Sara is an expert in digital devices. As a computer science graduate, she is a frequent user of digital devices. However, she has a passion for exploring new features on a digital device.

Motivation for use
She frequently uses mobile phones for most of her communication tasks. As a result, she occasionally becomes distracted by social media or other mobile apps. Because of this, she occasionally uses her phone excessively. She therefore wants to track and manage use of her phone.

Accessibility
She uses her laptop, smartphone, and an iPad for some remote office work. As she's been using these devices for a long period of time, she has expertise on these devices. Through screen time, she gains an understanding of how much time she has been dividing between various activities. It therefore enables her to better manage her time.

Persona-2
Thomas The Balanced Cinematographer

William Thomas is 25 years old and born in Australia. He is currently residing in Copenhagen due to his Master's program. He is doing his master's in film and media studies. His degree is concentrated in cinematography. While doing his daily things he uses a MacBook and iPhone to manage his files and documents. He takes his most shots on his phone.

Attitude Towards Digital Solutions
Thomas believes that digital tools such as the Screen Time feature on iPhone are useful yet not required. However, screen time tools mean the insights are very clear yet sometimes there are a lot of statistics and notifications that are overwhelming. He is definitely moderately tech literate but prefers uncomplicated methods that do not detract him from getting things done or engaging in any creative work.

Motivation for use

As a multimedia student he creates material on his phone and posts it to several social networks, so he cannot say when he is most effective. He was able to understand that he spent much time with social media using the screen time report social media category. He found that he had too much chance to be idle and find things to do in social media outlets so he attempted to use the downtime settings to minimise how much time he spent in the social media sites as well as minimising the time that he had to rest. Nevertheless, each time he attempts to balance such activities as social media and rest he always struggles to change the time duration constantly.

Accessibility
Thomas conveniently adapts to the Screen Time option of his phone with ease, and he has no difficulty in making use of it. Unfortunately, he is making an appeal to himself in that manner, because at times he finds it hard to grasp all-encompassing reports on his usage. Due to his busy schedule, he is unable to turn on the feature every day; however, he does use it at times. At peak load days or when a deadline is approaching, he relies upon relaxation periods and the limits regarding app usage.

Persona-3
Emma The Minimalist Researcher

Emma Adelaide is a French girl who just turned 25 and enrolled in a master's program in Sustainable Development at Aalborg University. Considering the fact that Emma is passionate about taking action against climate change, she spends most of her time doing research, attending seminars, and collaborating with others on green projects. In order to focus on her studies and her work related to the environment, she tries to avoid using her whenever possible.

Attitude Towards Digital Solutions
Emma thinks that tech devices, such as the iPhone's screen time feature, are outright unnecessary for her lifestyle. In her opinion, self-discipline and clear boundaries make it unnecessary for technology to intervene. While she understands that particular setting may be useful to some, she feels it has less impact for someone who is naturally averse to the screen and controls their own behavior towards digital devices.

Motivation for use
It took her a long time to find and know about screen time limits. She rarely uses the screen time and sets limits on using her phone to avoid getting sidetracked. Whenever she tries this feature, she feels like these restrictions help her Check out app usage from time to time out of curiosity,

especially when it is busy academic times. Use the screen time as a means of reinforcement to support her effective temporal management strategies.

Accessibility

Emma does not often utilize the iPhone's Screen Time feature because she feels that the device's interface is simple and not a requirement on a daily basis. While she appreciates features such as app usage summaries, she does not play around with advanced functions, including setting app limits or downtime as She finds it less flexible to modify according to her need. She does not see her average use of the tool progressing into something that is based on more interaction with the tool, which is why she hopes there are better options available to accommodate people like her who want to limit their time using their devices.

6. Preparing scenarios

Situation** for **Sara

Sara is balancing a lot of responsibilities this week. Along with attending to an academic paper for her master's program that is due in a few days, she has a significant software deployment project at work that necessitates regular communication with her team and clients. In an attempt to effectively manage her workload, she finds herself alternating between her tablet, phone, and laptop. Even outside of work and school, Sara finds that she is using her phone excessively, getting absorbed by personal chats and social media updates. She feels overburdened and less productive as a result. To give her day some structure, she chooses to utilize the iphone's screen time features.

When Sara looks at her Screen Time dashboard, she discovers that she uses her phone for more that eight hours per day, primarily for communication and productivity apps. She does observe, though, that a starling amount of time is present on Instagram and Youtube. In order to prevent herself from being engaged in endless scrolling during her breaks, she limits her daily usage of social media apps to one hour. Sara plans her break from 11 PM to 7 AM in order to get enough sleep and prevent stress from working late into the night. Email and Slack are instances of essential apps that are exempt. She sets up the 'Down time' function to alternate between "Work" and "Study" modern according to her schedule. Only official notifications are sent during working hours. Work-related apps are turned off when studying.

Outcome

Sara feels more in charge of her day now that the changes have been made. She is able to cut down on needless social media use because of the app constraints, which frees up more time for self-care and relaxation. She receives at least 7 hours of sleep, and she thinks Downtime enhances her general wellbeing. She can focus on her work without being distracted by unimportant notifications when she is in focus mode.

Reflections
Sara finds that screen time helps her identify productivity gaps and improve her phone habits. However, she thinks the tool could be improved by including AI-based suggestions, such personalized reminders for breaks or information on her multitasking skills.

Scenario** for **Thomas
Thomas is in the midst of a hectic week at his university schedule. Lectures, project deadlines, and freelance cinematography work fill his days. He is making an effort to efficiently manage his time without sacrificing his artistic output or his well-being. He needs to do a lot of research and video editing for a big project that is due in three days. He sees that his productivity is being negatively impacted by the additional time he spends looking through social media apps in between the time while working on his contents. Even though he does not feel dependent on his phone, the amount of time he spends on unnecessary activities is beginning to affect how he works. Thomas chooses to use the Screen Time app function to limit social networking apps to 30 minutes each day. To determine where the majority of his screen time is going, he looks over his weekly usage report. He observes that his top two categories are Social Media and Youtube. Thomas allows downtime throughout his busiest work hours (9 AM-12 PM) in order to maintain focus during his editing sessions. All non-essential programs are momentarily disabled, with the exception of his communication and editing tools.

Outcome
Thomas is able to drastically cut down on distractions while working. He feels more in charge of his schedule and finishes the project one day ahead of schedule. He does that, though, on occasion, when he needs a creative mental break, he disables downtime and then activates again whenever he feels like using it again.
Reflections
Though he wishes the app could offer more proactive recommendations, such as establishing productivity goals or suggesting break during prolonged work periods, Thomas believes that Screen Time helps him remain aware of how much time he spends on his phone

Scenario** for **Emma

Emma observes that she has been using her phone a little more lately as she gets closer to a

crucial research paper deadline. She uses it to respond to group messaging and monitor academic forums for updates. She wants to make sure her attention stays on the paper even though this has little bearing on her task. However, she is noticing that she's been using social media randomly and scrolling reels mindlessly.

Emma checks her daily and weekly consumption by casually opening the Screen Time app. She observes that this week has witnessed a little increase in the use of her communication apps. Emma allocates her break from 7 PM to 9 PM using the down time feature on screen time for concentrated work in order to prevent interruptions while writing. She does not include necessary programs in the restriction, such as her reference tools and email. Although Emma rarely uses app limitations, she helps herself remember to be mindful of her time by setting a gentle reminder for her messaging app.

Outcome

Emma continues to use her phone in the same orderly manner. By preventing her phone from interfering with her nighttime ritual, the downtime feature helps her establish a concentrated habit. Emma examines her screen time data after submitting the article and is comforted to see that her behaviours still align with her values.

Reflections

Although Emma appreciates being able to review her behaviours, she believes the feature is insufficient for a casual user like herself. She wishes it were more flexible to understand and more transparent insights of the reminder notification window.

7. The organisation provides acceptance.

After creating the personas and their scenarios, it was presented in the group meeting, and discussion happened between members. After having a long discussion, all the group members accepted and approved the personas and their scenarios.

8. Dissemination of knowledge

All the members shared their own knowledge and ideas about the personas and their characteristics.

9. Everyone prepares the scenarios

Each member shared their own perception of the scenario based on the results that have been found on the data collection part. Finally, after group discussion, all ideas got together, prioritising the most relevant case.

10. Continuous adjustments.
Throughout the process, adjustments have been going on while doing the discussion.

6.1.2 Empathy Mapping

Empathy stands at the foundation of human-centred design and design thinking. To successfully identify and solve problems, it's important to immerse oneself in the subject matter and understand the challenges at hand (Neubauer et al., 2017). As design thinking facilitates methodical information collection and organisation, resulting in a thorough grasp of the target consumers' genuine issues, requirements, and expectations, diving deep into empathising with different users' insights is crucial. This is where the empathy mapping comes into the play.

An empathy map is a collaborative visualisation that describes what we know about a certain sort of user. It externalises knowledge about users in order to 1) foster a shared understanding of user demands and 2) help decision-making (Gibbons, 2024a). The empathy map visualises an individual's words, actions, and experiences to synthesise known knowledge about them (Cairins et al., 2021). Empathy mapping can be inspired by any type of study. They can assist UX professionals in determining which elements of their user they are familiar with and which areas require further user data. Empathy maps can capture a single person or represent an aggregate of numerous users (Gibbons, 2024a).

For our research, we have decided to go ahead with the aggregate empathy mapping because this type of mapping is made based on personas (Gibbons, 2024a). We already developed three different personas, and empathy mapping is an approach to visualising what we know about a character in an organised, empathetic manner.

The structure of the empathy mapping provided by Gibbons (2024a) has 4 different parts. These are categorised as Says, Thinks, Does, Feels.

The Says quadrant includes what the user says aloud in an interview or other usability assessment. Ideally, it includes exact and direct quotes from research. The Thinks quadrant represents what the user is thinking during the encounter. The Does quadrant contains the activities that the user performs. Lastly, the Feels quadrant depicts the user's emotional state, which is commonly represented with an adjective and a short statement for context.

We have made 3 different empathy maps based on our personas. In these, we have highlighted the four quadrants, relying on how the personas are expressing these and how these can eventually guide us towards the problems and gaps that should be solved by our design.

6.2 Define

Define is a step of the Design Thinking process that is likely the most difficult, as the defining of a problem will require synthesising the observations about users from the first stage of the Design Thinking process, known as the Empathise stage (Interaction Design Foundation - IxDF, 2020).

In the Define phase of our research, we synthesised the data gathered during the data collection by user interviews, contextual enquiries, and survey analysis and the personas as well as empathy maps created based on those findings in our empathise phase. These methods were instrumental in addressing most of our research questions, particularly those related to understanding user behaviour, preferences, and pain points. The rich insights from this stage allowed us to answer some of our research questions comprehensively. These findings provided a foundational understanding of the users' needs and behaviours, forming the basis for defining our design challenges.

While many user behaviour and preference-related questions were addressed during the previous steps and made our empathy phase effective, the *Define* phase concentrated on refining the specific design-orientated questions that emerged from our findings, as this is the step to refine focus, which eventually will help to find the solutions to the pain points shared by the users. These questions related to design are:

How can screen time features be designed to enhance students' awareness of phone usage patterns while minimising disruptions?
What design adjustments can be implemented to maximise user engagement to make it more interactive?
How can iPhone screen time tools be redesigned to support students in sustaining focus and maintaining productivity through reduced digital distractions?

From this to the next phases, we have focused on these questions to ensure that the Screen Time feature not only reflects user needs but also actively supports behaviour change non-intrusively. This targeted approach allowed us to translate user insights gained above and centralise them in such a way that we can meet actionable design goals that align with the broader research objectives.

There are some methods that guide the defined phase for the design team to stay on track and finally focus on a problem area. Out of these, we have combined POV (Point of View) along with HMW ideas to create a focus point for the next steps

6.2.1 POV- Problem statement

A point of view (POV) is a meaningful and actionable problem statement that allows the design team to brainstorm in a goal-orientated way (Dam & Teo, 2024b). This statement captures the design vision by specifying the appropriate challenge to solve during brainstorming sessions. A POV entails transforming a design challenge into an actionable problem statement. The method entails defining a point of view by integrating knowledge about the user for whom the design is intended, his or her wants, and ideas gleaned from research or empathy. The point of view should be an actionable issue statement that will guide the remainder of the design process.

When we looked into our findings from the empathy mapping and personas, it directed us towards some areas that needed to be addressed. In our research, data analysis from interviews and surveys revealed recurring themes about how university students perceive and interact with screen time management tools. Findings from empathy mapping highlighted the emotional frustration students face when tools are intrusive or fail to adapt to their personal needs and have a bit of a generic nature. Personas have presented that autonomy, ease of use, and meaningful engagement are necessary in adopting screen time management solutions for a longer period. When we looked into the empathy mapping combined with personas, it directed us towards some areas that needed to be addressed. Many users have expressed the desire for a system that will respect the user agency and offer personalised options rather than some rigid instructions. This insight formed the basis of our design focus, ensuring the user-centric approach for the intervention strategy.
Based on this, we have come up with the following problem statement:

[University students with excessive phone usage habits] need [a method to effectively regulate their screen time without feeling much interfered] because [current features frequently fail to engage and make them mindfully aware about the situation, which results in limited adoption patterns for long-term behavioural change].

6.2.2 HMW

When the design issue is identified from a certain point of view, the hunt for solutions begins (Dam & Teo, 2024b). The point of view can serve as the starting point, and work can be moved forward by asking a particular question beginning with "How Might We" or "In what ways might we?" How Might We (HMW) enquiries have the ability to elicit ideation sessions such as brainstorming? They should be broad enough to allow for a variety of solutions while yet being narrow enough to allow for the development of specialised solutions. While writing the How might we questions, it is important to strike a balance between creativity and practicality because these questions guide the team towards actionable solutions. This process also provides a great

opportunity for team collaboration where diverse perspectives and innovative ideas are expressed.

We have taken the help of our POV statement to frame our HMW questions, as it ensures that our design work directly addresses the core challenge and user needs. Furthermore, the structured design of HMW enquiries enables both creative investigation and the development of tailored solutions that respect user autonomy while encouraging long-term behavioural change. While creating these questions, we have also incorporated our theories. The reason behind this is that the selected theories provide a strong foundation for the design work by combining both SDT and persuasive design strategies (Fogg Model, Nudge Theory, and Gamification). Figure 20 represents prepared HMW questions from one of our design iterations.

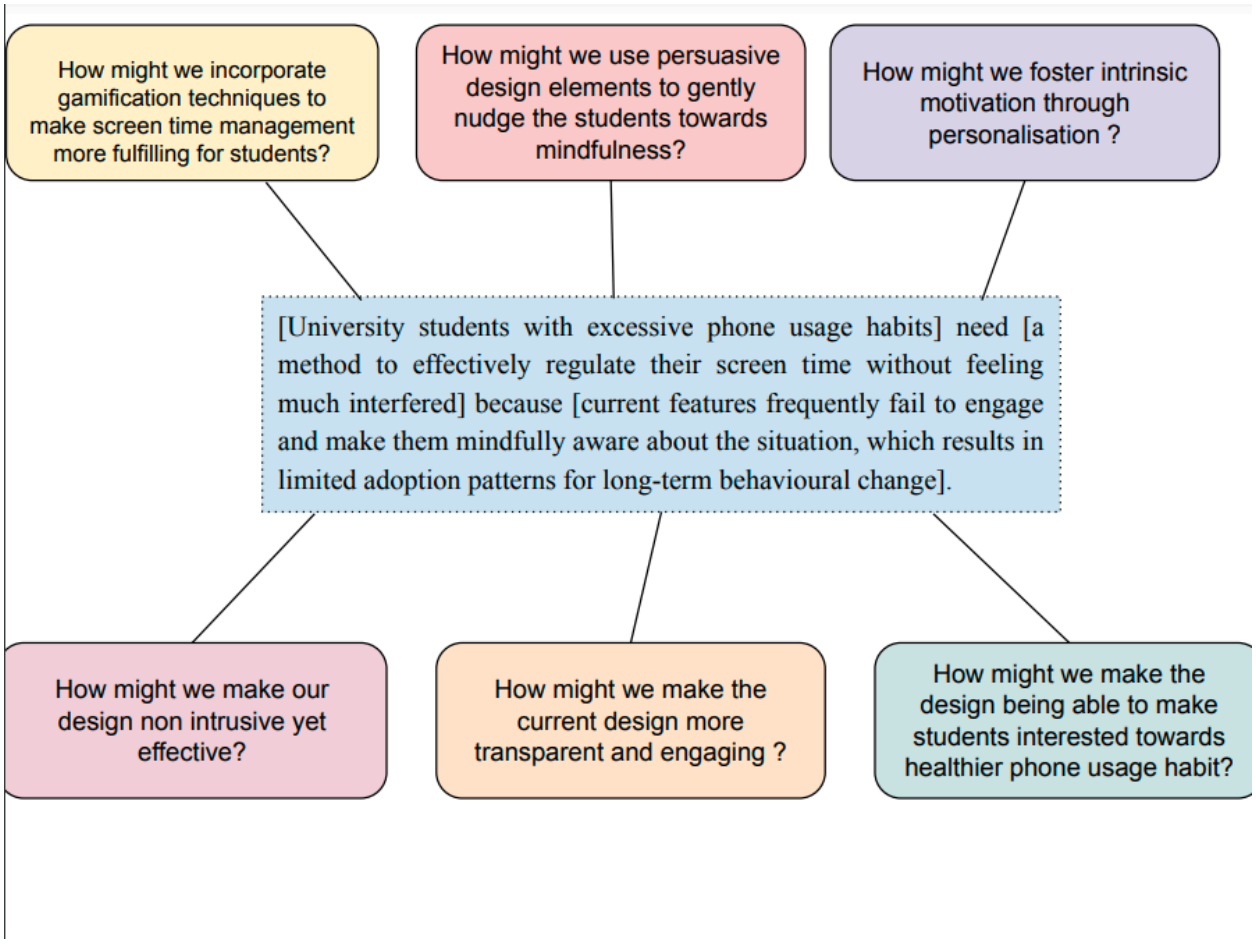


Figure 20: HMW Questions

6.3 Ideation

Ideation is the third phase in the Design Thinking process, following "*Empathise*" (gaining user insights through research/observation) and "*Define*" (identifying links/patterns within those insights to produce a meaningful and feasible problem statement or point of view) .

In the ideation phase, we started to look at the problem from the How Might We questions and the POV statement. First of all, we deeply analysed the relevant areas that need our attention in terms of answering or finding solutions for the problem faced by the user. To do that, we have basically followed two established ideation methods, which are brainstorming and storyboarding.

6.3.1 Brainstorming

Brainstorming is a method of coming up with a lot of ideas by utilising the group's collective intelligence, interacting with one another, paying attention, and expanding on previous concepts (*What Is Brainstorming? 10 Effective Techniques You Can Use*, 2024). In any brainstorming session, the goal is to come up with as many viable answers as they can. Team members build on each other's responses and ideas while concentrating on one issue or challenge at a time. The best answer or solutions can then be selected by refining and limiting them. Using the brainstorming technique proactively, one can come up with a lot of ideas one would not be able to with a simple pen and paper sitting down. As a result of interacting with one another, listening to one another, and extending on one another's ideas, brainstorming maximises the collective thinking of the group. A brainstorming session also establishes a specific window of time during which one deliberately activates the creative side of the brain and inhibits the evaluative side.

We have followed the eight rules while brainstorming designed by *Brainstorming? 10 Effective Techniques You Can Use*, 2024). Those are;

Set a time limit:
Typically, we aimed for a 30-minute session, as it strikes a balance between allowing ample time for creative thinking and preventing participants from becoming fatigued. However, the time varied depending on the topic or members' motivations.

Begin with a target problem
The founder of the brainstorming approach, Alex Osborn (1953), emphasises that brainstorming sessions are ineffective when they address more than one topic; instead, they should always focus on a single question or problem statement (also known as a point of view). We had our defined problem statement ready already, and the storyboarding also helped us visualise the core problem, which helped us to progress in this step easily.

Refrain from judgement

It is important for the speaker to maintain a constructive and non-threatening atmosphere while instructing participants to hold off their critique until a crucial phase of the brainstorming process. As participants, we always refrain ourselves from any judgement and let the ideas come in naturally, as this is important to have creative and innovative solutions.

Encourage weird and wacky ideas

"Creative leaps are frequently the result of wild ideas." By removing ourselves from technological or resource limits, we opened the door to inventive solutions that would otherwise go unnoticed.

Aim for quantity

The maximum number of fresh ideas should be the aim. It is assumed that the more ideas that are created, the higher the likelihood of coming up with a novel and workable solution. “Quantity breeds quality” is a saying that is praised in brainstorming. We prioritised having each idea documented so that nothing gets lost in the process.

Build on others ideas

Unconventional ideas should be accepted. Participants need to be enthusiastic and develop on other people's ideas. When participants utilize the other's thoughts to encourage their own ideas, brainstorming is most effective. Humans have very associative minds. It is easy for one notion to spark another. Utilising other people's ideas helps not to get stuck in their own mental models. When we started exploring potential solutions to our research questions, we looked into the literature again and mapped all the available options we had. Then we started redefining the options in terms of the pros and cons those options had. For instance, we have seen several apps available that may help people with screen time management issues. Similarly, there are also mentions of how mindfulness should be added to these types of solutions. We looked into our user group and personas while trying to connect their needs with our problem area. From the persona scenario and empathy map, we have learnt that users face problems when they are immersed in excessive phone usage, but the screen time app does not provide them with any mindful suggestions; rather, there are some generic visuals available. We tried to build on how the gaps of the current solution can be mitigated with some subtle nudges to encourage users towards healthier phone usage habits.

Stay visual

Drawing a concept out is the fastest way to communicate it. No matter how poor the sketching is, the concept behind the sketch is important. We have created storyboarding and also some visualisations about what the projected solutions might look like.

Allow one conversation at a time

It’s better to share ideas with each other and talk about one idea once. When all team members have presented their ideas, the best ideas can be selected. We have discussed all our ideas and then either proceeded with the best one or combined them.

6.3.2 Storyboarding

The term “storyboard” refers to a visual organiser, and it shows the development of a sequence, shot by shot (Soegaard, 2024). This storyboarding method has been used in several different aspects, and UX research is one of them. In any UX research, visualisation plays a key role in understanding the actual area to focus on. A UX storyboard is a visual tool that depicts a user's interaction with a product or service. Designers use storyboards to identify and fulfil user demands as they progress through the UX design process. Each one consists of a series of sketches or illustrations that depict a user's interactions with a product. They also depict the user's feelings and challenges—crucial bits of UX research to employ as the product evolves.

The storyboards employ pictures, which our brains digest faster than words, and this attribute promotes rapid comprehension across teams (Soegaard, 2024). Additionally, these are centred on people, which encourages designers to consider the user's perspective and have user stories define the user's needs and goals—and they make sure that the development team builds features that truly benefit the end user.

We have deployed storyboarding because it helps designers generate ideas and allows designers to sketch how people could utilise a feature. This helps the design and development teams understand the user's settings before they begin building. Storyboards for ideation spark discussions and that is what was needed for us

There are several different ways to do storyboarding, such as sketching, pictures, and illustrations. We have done both sketching and illustrations. We have added the picture of our storyboard pictures in the appendix.

In order to address a variety of possible problems, like questions, comments, or lack of functionality, storyboarding can be used with personas and scenarios. For instance, designers can pick one persona and apply it to two or three scenarios, which will result in the design of a timeline of users’ interactions. This timeline can then become a conversation point about some potential technical issues, hassles, or scenarios that are not heavily designed. Some guidelines found in literature that relate to this suggestion include Nielsen’s (1993) usability heuristics, where the focus is put on identifying gaps in usability early in the process, and Cooper et al. (2014) suggested about including persona-based scenarios to storyboarding to create a better match to users’ needs. This confers rich organisation for added functional knowledge and emotional and contextual perception of the method.

6.4 Prototype

Prototype is basically a phase in the design thinking method where all the research that has been done in the previous parts takes a visual shape. “A prototype is one manifestation of a design that allows stakeholders to interact with it and to explore its suitability; it is limited in that a prototype will usually emphasise one set of product characteristics and de-emphasize others” (Sharp et al., 2015, p. 386). The purpose of prototypes is to refine requirements, communicate with teams and stakeholders, explore design solutions, and actively learn about the design space and relevant phenomena, including gradual improvement, sharing information, diverging from one another, and acquiring knowledge (Camburn et al., 2017). Prototyping interactive systems may be challenging during the early phases of a project due to their complexity. Additionally, creating a focused prototype is an art form, and effectively expressing its goal to different audiences is crucial.

Budde et al. (1990) presented that there are three different types of prototyping available.

- Exploratory prototyping is utilized when the situation at hand is unclear. In this, initial concepts help highlight user and administrative needs for the future system. Changes in work content, as well as the kind and breadth of computer support, are all considered equivalent. Exploratory prototyping is crucial for project acquisition, especially when developers and consumers are from separate firms.
- Experiment prototyping focuses on the technological realisation of development goals. Experimentation helps consumers develop their understanding of computer support needs.
- Evolutionary prototyping extends beyond a particular development project. It is a constant process of adjusting an application system to changing organisational restrictions. Software development is now integrated into the program as a continuous feature rather than a standalone project.

There are different types of prototyping available catering to the needs or goals of our study; iterative prototyping is the best fit, as we are doing design thinking research, which is an iterative method. To explore the solution of screen time management is a complex process, only iterative research and prototyping can help us reach through the core of the problem and provide a genuine solution. Combining both exploratory and iterative prototyping, we have presented a functional prototype based on our design problem.

Low-fidelity and high-fidelity Prototypes

Low- and high-fidelity prototypes contrast from each other in terms of functionalities and presentation. A low-fidelity prototype differs from the final product in appearance and

functionality (Preece et al., 2019). For example, it may employ quite different materials, such as paper and cardboard, instead of electrical displays and metal; it may do just a restricted number of operations; or it may merely depict the functions without performing any of them. These prototypes are beneficial because of their simplicity, low cost, and speedy production. This also means that they are simple, inexpensive, and easy to adapt, allowing for the exploration of many designs and concepts.

On the other hand, a high-fidelity prototype resembles the final product and typically offers greater functionality than a low-fidelity prototype (Preece et al., 2019). It can sometimes be mistaken for the final product. For example, a prototype of a software system written in Python or another executable language has more fidelity than a paper-based mock-up. High-fidelity prototypes may be created by changing and merging existing components—both hardware and software—that are readily available through different development kits and open-source software.

It is common for prototypes to evolve through various stages of fidelity within the design-evaluate-redesign cycles (Preece et al., 2019). We have chosen to use low-fidelity prototypes as this is the very first attempt at redesigning the iPhone's screen time feature. Because early phases of development, such as conceptual design, require flexible prototypes that allow for exploration and adaptation of concepts (Preece et al., 2019).

However, even though we have finally developed low-fidelity prototypes, there were several steps we have gone through to finalise our first prototype. The process of doing that is described below.

6.4.1 Sketching

The actual journey of prototyping starts here. The process of sketching in prototyping involves rapidly translating conceptual ideas into tangible forms, emphasising quantity over quality. By collecting a diverse array of concepts rapidly, designers can explore a broad spectrum of possibilities. This approach aligns with Linus Pauling's philosophy that having numerous ideas enhances the likelihood of discovering a good one. Moreover, the iterative nature of this kind of prototyping ensures that designs can evolve and improve progressively, allowing for refinements and enhancements as the creative process. The advantage of sketches is that they preserve ambiguity while also allowing key details to be expressed, enabling designers to explore a spectrum of variants intuitively. Additionally, designers use physical prototypes during early design phases in order to understand how a design will function, how it will be used, or what it will accomplish (Elsen et al., 2012). After deciding about the interactive screen in the ideation phase, we started developing ideas of the features and core functionality the screen should have. From the guidelines of the literature review and existing interactive screens, we have progressed

in our sketching phase.

We have followed the Design Studio method for sketching. This initially has three steps.

1. Sketch: After we had a rough notion for the design solution, we addressed the many parts of the user's demands using the previously outlined storyboarding and empathy mapping techniques. We agreed that each member of the group would come up with a concept for a prototype.
2. Present: After each of us finished drawing a prototype, we integrated all of the futures and functionalities that cater to our personas, as well as the path mapping.
3. Critique: Finally, we examined the positive and negative features of the combo, which helped us perfect our prototype for user testing.

6.4.2 Paper Prototyping

Design teams create paper representations of digital products to help them realise concepts and test designs by drawing sketches or adapting printed materials for paper, and these low-fidelity screenshot samples are used by designers to guide their designs and observe user reactions to them (What is paper prototyping?, 2024). Using paper prototypes in an iterative design and assessment process can pave the way for more complex coding versions later in the project. Paper prototypes require simple materials such as paper, pencils, scissors, glue, and interested consumers to provide feedback as design concepts may be rapidly mocked up, tested, updated on the fly, and retested.

Paper prototypes are very quick in terms of their quick iteration. Teams can make an easy overview of the design instead of going into too many details (What is paper prototyping?, 2024). Everyone in the team can make rough sketches of the core functionalities and have a hard copy as a proof of documentation. The feedback seems to be more honest than an actual developed system.

Even though paper prototypes are normally made very early in a system development, building any type of prototype requires integration of both conceptual design and concrete design (Preece et al., 2019). Conceptual design outlines a product's functionality and interaction principles, whereas concrete design focuses on design specifics like layout and navigation. In our case, once the sketching was done, we geared up for arranging a paper prototype to make it ready for user testing. In our first round of prototyping, we had sketched and finalised a prototype. In that prototype, we integrated different functionalities that would help the user be mindful of their excessive smartphone usage and try to reduce that eventually. However, we finally decided to go along with low-fidelity figma prototypes, and the reason behind this will be discussed below.

6.4.3 Low-fidelity Figma prototyping

Paper prototyping, with all its advantages, has its own demerits. After building our paper prototype, we have done pilot testing and faced some difficulties along the process. Modification of an already existing product or system is challenging because the user already has a model in their mind and gets confused with the new arrangements. Fortunately, the Figma tool allows us to make a low-fidelity prototype where we do not have to spend much time in terms of adding functionalities from the core, yet we could design interactions that could provide a similar interface the end users are accustomed to using. In our proposed system, it is an important part that users need to go back and forth, which was a bit difficult in paper prototyping (Snyder, 2003). Another reason we have opted for this was its ability to be shared digitally, enabling remote testing and accommodating the varied schedule of university students. It also provided an easier way for recording interaction digitally and helped in terms of tracking user flow and understanding the impact of added design elements on decision-making. This approach facilitated flexible, accessible, and relevant usability testing.

Our final product, along with the 1st and 2nd iterations, will be discussed in the following parts, with discussion and user testing in the following part.

6.5 User Testing

When a design has been formed, it is crucial to test that with the real users. In this phase, putting the prototype in front of actual users and verifying if it is fulfilling the end goal the design was made for in the first place is necessary (Gibbons, 2024). To understand if the user perspectives align with the ideas the researcher acclaimed to gain from the presented design. In design thinking, the test may reveal fresh insights, allowing the team to fine-tune the prototype or even return to the *Define* step to examine the problem again (What Is Design Thinking?, 2024).

As we said before, the design thinking process allows us to work iteratively. Therefore, we have planned to test our design to assess the efficacy of our solution so that we can go back and make changes to the design again.

For conducting the user testing and gathering feedback, we have essentially followed the guidelines provided by Dam & Teo (2023).
There were 6 steps to conduct the test:

1. Think of How to Solicit Feedback

In the previous part, we described how we actually chose the method for our testing. For the low-fidelity figma prototype, we have arranged digital and remote feedback. To encourage critical feedback, we have asked them to compare the new design with their already available solution. Additionally, we have asked the users to talk aloud along the way they were experiencing and completing the tasks so that the real confusions can be expressed.

2. Test Your Prototypes on the Right People
Choosing the right people is important for getting feedback, which is eventually going to help the iterations of the design. As the user is the most valuable entity in user-centred design research, we have been careful in terms of choosing our users. Firstly, we have reached out to the users who have participated in our interviews and contextual enquiries, as they were the base for building personas. Some of them agreed, and we made plans to run the tests. We have tested both our prototypes with three participants.

3. Ask the Right Questions
To gain actionable insights about the future design ideas, we have formulated some open-ended questions along the way we were doing testing. These questions were specific to different aspects of the presented prototype, such as usability, clarity of information, and relevance of user needs.

4. Be Neutral When You Present Your Ideas
While we presented the prototype, we made sure that participants were not led towards any unnecessary personal bias, which is very important to get effective feedback. This was to ensure authentic feedback rather than one influenced by our expectations.

5. Adapt While You Test
For conducting the test, we made an initial process including tasks and open-ended questions. However, we did not stick to the flow we planned before. Rather, we prioritised a spontaneous approach where the participants were immersed in the process and the tasks came naturally. This actually gave us some unexpected areas to think about of which we were not aware while designing the prototype.

6. Let Your Participants Contribute Ideas
Participants were thoroughly encouraged to suggest their own solutions or improvements during the session as well as after the completion of the testing. The users were notified before that they were allowed to share whatever was on their minds regarding the design. This collaborative session actually provided us with enriched user feedback and opened the new door for iteration of the prototypes. However, we have also kept in mind that our ultimate purpose was to silently observe the person interacting with the design rather than conversing with the participant.

Getting inspiration from the iterative nature of the testing phase, we recognised the significance of conducting multiple user tests. This iterative approach provided us with a more thorough

understanding of user preferences and pain points, guiding us toward continuous enhancements.

In the subsequent sections, we will delve into the various iterations of the prototype and analyse the constructive feedback received from users. This process of refinement is crucial to shaping a solution that aligns closely with user expectations and addresses the issues of screen time management effectively.

6.5.1 First Prototype

For designing our first prototype, we have taken inspiration from the literature review, theory, and heuristic evaluation, as it was a relatively earlier stage of our research. To inform decisions, we have delved into existing research or systems that might help us gather knowledge in terms of functionalities, which may help us make students more aware of their usage and subtly nudge them towards lesser usage (Figure 21, 22 and 23).

1. The first thing we noticed was that screen time management, even though widely talked about, was not a default function, and the user needed to turn that on first to see the activity. In our design solution, the screen time was on default.
2. Another functionality was selecting a specific date, which was not available in the current solution. We decided to add this new button called *Select a date* so that the user can transport to any date that the iPhone does not support currently and also do not save the report that is older than 3 weeks. However, it takes an average of 66 days to consistently include one of three new daily activities (Solis-Moreira, 2024).
3. If they press the select a date button, they will be redirected to a calendar where they can press on a specific date and see their activities on that day. It is designed specifically for making users realise the trend of their smartphone usage.
4. We have added gamification features like rewards, where users will get rewards if they can fulfil the requirements of not ignoring the app limit for 7, 14, and 21 days in a row. This is important because it aims to foster the autonomy and competence of a user.
5. Once the users reach their app limit set by themselves, there will be a prompt including information about the number of times they picked up the particular app and the amount of time they have spent that day. Previously, there was a generic prompt with no information, which might motivate the user.
6. In this prompt, we have highlighted the Do not ignore button compared to the ignore limit button for nudging them.

We have added the pictures to the specific pages we have changed below. However, the link for the full interaction design is added in the appendix.

Figure 21: Prototype 1

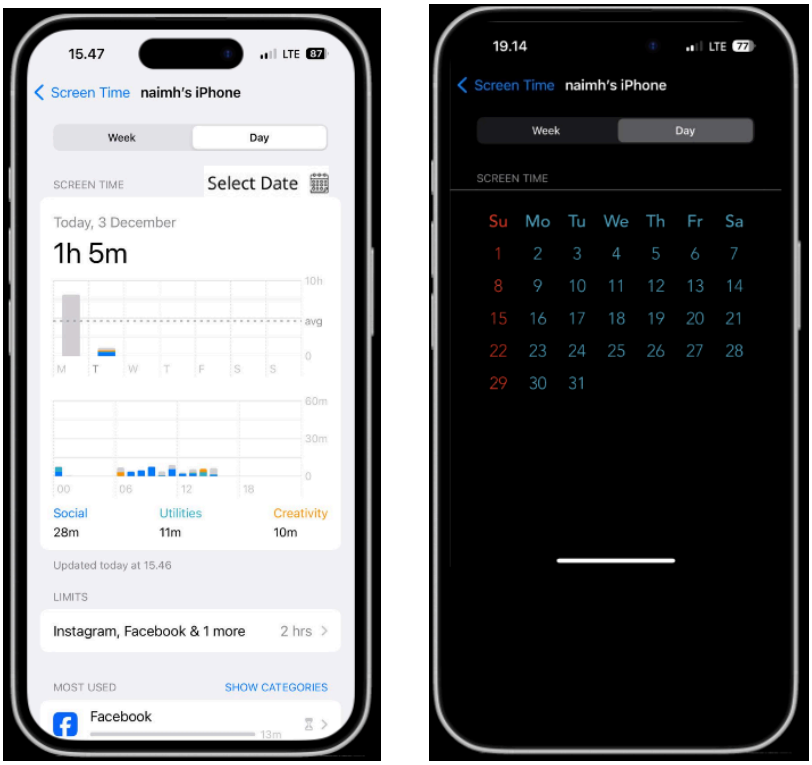


Figure 22: Prototype 1

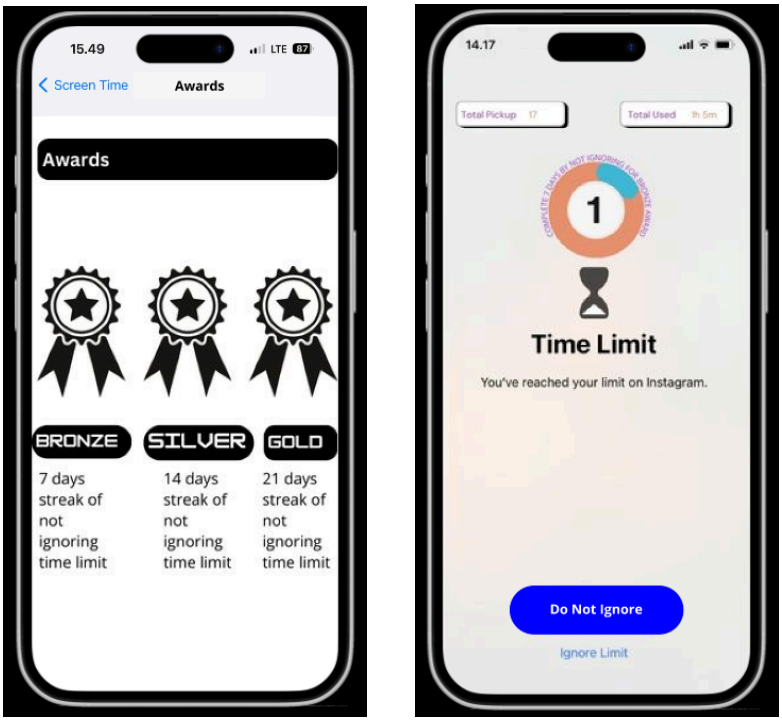


Figure 23: Prototype 1

User Testing Analysis:

After a round of user testing was completed, we started to brainstorm and plan to analyse the user testing. The feedback given by the real users was crucial in terms of ideation for our next iterations. To analyse the data gathered from the testing sessions, we have looked through the analysing methods suggested by Dam & Teo (2023). There are 3 methods, such as *I like, I wish, What If, Sharing Inspiring Stories*, and *Feedback Grid* which could be applied to understand the user experience. In I like, I wish, What If method,

"I Like…" comments encourage people to provide positive feedback on the prototype.
"I Wish…" comments invite participants to provide suggestions on how to enhance the prototype to solve their issues and allow both constructive criticism and negative feedback.
Finally, in "What If..." statements, participants are asked to propose additional recommendations that may not directly relate to the presented prototype but open up new possibilities for refining it in the future (Dam & Teo, 2023).

In the Sharing *Inspiring Stories* method, the researchers take notes at the time of testing and gather together once the round of testing is done (Dam & Teo, 2023). They share detailed and

inspiring stories from the completed testing together, as stories are powerful tools to inspire teams and to refine ideas. In the gathering, the team highlights and discusses the key observations and arranges these as displays on the wall. Common themes and insights can be identified about the users by examining these stories expressed and collected by the team. Finally, these shared experiences can help to take actionable steps and generate innovative solutions

In the *Feedback Grid* method, a feedback grid helps the team organise input in a disciplined manner. It may be used during the exam to collect feedback from participants in a systematic way or after the test to organise the input. The information expressed by the users is grouped into four quadrants. The first one named Likes is used to capture positive points of the prototype; the second one, Criticism, stores the negative feedback; the third section, Questions, is used to collect the confusion points of the user for the prototype; and the last section, called Ideas, includes areas that require improvement.

All the methods discussed above have their own strengths in terms of capturing participant feedback. However, we have gone ahead with the *Feedback Grid* method. Unlike the *I like, I wish, What If* method*,* which basically relies mostly on participants creativity and engagement, this provides more room for analysing the underlying facts. It also provides more flexibility without being too intrusive. The *Feedback Grid method* also differs from the *Sharing Inspiring Stories* method because the latter one requires extensive team collaboration and discussing thematic insights. Additionally, the visual format of the grid makes it easy in terms of spot patterns for different participants. This also ensured no feedback is ignored, which makes the selected method ideal for iterative design.

Testing feedback for 1st prototype:

In the course of making the general assessment, users provided some features of the prototype that they liked, as well as defects and possible amendments to the design. By far, most of the users appreciated the information the app provided, including total pickup time and total use time in the notification window. The participants also pointed out that the strike circle and rewards were motivational aspects of the app, which were not present with the previously mentioned conventional applications. For this, they said that the use of gamification within the application brought out fun as well as responsibility in completing the tasks. The daily average of the current week was considered to be more accurate and concise than the iPhone Screen Time option. Also, the comment with regards to the calendar that was built into the program was well received because users could choose dates of the month they wanted to have detailed reports for. The second positive response was regarding the wordings of the nudge text of “Do not ignore” in the app limit reminder window. The reward section remained on the rise for receiving more appreciation for the users who found motivation in engaging with the screen time feature and an

ability to manage time on this application. However, from the study, users highlighted the following as some of the drawbacks associated with use of social networks. The concept of switching between daily and weekly reports was blurred for some of the users; they could not tell where one report ends, and another begins. They also observed that the feature to limit use of the phone was under the phone setting and was not easily visible. Several participants noted that they were not sure about the app limit reminder window 'total pickup' and the meaning of the information in the circular design. Moreover, the reward section was not very apparent on the platform, and some of the users complained that they could make sense of how the reward option worked.

Many users provided good suggestions for improving the design of the prototype. Some recommended that its streak circle should be personalized and the reward features to fit interests that people have, thus increasing the download rate of the app. They also suggested making the reward section have more colors and graphics and mimic the accomplishment rings that the fitness app has. It was also suggested that people should be rewarded hierarchically depending on how well they perform to the goals that were set to make the process more exciting. Finally, they demanded the relocation of the Screen Time feature from the settings menu and its placement into its own app that will be easily discoverable.

6.5.2 Second Prototype

Following a round of user testing on the first prototype, we collected and analysed data as explained above. From the feedback received, we went back to the *Define* stage of the design thinking process. This helped us to better define what users require, what pain points were not initially considered, and to elaborate upon the problem that would frame the next version of our prototype (Figures 24, 25, 26, 27, and 28).

1. The Screen Time feature is now located on the home screen, which is much more convenient than if it were found in the Settings menu as suggested by the user. This change minimises resistance in one's screen time information, making them to be accessed frequently and thereby enhancing the engagement of users. With the integration of Home, Awards, and Profile, a user gets the possibility to switch between tracking the time spent on the phone and watching the progress through the Award system and editing his or her settings in Profile. The addition of a footer navigation bar further simplifies usability, ensuring seamless transitions between key features. This design feature is consistent with behavioral design science, from a user experience standpoint, accessibility and convenience are key best practice indicators when it comes to extending patterns of use and repeatedly visiting and engaging the site (Fogg, 2002).

2. The application first guides the user through a sequence of onboarding screens that describe the main features of the app, namely Screen Time Report, Daily Goal, and Downtime. This way, people who have not been using the app before know how to use it optimally, improving usage rates.

3. This screen enables the user to set specific daily screen times and set alerts. Allowing users to control their goals is one of the methods in the presented feature that encourages intentional, which is consistent with the user-initiated behaviour change theory (Ryan & Deci, 2000).

4. A subtle banner appears if the user has been active in a particular application for 30 minutes. This real-time feedback is not intrusive and guides users to be attentive to their experience without invasive interventions. Such gentle periodic prompts are useful in influencing behavioural change by means of 'twists' (Fogg, 2002).

5. The Screen Time Overview summary gives the average amount of time spent on screen in general and in categories, including Social, Utilities, and Productivity & Finance. It makes some tips and tricks highlighted and provides one-click access to the most frequently used tools such as Downtime, App Limits, or Screen Time features.

6. The application has buttons to flip between working in the weekly and daily perspectives in order to offer the most detailed and generalised modes. The breakdown by categories and apps on this screen raises a conscious effort to review their behaviour and make changes that align with the outlined goals and objectives. This approach creates powerful self-awareness and teaches effectively by presenting the data in a simple and understandable manner.

7. The calendar aspect enables users to choose particular dates to see the past records of the screen time, which is not present in the current iPhone solution and has no long-term analysis. This feature is helpful for the user in referencing the trends and patterns in their use, which is essential for habit creation and awareness (Solis-Moreira, 2024).

8. The process of gamification is achieved by tracking streaks (seven, fourteen, twenty-one days), and thus encouraging users to stay within their app usage limit. These rewards are intrinsically motivated as they increase the user's perceived control or autonomy and perceived skills or competence as proposed through Self-Determination theory (Ryan & Deci, 2000). This design seeks to ensure that people are encouraged, happy, and motivated to develop habits.

Figure 24: Prototype 2

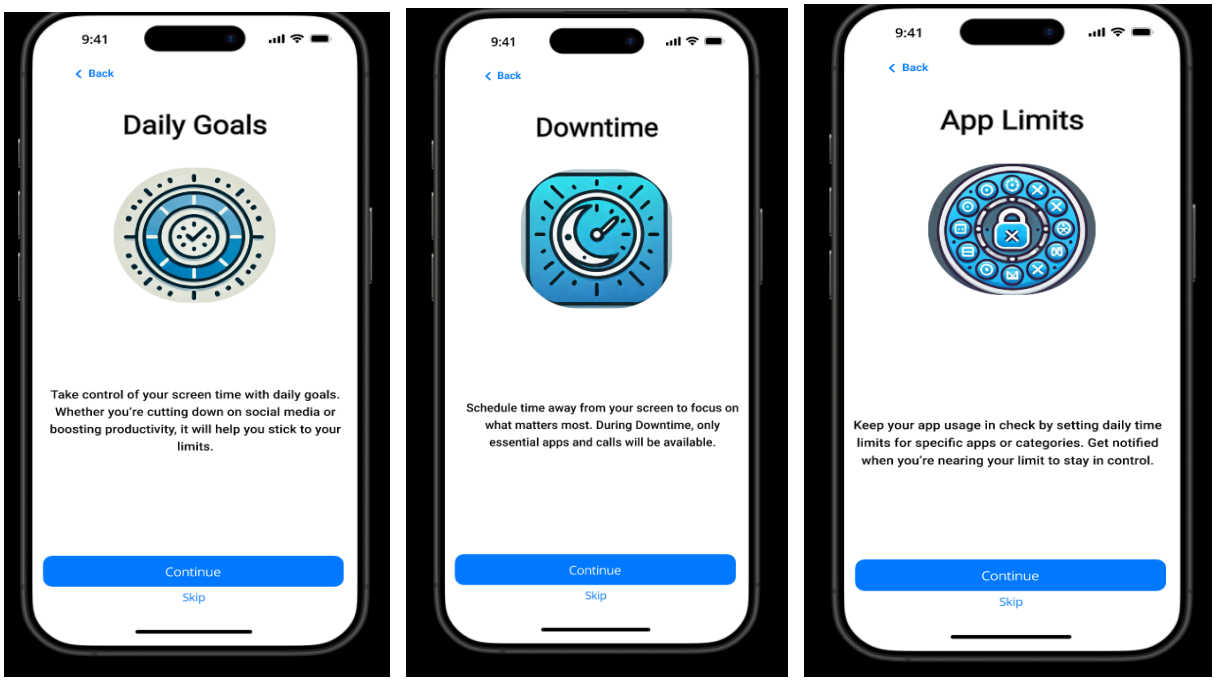


Figure 25: Prototype 2

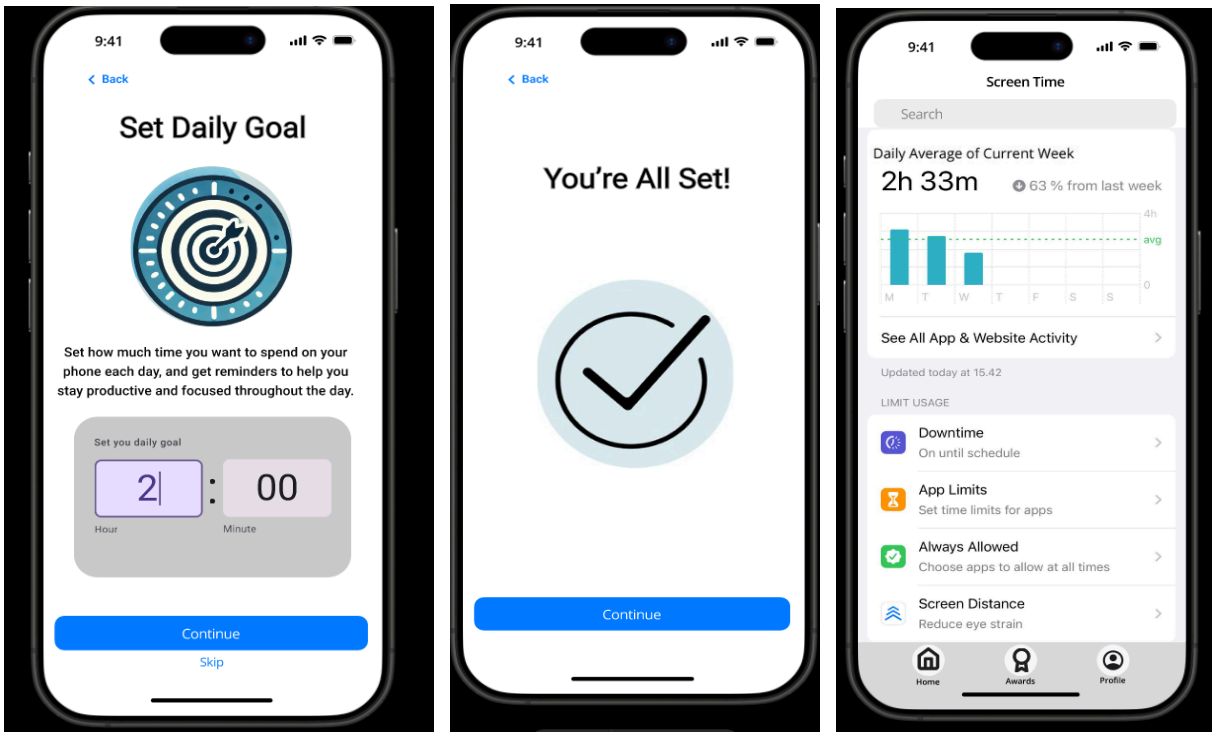


Figure 26: Prototype 2

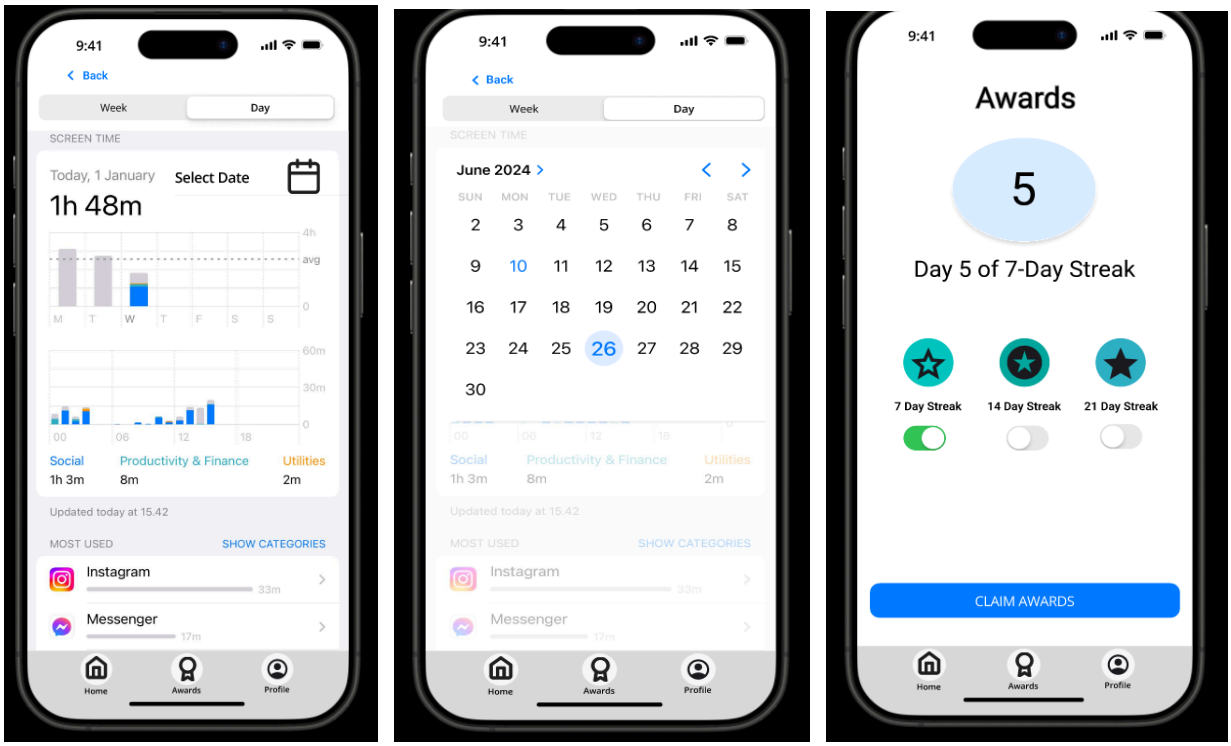


Figure 27: Prototype 2

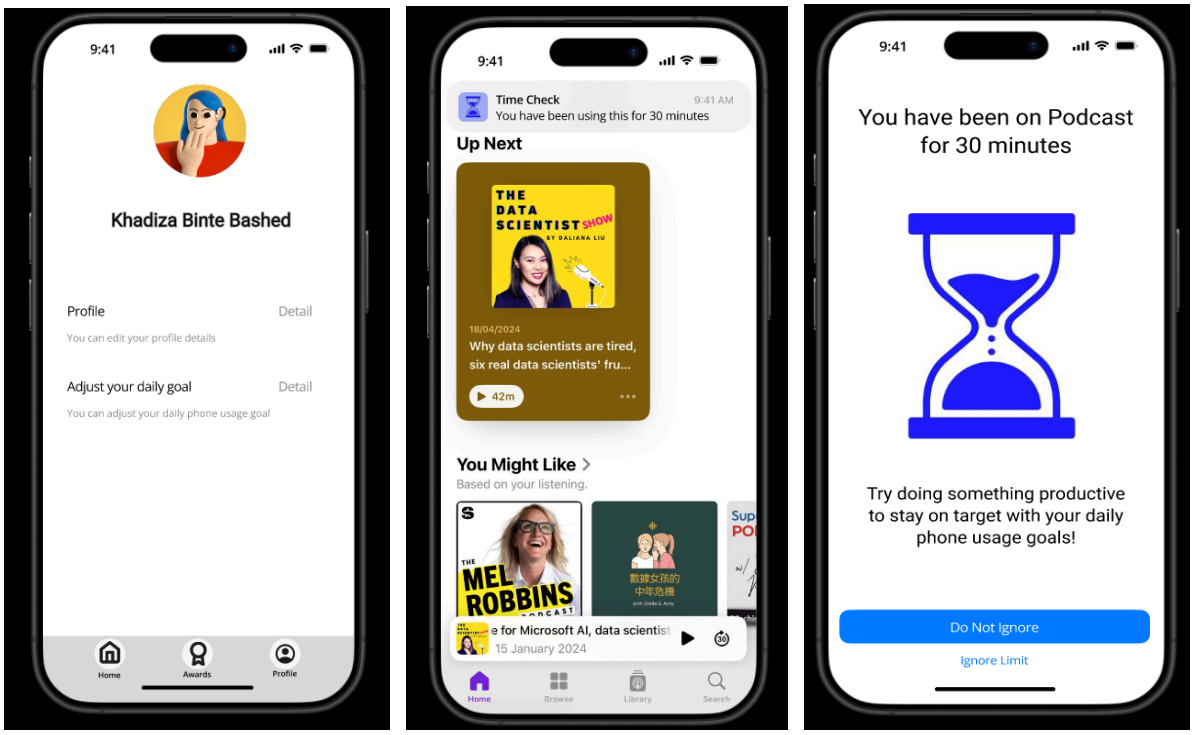


Figure 28: Prototype 2

Feedback of second prototype

This second prototype brought some modifications, to which users had different reactions. Some noted that flexibility of the new onboarding modifier was welcome and to the point stating that: It was well organised and clear where to go next; that was engaging; the new onboarding modifier was efficient and receptive, and everyone wanted to dig into the app more. Among all the descriptions provided during onboarding, people particularly liked the descriptions given in this section because it was easy to understand as well as engaging, and it made the app seem friendly and easy to use. Notably, it was agreed that the calendar feature, intended to allow the user to view the report of the selected date, remained a favourite. They noted it as highly functional, much better than the previous versions, as it made it easier to navigate and find particular reports. Another quality that was considered valuable was the possibility to change daily objectives; it gave the users a sense of influence. The award section, which remained the most important component in motivation focus, was also welcomed as providing sustained involvement. Moreover, there is some notion concerning the new feature in the reminder window of setting the app limit where users mentioned that the function “more options” was helpful for them.

But there were several criticisms and concerns as well. The first area of concern was the lack of special features regarding the profile section that people claimed to be blunt to have no essential

added value when observed. Some users went up to the second or third level of subfolders to search for the daily report, meaning that there was still some way to go for navigation. As for the Live feature, some of the respondents preferred the "stop for today" option stated in the app limit reminder window; others argued that this suggestion is unnecessary because the application is focused on time limits on the screen. Users then provided suggestions for improvements on the app as grounded on their experiences with the app. That is why they added some more options to the profile section, for example, whether the user has increased or adheres to the time limits set for using the application. This might offer more information and add to the satisfaction, as well as increase the chance of the user to observe his/her progress. Further, they suggested improving the consideration and look of the profile section for inclusion among the good-looking and accurate sections so that a person could find useful figures or data representation models for individual accounts. In total, these concepts are a search for a more active, useful approach that would tell not only the time spent on the screen but also adapt to the user.

7. Discussion and Conclusion

This final chapter synthesises the research undertaken in this study regarding the value of Screen Time tools on the iPhone in helping the university students identify and self-regulate their phone use. This work discusses the difficulties students have in managing non-essential use and assesses existing features. From survey and interview questions, contextual interviews, and design thinking, the study identifies some limitations and user requirements.

In particular, the stages of design thinking were helpful for understanding users' behaviour and suggesting improvements; these stages encompassed empathy and prototyping. Such insights are further anchored within the theoretical orientations of an area known as Human-Computer Interaction (HCI) as well as Self-Determination Theory (SDT). Thus, in accordance with this analysis, the chapter outlines the design recommendations that promote the development of screen time tools to increase users' interest. The results of the present study are expected to inform additional empirical work and the creation of proper instruments to help students regulate the use of digital technologies.

RQ1: How does the current screen time feature serve the purpose of regulating phone usage?

The heuristic evaluation showed that even though the iPhone Screen Time is useful in monitoring phone use, it holds shortcomings in design that reduce its functionality when used as a regulating tool. It has the visibility of usage patterns through daily and weekly reports and app limit settings in accordance with Nielsen's heuristic principle of feedback. Though two major concerns are that reminders and downtime schedules are not customisable, which goes against

user control and freedom where users cannot set their own free preferences but have to settle for the standard ones for everyone.

The feature also lacks error prevention because app limits may be easily negated by the user, which defeats the purpose. Furthermore, the inability to define granularity between compulsory (educational) and non-compulsory (entertainment) use disregards the static and dynamic usage flexibility and efficiency criteria, avoiding its usability for various user's needs. Although the identified static visualisations help users gain certain insights, the tool cannot offer interactive problem-solving actions and thus fails to conform to the help and recovery heuristic.

Behaviour change can only be sustained if people are intrinsically motivated, which Self-Determination Theory (SDT) suggests is when a user feels self-determined, capable, and related to (Ryan & Deci, 2000). However, the cited Screen Time feature does not allow for significant personalisation, for example, using rather impersonal messages and static configurations of the restricting applications, which do not promote autonomy and actually do not develop a sense of competence. For instance, interview data highlighted that students perceived that the app limit notifications were either overly strict or quite easily bypassed.

Finally, the tool does not recommend contextual suggestions or adaptive cues as essential for immediate behaviour modification. However, for awareness to improve the customisation, interactivity, and flexibility, it is now needed to strengthen those aspects to control phone usage in Screen Time.

RQ2: How do university students currently utilise iPhone screen time management features, and what factors influence their engagement with these tools?

According to the survey, about 25% of the participants utilise the feature for merely tracking their daily and weekly phone usage, while 26.5% of the participants never utilise the tool; this can be seen in Table 5. However, App limits, downtime and always allowed apps are used respectively by 18.1%, 7.1% and 9%. Moreover, it also shows that the tool is actually seen as a tracking device if used and not a behavioural modification tool as the feature initially intended. It is also shown that only around 10% of the users are deemed high users of the tool, the rest are mostly moderate, and some are low users. The contextual inquiry revealed that, although the participants liked the idea of usage-pattern visualisation, a significant number of users reported difficulty in effectively employing the information introduced to modify their behaviour; the lack of motivational cues or immediate feedback was named as a primary issue.

The interviews also showed that the idea of managing phone usage enhances the initial entry to the feature, but students found the Screen Time feature to be passive in its design. Static visualisations and simple prompts proved insufficient for deep consideration; occasional complaints about difficulties in the settings or options' configuration lessened the effect.

Contextual inquiry also highlighted the importance of features that augment ingrained activity patterns, including adaptive notifications that dynamically adjust to the user's behaviour patterns. For instance, one participant intuited, "It could offer things like, 'You have spent two hours on Facebook; it is time for a break or a focused work,' instead of giving numbers only." These findings are in consonance with the HCI principles, which recommend naturalistic and user-friendly design, and Fogg's behaviour model, which stresses timely and clear cues for sparking the required behavioural change (Fogg, 2002).

Overall relevance affects engagement to various degrees, as evidenced by survey results, with 47% of all participants struggling to separate educational and entertainment uses of smartphones. Students complained that the tool could not distinguish between effective and ineffective task focus. This is in line with Keller et al. (2021) on noting the usability of features based on contexts since the phone is used for academic, social, and individual purposes in the university lifestyle.

RQ3: What are the most common patterns of smartphone usage among university students, particularly in relation to non-essential activities (e.g., social media, entertainment)?

According to the survey, 62.5% of students indicated that their primary use was social media, while 9% identified entertainment purposes such as streaming and games, and 22.3% identified messaging apps as shown in Table 9. 42% of participants use the phone for around 2-4 hours a day (Table 10). Similar to Zhang et al. (2014), this study shows that coping and social motives are influential factors in the use of the smartphone. Table 11 presents that 71% of the participants from the survey admitted that they overuse the phone in terms of non-essential activities, which is an alarming issue. Respondents commented that this behaviour occurs in a routine and unintentional manner during free time during class changes or late at night. This was backed by contextual inquiry that showed the phone during downtime was spent using non-essential apps, namely, messaging and social media.

Interviews supported how ritualistic usage tends to be habitual or conditioned and derived from perceived boredom, stress, or time-killing as intended by Hiniker et al. (2016). For example, one of the participants said, "I mindlessly scroll through social media every time I have nothing to do or when I am stressed." This entails the fact that students are not very keen on the way they are using their devices, as analysed by Thatcher et al. (2018).

From the SDT perspective, such a trend could be explained by the lack of satisfaction of the psychological needs for autonomy, competence, and relatedness. For instance, students who feel lonely are likely to change their mode of interacting with peers by using their phones in the class, thereby compromising on the time they should be using to study. This underlines the necessity of developing any intervention to fulfil not only the information function but also to offer viable solutions for these needs' satisfaction.

Reviewing Twenge & Campbell (2018), it can be highlighted that focusing on screen time, especially on social networks, has a negative impact on the happiness and productivity of individuals. Students in this study indicated that they wanted features that could categorise usage as mandatory and non-mandatory so that students could focus adequately.

RQ4: How do students perceive the effectiveness of these tools in helping them recognise and manage their non-essential phone usage?

Students observed that while they liked things like weekly use reports, during the contextual inquiry, they seldom pay attention to app-specific breakdowns; some participants categorised them as “Usability and overloaded graphs with multiple categories are difficult to make sense of." This aligns with Berr (2019), who pointed out that while the tool was being developed, there was no plan for how responses to the questions would be managed. As there was no clear instruction as to exactly how the information is applicable or how it may be adapted to the students’ contexts, such students found it difficult to understand how minus usage could be translated into workable strategies for minimising unessential minus application.

Interviews further emphasised that while students minimised use of certain critical design features like the ability to filter productive nonproductive apps or a graphical view of progress over weeks. Collected data captured the following comment from one of the participants: “If the application was indicating that I was making some form of development over time, then I would be using the application.” This accords with HCI best practices concerning the ease of use and designing of element plans as well as actionable information to keep users engaged.

Moreover, here we have learnt that students also noticed the lack of contextual cues or prompt messages indicating that usage of unnecessary applications is too frequent, which can act as prompts to minimise non-productive interferences. This observation is in agreement with Olivieri (2021), who postulated about the importance of reflective feedback for the development of regulation. These interactive features helped differentiate between tools that gave awareness towards such usage and those that could actually assist in decreasing non-essential use.

In conclusion, though the identified tools to a certain extent let students become aware of their usage patterns, these tools’ efficacy is experiencing such important drawbacks as excessive values, noninteractivity, and the lack of actionable and contextual support. To enhance management, it’s required to have features, including tracking, prescriptive, and contextual suggestions to turn data into successful actions.

RQ5: How do app limits and generalised reminders in screen time tools affect students' phone use?

App limits and generalised reminders received mixed feedback. The survey showed that 45% of students found limitations of the apps useful, whereas 34% admitted to disconnecting or

demoting the app when such limits interfered with their use of the app or rarely taking any action after getting a reminder. It was established in the course of contextual inquiry; for example, participants complained that reminders were missing the needed content and presence, which they felt were annoying and easy to dismiss. For instance, one participant noted that "The app limit appears, but I respond ‘skip’ without giving it a second thought.”

It was seen that use of app limits can be more effective when integrated with goals or incentives. For instance, the students with specific goals concerning the use of the app in relation to studying were more likely to honour the limits than those who set general usage limits. This tallies with Keller et al. (2021), who conceived it vital to have motivational aspects complement the limits.

Throughout the whole Persuasive Design approach, static reminders are seen as unadaptable tools, which diminish their persuasiveness. Some ideas participants proposed included real-time ones, for instance, breaking down app messages based on the time of the day. This is in line with Fogg’s Behaviour Model, which states that those triggers must be well adapted to the context of a user (Fogg, 2002).

RQ6: How can screen time features be designed to enhance students’ awareness of phone usage patterns while minimising disruptions?

For the screen time feature to achieve the goal of increasing awareness without being invasive, they must provide information that is easily understandable and call to actions that are not disruptive. During the user testing stage, valuable data was obtained by the students, and it was identified that tools that offer consumption reports, but often the presented reports are too broad in order to filter out recreational and efficient usage of the app. Adding these features with the categorised insights (for instance, separating the education application from the social or entertainment application) helps the users to understand the behaviour. This is in consonance with Self-Determination theory, which points out competence as one of the motivating factors.

They also talked about context-aware prompts as recommendations that give suggestions while not intruding into their activities. Less obtrusive methods of reminding, for instance, notifications that one has spent a lot of time on apps, were considered useful in making people reflect on their usage without discomfort. These correspond to Fogg’s Behaviour Model (2002), which is based on timely and relevant cues for change.

Simplified navigation, such as a dedicated standalone app, ensures that features like reports and limits are easily accessible. This eliminates unnecessary interference, which in turn informs the users to continue to use the tool frequently. Explaining through an onboarding educational course what the tool is and what it can do creates a more beneficial form of awareness familiarisation. These changes are what make it possible to ensure that there is an increase in awareness without infringing on the user’s freedom of choice most of the time with minimal interference.

RQ7: What design adjustments can be implied to maximise the user engagement to make it more interactive?

To achieve user engagement, motivational features, interactivity, and personalisation should be built into the application. Some of the tested features, like the streaks and additional quests for daily tasks, proved to be efficient during the experiment. All of these aspects fulfil the self-determination theory by stimulating the achievement and competence of the students. For example, users were intrinsically driven by badges for following app usage restrictions within consecutive days; this, in turn, allowed users to transform into better versions of themselves.

Some of the features include tap-to-expand graphs or completely separate categories specific to the app. Many students noted that they would prefer to have something more interactive with which they could dig deeper into the screen time data themselves. This approach is consistent with HCI guidelines because users have control through the way they interact with an interface.

Another factor that has a huge influence on enhancing engagement is the factor of personalisation. Enabling users to select which app categories are allowed, which notifications should be received, and which limits are to be set makes the tool relevant to the user personally. This flexibility enhances independence and also ensures that the concept is topical. Finally, basic site navigation such as footer navigation buttons or widgets remove barriers to the tool's use and make the tool more engaging.

RQ8: How can iPhone screen time tools be redesigned to support students in sustaining focus and maintaining productivity through reduced digital distractions?

It is shown by the survey that 60% of the participants intend to use the screen time feature for productivity improvement and to manage distraction. For doing that, screen time tools should have additional attributes that are efficient to control distractions but allow the right use of technology. Studying the current research, attention is paid to the possibilities of individual focus modes so that students or learners can limit the use of other applications that are not related to learning or work during specific time intervals. This is echoed by the Pre and Post HCI, wherein task-relevant adaptability is observed to facilitate efficiency.

It is important to note that progress tracking elements appeared to be important for design to include as it allowed users to monitor, for instance, the trends of decrease in distractions or increase in focus. Weekly or monthly reports offer students' self-reflecting summary of their behaviours, which promote consciousness and responsibility. They also reflect the concepts of Self-Determination Theory (Ryan & Deci, 2000), as these increase learners' competence and intrinsic interest.

That is why the findings of the research introduced the efficient approach to supporting users by providing occasional motivational cues to keep them on track gently and smoothly. Cues to

return to focus sessions or to take a productive break were effective when tested with users as long as they were not disruptive. This approach is well within Fogg's Behaviour Model (Fogg, 2002), where timely interrupts that do not interrupt the flow of activity are effective in encouraging target behaviour.

Another feature contributing to productivity is the individualised turn-off times as well. Enabling people to set which app stays available in focus mode guarantees that the tool is friendly to the nature of one's tasks. This feature obtains the principle of autonomy with very little interference, which is in line with Nudge Theory (Thaler & Sunstein, 2008).

These redesigns, which incorporate users' opinions and behaviouristic concepts, develop an instrument that assists students regarding their ability to maintain attention and productivity. When features interfere with distractions, the screen time tools can effectively guide students with reasonable aims while excluding imposed limits.

7.1 Reflections on Working as a Group

Studying iPhone Screen Time has been an insightful and enlightening experience throughout this project. This has provided us the opportunity to experiment with several methods and solve some of the challenges in applying multidisciplinary perspectives towards studying user behaviour.

Time Management
The timeframe was modified to guarantee consistent development by considering unanticipated events. A well-organised timeline from the start of the study's literature review to data collection and analysis was crucial to balancing our study's many components. For example, we established specific weeks of surveys and semi-structured interviews to make sure that the data collection is complete before moving onto the theme analysis. We sorted out interviews with participants and solved technological problems that arose during the data collection process, but nonetheless kept to deadlines and kept up standards in maintaining our work approach to studying user behaviour.

Communication and Cooperation
We have used the digital tools (Zoom, Microsoft Teams) as a group to collaborate and have made regular meetings very easy. According to skill, duties were assigned with this strategy. As an example, some of us wrote theme codes for interview transcripts, and others who were stat-savvy did the analysis of survey findings. The combination of these tactics ensured reducing duplication and completion of every activity. This increased efficiency further by assigning one of us to facilitate and the other to take notes during interviews and contextual queries.

Learning and Adjustment
Adapting to resolve conflicts and having thoughtful conversations improved the research process. Opening up the conversation and showing respect to each other's opinions was one of

the key ways to overcome those obstacles. The process involved prototyping and analysis iteratively, leading to ongoing development and worthy learning. Our research consisted of an iterative process that highlighted the importance and flexibility of reflection. We re-examined the data after reviewing preliminary thematic analysis findings, which revealed several subthemes, including the need for motivating reminders and a lack of clarity about the interface. These findings deepened our investigation and led to practical suggestions on how to improve the Screen Time features.

Personal and Professional Growth
This project has helped greatly to develop both professional and personal abilities. It has enabled us to exercise greater critical analysis, problem solving, and use of appropriate research methods. The experience also validates empathy and user-centred design, which is in line with the ideas of design thinking. But it also stressed the importance of versatility and adaptability, which are key assets in research, particularly with unforeseen problems.

The reflection is based on teamwork and the need to be flexible in solving challenging research projects. In addition to academic insights into digital behaviour and design thinking, we have also developed practical skills in problem solving, cooperation, and how to adapt to challenges through our work.

7.2 Contributions to the Research Field

This research has practical implications for digital well-being literature through the discovery of strategies to design screen time tools that build user awareness as well as increase user engagement coupled with productivity. It fills a significant gap between mainstream theories—self-determination theory (Ryan & Deci, 2000)/Fogg's behaviour model (Fogg, 2002)—and application by incorporating human-centred design approaches and unexpected outcomes. This study briefs the audience on personalisation, adaptability, and gamified motivation in implementing tools for behaviour change supporting digital habits and more broadly falls into the expansive field of behavioural change technology.

Moreover, survey data supplemented by interviews and contextual enquiries together with a prototype development approach offer a systematic framework for further research in the field. This is against the background of providing fine-grained, practical data and push interventions, which contribute to the understanding of people's freedom and their susceptibility to gentle direction. Because the target group is university students, who are highly susceptible to digital disruptions, the research identifies an important issue in the present-day digital context and shares actionable recommendations that can be used to develop more efficient comparable applications within different platforms.
Furthermore, in practice, the study advances the debate on ethical technology design by grounding its prescriptions with Nudge Theory (Thaler & Sunstein, 2008) and HCI principles,

whereby the introduced interventions would not infringe on the user's liberty, as they seek to design healthier technology use. It is a valuable contribution to the existing literature and a valuable reference tool for developers wishing to develop effective and meaningful digital well-being applications. In exploring not only theoretical but also practical aspects, such contributions enhance the field's knowledge of how technologies make users more effective in their goals: in focus, productivity, or, more broadly, digital wellness.

7.3 Conclusion

This paper has sought to examine how screen time management tools have been developed and how well they work addressing the goals of raising user consciousness and utility. In highlighting such gaps in the current tools and in adopting a user-centred approach, the research underlines the principles of designing effective tools that are sufficiently usable, sufficiently tailored to a given user population, and sufficiently ethically acceptable.

It's important to rightly identify and target specific unhealthy user practices, which is why presented customised features as well as non-obtrusive alerting are preferably effective to regain more healthy usage among university students. Such insights reveal the opportunities that are given by the right tools to help people manage their screen time and have more conscious interaction with the devices.

In this way, the research enriches the knowledge about the concept of digital well-being by combining theoretical concepts and ID insights derived from successive iterations. Besides, it defines the most promising directions of improvement of the available tools for managing current screen time as well as outlines a basis for the creation of new solutions that can help in attaining effective and sustainable usage of smartphones. These ideas are essential in the development of tools with user concern and meet the dynamic complexities of interaction management.

8. Limitations and Future Work

This section discusses the shortcomings observed during the research process, and the corresponding actionable suggestions are then made for future work. Thus, while also presenting methodological, practical, and theoretical concerns that may have influenced this study, this section elaborates about aspects that could be further developed or elaborated. The recommendations are intended to inform future research and development of better and more acceptable screen time interventions for digital health.

Limitations

Availability Of Participants and Prototype Testing

The activity of our prototype's development was relatively difficult in terms of logistics. Apparently, more participants had to be included alongside those in the interviews, though the intention was to show them the design and seek confirmation on some aspects. Fortunately, it was beneficial for a range of viewpoints; this type of cooperation between participant groups could have introduced complexity and variability to the user's reaction. However, the knowledge obtained was a good guide in enhancing the design of the prototype.

Sample Size and Diversity

The sample selection could not be generalisable to a population of iPhones' users because our study targeted university students. This limitation points out that future research has to incorporate a larger and more diverse sample in order to enhance the generalisability of the outcomes.

Short-Term Assessment

Our research focused on initial impressions and first-time observations of the Screen Time tools and prototypes because of time constraints. However, more details about the behavioural and productivity consequences of these methods with prolonged use may be revealed in a longer time span of the evaluation.

Future Work

Longitudinal Research

In future research, a longitudinal study should be undertaken to assess what long-term changes in behaviour can be effected using the Screen Time tools and whether that effect remains continuous to overcome the limitation of the current study, which is a short-term examination. This may eventually help to introduce trends or difficulties in maintaining digital wellbeing over a period of time.

Integrating Health Apps

The synchronisation of Screen Time features with health information (for example, activity and sleep) may help consumers have a better understanding of the effect that screen consumption has on their overall health, as many people use health apps now. Information about the feasibility and impact of these integrations needs to be examined in future research.

User Testing in Larger Groups

The results will be accurate and applicable if user testing is done increasingly to an expanded population of randomly selected participants. It would be easier for researchers to consider the

several demands, interests, and behaviours of the users/clients, particularly the demographic constituencies interested in a particular innovation.

Examination of Gamification and Personalised Interventions

This could be followed in further research by incorporating more tagged components of gamification, like giving bonuses for separately increasing the screen Time to a new record or for daily accomplishment. Some other questions related to the usage of the personalised approach might also be explored, for example, increasing the efficiency and popularity of the developed solutions, including adaptive alerts with reference to the users' behaviour.

Stages of collaborative design

Participation in the next iterations of the prototype design, for example, through workshop sessions, will increase the prototype's ability to address the desires and needs of the participants. This strategy will ensure that the tools remain relevant and easy to use all the time for the users.

Real-world Test Environments

The future studies should include real-life, as it will be interesting to observe the scenarios in which people make use of Screen Time features. This method would give further understanding to the contexts of use and obtain comprehensions of multitasking, interruptions, and other factors influencing the Screen time.

9. References

Abhari, K., Klase, M., Koobchehr, F., Olivares, F., Pesavento, M., Sosa, L., & Vaghefi, I. (2021, July). Toward a theory of digital mindfulness: A case of smartphone-based self-monitoring. In *International Conference on Human-Computer Interaction* (pp. 549–561). Cham: Springer International Publishing.

Abras, C., Maloney-Krichmar, D., & Preece, J. (2004). User-centered design. In Bainbridge, W. *Encyclopedia of Human-Computer Interaction* (pp. 445–456). Sage Publications.

Abuhamdah, S. M., & Naser, A. Y. (2023). Smart phone addiction and its mental health risks among university students in Jordan: a cross-sectional study. BMC psychiatry, 23(1), 812.

Adams, W. C. (2015). Conducting semi‐structured interviews. In K. E. Newcomer, H. P. Hatry, & J. S. Wholey (Eds.), *Handbook of Practical Program Evaluation* (1st ed., pp. 492–505). Wiley. https://doi.org/10.1002/9781119171386.ch19

Adeoye‐Olatunde, O. A., & Olenik, N. L. (2021). Research and scholarly methods: Semi‐structured interviews. *JACCP: Journal of the American College of Clinical Pharmacy, 4*(10), 1358–1367. https://doi.org/10.1002/jac5.1441

Al-Barashdi, H., Bouazza, A., & Jabur, N. (2015). Smartphone addiction among university undergraduates: A literature review. *Journal of Scientific Research and Reports, 4*(3), 210–225.

Alfawareh, H. M., & Jusoh, S. (2014). Smartphones usage among university students: Najran University case. *International Journal of Academic Research, 6*(2).

Aljomaa, S. S., Qudah, M. F. A., Albursan, I. S., Bakhiet, S. F., & Abduljabbar, A. S. (2016). Smartphone addiction among university students in the light of some variables. *Computers in Human Behavior, 61*, 155–164.

Allmark, P., Boote, J., Chambers, E., Clarke, A., McDonnell, A., Thompson, A., & Tod, A. M. (2009). Ethical issues in the use of in-depth interviews: Literature review and discussion. *Research Ethics, 5*(2), 48–54. https://doi.org/10.1177/174701610900500203

Alrobai, A., McAlaney, J., Dogan, H., Phalp, K., & Ali, R. (2016). Exploring the requirements and design of persuasive intervention technology to combat digital addiction. In Human-Centered and Error-Resilient Systems Development: IFIP WG 13.2/13.5 Joint Working Conference, 6th International Conference on Human-Centered Software Engineering, HCSE 2016, and 8th International Conference on Human Error, Safety, and System Development, HESSD 2016, Stockholm, Sweden, August 29-31, 2016, Proceedings 8 (pp. 130-150). Springer International Publishing.

Alter, A. (2017). Irresistible*: The* rise *of* addictive *technology and the business of keeping us hooked*. Penguin.

Alsalmia, A., Abdulkarimb, L., Alzahranic, B., Abahussaind, D., Alsaeede, M., & Zaidif, U. (2020). Excessive mobile usage, stress, and memory among health sciences students at PNU. Int. J. Innov. Creativity Chang., 10, 38-100.

Aman, T., Shah, N., Hussain, A., Khan, A., Asif, S., & Qazi, A. (2015). Effects of mobile phone use on the social and academic performance of students of a public sector medical college in khyber pakhtunkhwa Pakistan. KJMS, 8(1), 99-103.

Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research?. Educational researcher, 41(1), 16-25.

Aparicio, A. F., Vela, F. L. G., Sánchez, J. L. G., & Montes, J. L. I. (2012, October). Analysis and application of gamification. In Proceedings of the 13th international conference on interacción persona-ordenador (pp. 1-2).

Apple. (2018). iOS 12 introduces new features to reduce interruptions and manage Screen Time. Apple Newsroom. https://www.apple.com/newsroom/2018/06/ios-12-introduces-new-features-to-reduce-interruptions-and-manage-screen-time/

Atas, A. H., & Çelik, B. (2019). Smartphone use of university students: Patterns, purposes, and situations. Malaysian Online Journal of Educational Technology, 7(2), 59-70.

Babbie, E. (2020). *The Practice of Social Research* (15th ed.). Cengage Learning.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. Annual review of psychology, 52(1), 1-26.

Bang, M., & Ragnemalm, E. L. (2012). Persuasive technology. design for health and safety. In Lecture notes in computer science. https://doi.org/10.1007/978-3-642-31037-9

Barab, S., & Squire, K. (2016). Design-based research: Putting a stake in the ground. In Design-based Research (pp. 1-14). Psychology Press.

Bayer, J. B., Dal Cin, S., Campbell, S. W., & Panek, E. (2016). Consciousness and self-regulation in mobile communication. *Human Communication Research, 42*(1), 71–97.

Beattie, A., & Daubs, M. S. (2020). Framing "digital well-being" as a social good. *First Monday, 25*(12). https://doi.org/10.5210/fm.v25i12.10430

Berners-Lee, T. (1989). *Information Management: A Proposal.* CERN. Retrieved from https://www.w3.org/History/1989/proposal.html

Berr, K. (2019). Slaves to our Screens?: A Critical Approach to Self-Regulation of Smartphone Use at the Example of Apple's Screen Time Feature.

Beyer, H., & Holtzblatt, K. (1999). Contextual design. Interactions, 6(1), 32-42.

Bharadwaj, S. H. (2021). Screen time and its impact on health. ResearchGate. https://www.researchgate.net/publication/351048905_Screen_time_and_its_impact_on_health

Böckle, M., Micheel, I., Bick, M., & Novak, J. (2018). A design framework for adaptive gamification applications.

Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Review of Psychology, 54*(1), 579–616. https://doi.org/10.1146/annurev.psych.54.101601.145030

Bodker, K., Kensing, F., & Simonsen, J. (2009). Participatory IT design: designing for business and workplace realities. MIT press.

Brand, C., Fochesatto, C. F., Gaya, A. R., Schuch, F. B., & López-Gil, J. F. (2024). Scrolling through adolescence: unveiling the relationship of the use of social networks and its addictive behavior with psychosocial health. Child and Adolescent Psychiatry and Mental Health, 18(1), 107.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brown, T. (2009). Change by design: How design thinking creates new alternatives for business and society. Collins Business.

Bryman, A. (2016). *Social research methods* (5th ed.). Oxford University Press.

Buchanan, R. (1992). Wicked problems in design thinking. Design issues, 8(2), 5-21.

Büchi, M. (2024). Digital well-being theory and research. *New Media & Society, 26*(1), 172–189. https://doi.org/10.1177/14614448211056851

Budde, R., Kautz, K., Kuhlenkamp, K., & Züllighoven, H. (1990). What is prototyping?. Information Technology & People, 6(2/3), 89-95.

Budiu, R. (2024, January 31). Memory recognition and recall in user interfaces. Nielsen Norman Group. https://www.nngroup.com/articles/recognition-and-recall/#:~:text=you%20would%20use%20a%20process,more%20likely%20to%20pick%20it.

Burr, C., Taddeo, M. & Floridi, L. The Ethics of Digital Well-Being: A Thematic Review. Sci Eng Ethics 26, 2313–2343 (2020). https://doi.org/10.1007/s11948-020-00175-8

Cabrita, M., op den Akker, H., Tabak, M., Hermens, H. J., & Vollenbroek-Hutten, M. M. (2018). Persuasive technology to support active and healthy ageing: An exploration of past, present, and future. Journal of biomedical informatics, 84, 17-30.

Cairns, P., Pinker, I., Ward, A., Watson, E., & Laidlaw, A. (2021). Empathy maps in communication skills training. *The Clinical Teacher, 18*(2), 142–146. https://doi.org/10.1111/tct.13253

Camburn, B., Viswanathan, V., Linsey, J., Anderson, D., Jensen, D., Crawford, R., Otto, K., & Wood, K. (2017). *Design prototyping methods: State of the art in strategies, techniques, and guidelines*. Design Science, 3, e13. https://doi.org/10.1017/dsj.2017.10

Campbell, D. T., & Stanley, J. C. (1966). *Experimental and quasi-experimental designs for research*. Houghton Mifflin.

Candussi, C. J., Kabir, R., & Sivasubramanian, M. (2023). Problematic smartphone usage, prevalence and patterns among university students: A systematic review. *Journal of Affective Disorders Reports, 100643.*

Cao, X., Cheng, Y., Xu, C., Hou, Y., Yang, H., Li, S., ... & Wang, Y. (2022). Risk of accidents or chronic disorders from improper use of mobile phones: a systematic review and meta-analysis. Journal of medical internet research, 24(1), e21313.

Caponetto, I., Earp, J., & Ott, M. (2014, October). Gamification and education: A literature review. In European conference on games based learning (Vol. 1, p. 50). Academic Conferences International Limited.

Caraban, A., Konstantinou, L., & Karapanos, E. (2020, July). The nudge deck: A design support tool for technology-mediated nudging. In Proceedings of the 2020 ACM Designing Interactive Systems Conference (pp. 395-406).

Carroll, J. M. (1997). Human-Computer Interaction: Psychology as a Science of Design. International Journal of Human-Computer Studies, 46(4), 501–522.

Castleberry, A., & Nolen, A. (2018). Thematic analysis of qualitative research data: Is it as easy as it sounds? *Currents in Pharmacy Teaching and Learning, 10*(6), 807–815. https://doi.org/10.1016/j.cptl.2018.03.019

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. SAGE Publications.

Chou, S. W., Hsieh, M. C., Pan, H. C., & Ye, X. M. (2024). Understanding negative technological use from a self-regulation perspective. Behaviour & Information Technology, 1-20.

Clarke, V., & Braun, V. (2014). Thematic analysis. In T. Teo (Ed.), *Encyclopedia of Critical Psychology* (pp. 1947–1952). Springer. https://doi.org/10.1007/978-1-4614-5583-7_311

Cohen, J. (1990). Things I have learned (so far). *American Psychologist, 45(12),* 1304–1312.

Cohen, L., Manion, L., & Morrison, K. (2017). *Research methods in education* (8th ed.). Routledge.

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications.

Cronin, P., Ryan, F., & Coughlan, M. (2008): Undertaking A Literature Review: A Step-By-Step Approach. British Journal of Nursing, 17(1), 38–43.

Cross, N. (2001). "Designerly Ways of Knowing: Design Discipline Versus Design Science." Design Issues, 17(3), 49-55.

Cugelman B. Gamifcation: what it is and why it matters to digital health behavior change developers. JMIR Serious Games. 2013;1(1):e3-e.

Dam, R. F. (2024, March 1). The 5 Stages in the Design Thinking Process. Interaction Design Foundation - IxDF. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

Dam, R. F. and Teo, Y. S. (2023, August 31). Test Your Prototypes: How to Gather Feedback and Maximize Learning. Interaction Design Foundation - IxDF. https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning

Dam, R. F. and Teo, Y. S. (2024b, January 12). Stage 2 in the Design Thinking Process: Define the Problem and Interpret the Results. Interaction Design Foundation - IxDF. https://www.interaction-design.org/literature/article/stage-2-in-the-design-thinking-process-define-the-problem-and-interpret-the-results

Daniyal, M., Javaid, S. F., Hassan, A., & Khan, M. A. (2022). The relationship between cellphone usage on the physical and mental wellbeing of university students: A cross-sectional study. International journal of environmental research and public health, 19(15), 9352.

Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. University of Rochester Press.

Deci, E. L., & Ryan, R. M. (2000). The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. Psychological inquiry, 11(4), 227-268.

Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology* (Vol. 1, pp. 416–436). Sage Publications.

Deloitte's 2019 global mobile consumer survey. (n.d.). Deloitte Insights. https://www2.deloitte.com/us/en/insights/industry/telecommunications/global-mobile-consumer-survey-2019.html

Demirci, K., Akgönül, M., & Akpinar, A. (2015). Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *Journal of Behavioral Addictions, 4*(2), 85–92.

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification. using game-design elements in non-gaming contexts. In CHI'11 extended abstracts on human factors in computing systems (pp. 2425-2428).

de Segovia Vicente, D., Van Gaeveren, K., Murphy, S. L., & Vanden Abeele, M. M. (2024). Does mindless scrolling hamper well-being? Combining ESM and log-data to examine the link between mindless scrolling, goal conflict, guilt, and daily well-being. Journal of Computer-Mediated Communication, 29(1), zmad056.

de Toledo, F. P., Devincenzi, S., Kwecko, V., Mota, F. P., & da Costa Botelho, S. S. (2018, October). A framework for modeling Persuasive Technologies based on the Fogg Behavior Model. In 2018 IEEE Frontiers in education conference (FIE) (pp. 1-5). IEEE.

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education, 40*(4), 314–321. https://doi.org/10.1111/j.1365-2929.2006.02418.x

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing, 62*(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Elsen, C., Demaret, J. N., Yang, M. C., & Leclercq, P. (2012). Sketch-based interfaces for modeling and users' needs: Redefining connections. AI EDAM, 26(3), 281-301.

Emanuel, R., Bell, R., Cotton, C., Craig, J., Drummond, D., Gibson, S., & Williams, A. (2015). The truth about smartphone addiction. *College Student Journal, 49*(2), 291–299.

Eyvazlou, M., Zarei, E., Rahimi, A., & Abazari, M. (2016). Association between overuse of mobile phones on quality of sleep and general health among occupational health and safety students. Chronobiology international, 33(3), 293-300.

Fairclough, N. (2003). *Analyzing discourse: Textual analysis for social research*. Routledge.

Fan, W., & Yan, Z. (2010). Factors affecting response rates of the web survey: A systematic review. Computers in human behavior, 26(2), 132-139.

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5*(1), 80–92. https://doi.org/10.1177/160940690600500107

Fessenden, T. (2022, February 15). Aesthetic and minimalist design (Usability Heuristic #8). Nielsen Norman Group. https://www.nngroup.com/articles/aesthetic-minimalist-design/

Foer, J. S. (2017, November 29). Jonathan Safran Foer: technology is diminishing us. The Guardian. https://www.theguardian.com/books/2016/dec/03/jonathan-safran-foer-technology-diminishing-us

Fogg, B. J. (2002). Persuasive technology: using computers to change what we think and do. Ubiquity, 2002(December), 2.

Fogg, B. J. (2009, April). A behavior model for persuasive design. In Proceedings of the 4th international Conference on Persuasive Technology (pp. 1-7).

Fook, C. Y., Narasuman, S., Abdul Aziz, N., & Tau Han, C. (2021). Smartphone usage among university students. Asian Journal of University Education (AJUE), 7(1), 282-291.

Fowler, F. J. (2014). *Survey research methods* (5th ed.). SAGE Publications.

Fricker, R. D., & Schonlau, M. (2002). Advantages and Disadvantages of Internet Research Surveys: Evidence from the Literature. Field Methods, 14(4), 347-367. https://doi.org/10.1177/152582202237725

Galesic, M., & Bosnjak, M. (2009). Effects of questionnaire length on participation and indicators of response quality in a web survey. Public opinion quarterly, 73(2), 349-360.

Gee, J. P. (2014). *An introduction to discourse analysis: Theory and method*. Routledge

George, T. (2023, June 22). Semi-Structured Interview | Definition, Guide & Examples. Scribbr. Retrieved October 8, 2024, from https://www.scribbr.com/methodology/semi-structured-interview/

Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: Interviews and focus groups. *British Dental Journal, 204*(6), 291–295. https://doi.org/10.1038/bdj.2008.192

Gibbons, S. (2024a, January 24). Empathy Mapping: the first step in design thinking. Nielsen Norman Group. https://www.nngroup.com/articles/empathy-mapping/
Goodman, E., Kuniavsky, M., & Moed, A. (2012). Surveys. In Observing the User Experience: A Practitioner's Guide to User Research (2nd ed., pp. 327–384).

Gorasia, H. (2021, December 16). Heuristics | Help Users Recognize, Diagnose, and Recover from Errors-Simplified by the examples | by Harsh Gorasia | Medium | UX Planet. Medium. https://uxplanet.org/heuristics-9-help-users-recognize-diagnose-recover-from-errors-simplified-by-the-examples-8f746aaabeec

Gower, A. D., & Moreno, M. A. (2018). A novel approach to evaluating mobile smartphone screen time for iPhones: Feasibility and preliminary findings. JMIR mHealth and uHealth, 6(11), e11012. doi: 10.2196/11012

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a Conceptual Framework for Mixed-Method Evaluation Designs. *Educational Evaluation and Policy Analysis*, 11(3), 255–274.

Greene, J. C., & Caracelli, V. J. (1997). *Advances in mixed-method evaluation: The challenges and benefits of integrating diverse paradigms.* Jossey-Bass. https://doi.org/10.1002/ev.1060

Groves, R. M., Fowler, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2009). *Survey methodology* (2nd ed.). Wiley.

Guest, G., Namey, E., & Mitchell, M. L. (2017). *Collecting qualitative data: A field manual for applied research*. SAGE Publications. https://doi.org/10.4135/9781506374680

Hamari, J. (2011). Perspectives from behavioral economics to analyzing game design patterns: Loss aversion in social games. In CHI (2011), Vancouver, Canada, May 7-12, 2011.

Hammersley, M., & Atkinson, P. (2019). *Ethnography: Principles in practice* (4th ed.). Routledge.

Hammoudi, S. F., Mreydem, H. W., Abou Ali, B. T., Saleh, N. O., Chung, S., Hallit, S., & Salameh, P. (2021). Smartphone screen time among university students in Lebanon and its association with insomnia, bedtime procrastination, and body mass index during the COVID-19 pandemic: a cross-sectional study. Psychiatry investigation, 18(9), 871.

Hariri, M., & Stone, R. (2024). Trigger Screen Restriction Framework, iOS use Case Towards Building a Gamified Physical Intervention. International Journal of Advanced Computer Science & Applications, 15(5).

Hassan, H. M., & Galal-Edeen, G. H. (2017). From Usability to User Experience. In Proceedings of the International Conference on Intelligent Informatics and Biomedical Sciences (ICIIBMS).

Hassenzahl, M., & Tractinsky, N. (2006). User experience-a research agenda. Behaviour & information technology, 25(2), 91-97.

Hauksdóttir, S., Sveinbjörnsdóttir, B., & Steingrímsdóttir, H. S. (2024). The effects of goal setting, notification alerts, and sharing results with peers on smartphone usage. Behavioral Interventions, 39(4), e2050.

Heitmayer, M., & Lahlou, S. (2021). Why are smartphones disruptive? An empirical study of smartphone use in real-life contexts. Computers in Human Behavior, 116, 106637.

Hiniker, A., Patel, S. N., Kohno, T., & Kientz, J. A. (2016, September). Why would you do that? predicting the uses and gratifications behind smartphone-usage behaviors. In Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing (pp. 634-645).

Holtzblatt, K., & Beyer, H. (2014). *Contextual design: evolved*. Morgan & Claypool Publishers.

Holtzblatt, K., & Beyer, H. (2017). *Contextual design: Design for life* (2nd ed.). Morgan Kaufmann.

Hu, Y. T., & Wang, Q. (2022). Self-control, parental monitoring, and adolescent problematic mobile phone use: Testing the interactive effect and its gender differences. *Frontiers in Psychology, 13*, 846618. https://doi.org/10.3389/fpsyg.2022.846618

Huber, M. Z., & Hilty, L. M. (2015). Gamification and sustainable consumption: overcoming the limitations of persuasive technologies. In ICT innovations for sustainability (pp. 367-385). Springer International Publishing.

Hunicke, R., LeBlanc, M., & Zubek, R. (2004, July). MDA: A formal approach to game design and game research. In Proceedings of the AAAI Workshop on Challenges in Game AI (Vol. 4, No. 1)

Husband, G. (2020). Ethical data collection and recognizing the impact of semi-structured interviews on research respondents. *Education Sciences*, *10*(8), 206.

InnerDrive. (2024, February 23). Is there a link between screen time and academic performance? InnerDrive. https://www.innerdrive.co.uk/blog/screen-time-and-academic-performance/#:~:text=Other%20research%20suggests%20that%20moderate,resulting%20in%20lower%20academic%20achievement.

Interaction Design Foundation - IxDF. (2020, October 1). What are Problem Statements?. Interaction Design Foundation - IxDF. https://www.interaction-design.org/literature/topics/problem-statements

Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing, 72*(12), 2954–2965. https://doi.org/10.1111/jan.13031

Kang, J. M., Seo, S. S., & Hong, J. W. K. (2011, September). Usage pattern analysis of smartphones. In 2011 13th Asia-Pacific Network Operations and Management Symposium (pp. 1-8). IEEE.10.1109/APNOMS.2011.6077030

Kapp, K. M. (2012). *The Gamification of Learning and Instruction: Game-Based Methods and Strategies for Training and Education*. Pfeiffer.

Karen, H., & Sandra, J. (2017). Contextual inquiry: A participatory technique for system design. In *Participatory design* (pp. 177-210). CRC Press.

Kaysi, F., Yavuz, M., & Aydemir, E. (2021). Investigation of University Students' Smartphone Usage Levels and Effects. *International Journal of Technology in Education and Science*, *5*(3), 411-426.

Keller, J., Roitzheim, C., Radtke, T., Schenkel, K., & Schwarzer, R. (2021). A mobile intervention for self-efficacious and goal-directed smartphone use in the general population: randomized controlled trial. JMIR mHealth and uHealth, 9(11), e26397.

Khayatan, T., SeyediAsl, S., Nazari Anamagh, A., Sadeghi Mollamahaleh, H., Minaee, H., & Nazari Anamagh, A. (2021). Comparison of Mental Health in Students with Problematic Use of Mobile Phones and Normal Students. Journal of Modern Psychology, 1(4), 22-29.
Kim, B. (2015). Game mechanics, dynamics, and aesthetics. Library technology reports, 51(2), 17-19.
Knopf, J. W. (2006). Doing a literature review. PS: Political Science & Politics, 39(1), 127-132.

Kolko, J. (2010). Abductive Thinking and Sensemaking: The Drivers of Design Synthesis. *Design Issues*, 26(1), 15–28.

Krosnick, J. A. (2018). Questionnaire design. The Palgrave handbook of survey research, 439-455.

Kuniavsky, M. (2003). *Observing the user experience: A practitioner's guide to user research*. Morgan Kaufmann.

Kujala, S. (2003). User involvement: A review of the benefits and challenges. *Behaviour & Information Technology, 22*(1), 1–16. https://doi.org/10.1080/01449290301782

Jamal, A., Sedie, R., Haleem, K. A., & Hafiz, N. (2012). Patterns of use of 'smart phones' among female medical students and self-reported effects. Journal of Taibah University Medical Sciences, 7(1), 45-49.

Jenn, N. C. (2006). Designing a questionnaire. Malaysian family physician: the official journal of the Academy of Family Physicians of Malaysia, 1(1), 32.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher, 33*(7), 14-26. https://doi.org/10.3102/0013189X033007014

Joyce, A. (2023, August 24). Help and Documentation (Usability Heuristic #10). Nielsen Norman Group. https://www.nngroup.com/articles/help-and-documentation/

Jung, Y. (2014). What a smartphone is to me: understanding user values in using smartphones. Information Systems Journal, 24(4), 299-321.

Lanaj, K., Johnson, R. E., & Barnes, C. M. (2014). Beginning the workday yet already depleted? Consequences of late-night smartphone use and sleep. Organizational Behavior and Human Decision Processes, 124(1), 11-23.

Laubheimer, P. (2024, August 13). Flexibility and efficiency of use (Usability Heuristic #7). Nielsen Norman Group. https://www.nngroup.com/articles/flexibility-efficiency-heuristic/

Landry, L., (2020, December 15). What is Human-Centered Design? | HBS Online. . Business Insights Blog. https://online.hbs.edu/blog/post/what-is-human-centered-design

Lavados-Romo, P., Andrade-Mayorga, O., Morales, G., Muñoz, S., & Balboa-Castillo, T. (2023). Association of screen time and physical activity with health-related quality of life in college students. Journal of American College Health, 71(5), 1504-1509.

Lazar, J., Feng, J. H., & Hochheiser, H. (2017). *Research methods in human-computer interaction* (2nd ed.). Morgan Kaufmann.

LeBlanc, A. G., Gunnell, K. E., Prince, S. A., Saunders, T. J., Barnes, J. D., & Chaput, J. P. (2017). The ubiquity of the screen: an overview of the risks and benefits of screen time in our modern world. Translational Journal of the American College of Sports Medicine, 2(17), 104-113.

Lee, K. S., Ahn, H. R., & Lee, K. H. (2011). Factors related to the overuse of mobile phone in elementary school students. Journal of Korean Academy of Psychiatric and Mental Health Nursing, 20(3), 271-280.

Lee, J., Cho, B., Kim, Y., & Noh, J. (2015). Smartphone addiction in university students and its implication for learning. In Emerging issues in smart learning (pp. 297-305). Springer Berlin Heidelberg.

Leong, B. D., Lee, B. Y. H., & Chow, K. K. N. (2018). Collective play versus excessive use: an insight into family-focused design intervention for mobile phone overuse. International Journal of Mental Health and Addiction, 16(6), 1404-1419.

Lewis, J. R., & Sauro, J. (2021). Usability and user experience: Design and evaluation. Handbook of human factors and ergonomics, 972-1015.

Lin, Y., Osman, M., & Ashcroft, R. (2017). Nudge: concept, effectiveness, and ethics. Basic and Applied Social Psychology, 39(6), 293-306.

Liu, F., Zhang, Z., Liu, S., & Feng, Z. (2022). Effectiveness of brief mindfulness intervention for college students' problematic smartphone use: The mediating role of self-control. PLoS One, 17(12), e0279621.
Liu, S., Wing, Y. K., Hao, Y., Li, W., Zhang, J., & Zhang, B. (2019). The associations of long-time mobile phone use with sleep disturbances and mental distress in technical college students: a prospective cohort study. Sleep, 42(2), zsy213.
Lockton, D. (2012). Persuasive technology and digital design for behaviour change. Available at SSRN 2125957.
Lubans, D. R., Lonsdale, C., Plotnikoff, R. C., Smith, J., Dally, K., & Morgan, P. J. (2013). Development and evaluation of the Motivation to Limit Screen-time Questionnaire (MLSQ) for adolescents. Preventive Medicine, 57(5), 561-566.
Lubans, D. R., Smith, J. J., Skinner, G., & Morgan, P. J. (2014). Development and implementation of a smartphone application to promote physical activity and reduce screen-time in adolescent boys. Frontiers in public health, 2, 42.
Lukoff, K., Yu, C., Kientz, J., & Hiniker, A. (2018). What makes smartphone use meaningful or meaningless?. Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 2(1), 1-26.
Lupinacci, L. (2021). 'Absentmindedly scrolling through nothing': liveness and compulsory continuous connectedness in social media. Media, Culture & Society, 43(2), 273-290.

Mac Cárthaigh, S. (2020). The effectiveness of interventions to reduce excessive mobile device usage among adolescents: A systematic review. *Neurology, Psychiatry and Brain Research, 35*, 29–37.

Martín-Martín, J., Roldán-Jiménez, C., De-Torres, I., Muro-Culebras, A., Escriche-Escuder, A., Gonzalez-Sanchez, M., ... & Cuesta-Vargas, A. I. (2021). Behavior change techniques and the effects associated with digital behavior change interventions in sedentary behavior in the clinical population: a systematic review. Frontiers in Digital Health, 3, 620383.

Marty-Dugas, J., Ralph, B. C., Oakman, J. M., & Smilek, D. (2018). The relation between smartphone use and everyday inattention. Psychology of Consciousness: Theory, Research, and Practice, 5(1), 46.

McGrath, C., Palmgren, P. J., & Liljedahl, M. (2018). Twelve tips for conducting qualitative research interviews. *Medical Teacher*, *41*(9), 1002–1006. https://doi.org/10.1080/0142159X.2018.1497149
McHugh, M. L. (2013). The Chi-square test of independence. Biochemia Medica, 143–149. https://doi.org/10.11613/bm.2013.018
McKim, C. A. (2017). The Value of Mixed Methods Research: A Mixed Methods Study. Journal of Mixed Methods Research, 11(2), 202-222. https://doi.org/10.1177/1558689815607096

Mei, S., Hu, Y., Wu, X., Cao, R., Kong, Y., Zhang, L., ... & Li, L. (2023). Health risks of mobile phone addiction among college students in China. International Journal of Mental Health and Addiction, 21(4), 2650-2665.

Miller, D., Abed Rabho, L., Awondo, P., de Vries, M., Duque, M., Garvey, P., ... & Wang, X. (2021). The global smartphone: Beyond a youth technology. UCL Press.

Monge Roffarello, A., & De Russis, L. (2019, May). The race towards digital wellbeing: Issues and opportunities. In Proceedings of the 2019 CHI conference on human factors in computing systems (pp. 1-14).

Montagni, I., Guichard, E., Carpenet, C., Tzourio, C., & Kurth, T. (2016). Screen time exposure and reporting of headaches in young adults: A cross-sectional study. Cephalalgia, 36(11), 1020-1027.

Morgan, D. L. (1997). *Focus groups as qualitative research* (2nd ed.). SAGE Publications. https://doi.org/10.4135/9781412984287

Mortensen, D. (2020, July 10). Stage 1 in the Design Thinking Process: Empathise with Your Users. Interaction Design Foundation - IxDF. https://www.interaction-design.org/literature/article/stage-1-in-the-design-thinking-process-empathise-with-your-users

Moser, A., & Korstjens, I. (2017). Series: Practical guidance to qualitative research. Part 1: Introduction. *European Journal of General Practice, 23*(1), 271–273. https://doi.org/10.1080/13814788.2017.1375093

Moss, P. A. (1994). Can there be validity without reliability? *Educational Researcher, 23*(2), 5–12. https://doi.org/10.3102/0013189X023002005

Muller, M. J., & Kuhn, S. (1993). Participatory design. Communications of the ACM, 36(6), 24-28.

Mushroor, S., Haque, S., & Riyadh, A. A. (2020). The impact of smart phones and mobile devices on human health and life. International Journal of Community Medicine and Public Health, 1, 9-15.

Naikoo, A. A., Thakur, S. S., Guroo, T. A., & Lone, A. A. (2018). Development of society under the modern technology-a review. Scholedge International Journal of Business Policy & Governance, 5(1), 1-8.

Nam, S. Z. (2013). Evaluation of university students' utilization of smartphone. International Journal of Smart Home, 7(4), 175-182.

Neophytou, E., Manwell, L. A., & Eikelboom, R. (2019). Effects of excessive screen time on neurodevelopment, learning, memory, mental health, and neurodegeneration: A scoping review. *International Journal of Mental Health and Addiction, 19*(3), 724–744. https://doi.org/10.1007/s11469-019-00182-2

Neubauer, D., Paepcke-Hjeltness, V., Evans, P., Barnhart, B., & Finseth, T. (2017). Experiencing technology enabled empathy mapping. The Design Journal, 20(sup1), S4683-S4689.
Nielsen, J. (1995). How to conduct a heuristic evaluation. Nielsen Norman Group, 1(1), 8.
Nielsen, J., & Mack, R. L. (Eds.). (1994). *Usability inspection methods*. Wiley.
Nielsen, J., & Molich, R. (1990). Heuristic evaluation of user interfaces. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 249–256. https://doi.org/10.1145/97243.97281
Nielsen, L. (2019). *Personas – User Focused Design.* Springer International Publishing.
Niranjanamurthy, M., Kavyashree, N., Chahar, D., & Jagannath, S. (2014). Analysis of e-commerce and m-commerce: Advantages, limitations, and security issues. *International Journal of Advanced Research in Computer and Communication Engineering, 3*(4), 9945–9951.

Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence-Based Nursing, 18*(2), 34–35. https://doi.org/10.1136/eb-2015-102054

Norman, D. A., & Draper, S. W. (1986). User Centered System Design: New Perspectives on Human-Computer Interaction. CRC Press.

Norman, D. A. (1988). *The Psychology of Everyday Things*. Basic Books.

Norman Donald, A. (2013). The design of everyday things. MIT Press.

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods, 16*(1), 1–13. https://doi.org/10.1177/1609406917733847

Nwagu, C., & Orji, R. (2024). Insights from the evaluation of a persuasive intervention for absent-minded smartphone use. Behaviour & Information Technology, 1-25.
OECD (2024), "Managing screen time: How to protect and equip students against distraction", PISA in Focus, No. 124, OECD Publishing, Paris, https://doi.org/10.1787/7c225af4-en.

Oeldorf-Hirsch, A., & Chen, Y. (2022). Mobile mindfulness: Predictors of mobile screen time tracking. *Computers in Human Behavior, 129*, 107170. https://doi.org/10.1016/j.chb.2021.107170

Oliveira, L. (Ed.). (2019). *Managing screen time in an online society*. IGI Global.
Olivieri, L. (2021). Persuasive technologies and self-awareness: a discussion of screen-time management applications. Phenomenology and Mind, (20), 52-60. https://journals.openedition.org/phenomenology/411
Orji, R., Kaptein, M., Ham, J., Oyibo, K., & Nwokeji, J. (2018). Personalizing persuasive technologies: A road map to the future. target, 7, 8.
Osborn, A. F. (1953). *Applied imagination: Principles and procedures of creative problem-solving*. Charles Scribner's Sons.
Oxford English Dictionary. (2023, July). *Screen time (n.), sense 2*. In *Oxford English Dictionary*. https://doi.org/10.1093/OED/9681660163
Pacherazova, M. (2019). Keep your screen happy: Improving the usability of screen time tracking apps (Dissertation). Retrieved from https://urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-164232
Park, C. S. (2019). Examination of smartphone dependence: Functionally and existentially dependent behavior on the smartphone. Computers in Human Behavior, 93, 123-128.
Parry, D. A., le Roux, D. B., & Bantjes, J. R. (2020). Testing the feasibility of a media multitasking self-regulation intervention for students: Behaviour change, attention, and self-perception. Computers in Human Behavior, 104, 106182.

Patino, C. M., & Ferreira, J. C. (2018). Internal and external validity: Can you apply research study results to your patients? *Jornal Brasileiro de Pneumologia, 44*(3), 183–183. https://doi.org/10.1590/S1806-37562018000000164

Pearson, C., & Hussain, Z. (2016). Smartphone addiction and associated psychological factors. Addicta: The Turkish Journal of Addictions.
Peraman, R., & Parasuraman, S. (2016). Mobile phone mania: Arising global threat in public health. Journal of natural science, biology, and medicine, 7(2), 198.
Plano Clark, V. L., & Ivankova, N. V. (2016). *Mixed Methods Research: A Guide to the Field*. SAGE Publications.
Powell, R. A., & Single, H. M. (1996). Focus groups. *International journal for quality in health care*, *8*(5), 499-504.
Preece, J., Rogers, Y. & Sharp, H. (2019): Interaction Design - beyond human-computer interaction. 5th ed. Chichester: Wiley. (Chapter 12 - Design, Prototyping and Construction)
Qi, J., Yan, Y., & Yin, H. (2023). Screen time among school-aged children of aged 6–14: a systematic review. Global Health Research and Policy, 8(1). https://doi.org/10.1186/s41256-023-00297-z
Rabionet, S. E. (2011). How I learned to design and conduct semi-structured interviews: an ongoing and continuous journey. *Qualitative report*, *16*(2), 563-566.

Raftopoulos, M. (2014). Towards gamification transparency: A conceptual framework for the development of responsible gamified enterprise systems. Journal of Gaming & Virtual Worlds, 6(2), 159-178.

Rai, S., Saroshe, S., Khatri, A., Sirohi, S., & Dixit, S. (2016). A cross sectional study to assess the effects of excessive use of smartphones among professional college going students. International Journal of Community Medicine and Public Health, 3(3), 758-763.

Randjelovic, P., Stojiljkovic, N., Radulovic, N., Stojanovic, N., & Ilic, I. (2021). Problematic smartphone use, screen time and chronotype correlations in university students. European addiction research, 27(1), 67-74.

Randolph, J.J. (2009). A Guide to Writing the Dissertation Literature Review. Practical Assessment, Research & Evaluation, 14(13), 1–13.
Raven, M. E., & Flanders, A. (1996). Using contextual inquiry to learn about your audiences. ACM SIGDOC Asterisk Journal of Computer Documentation, 20(1), 1-13.
Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important?. Review of educational research, 82(3), 330-348.
Regan, T., Harris, B., Van Loon, M., Nanavaty, N., Schueler, J., Engler, S., & Fields, S. A. (2020). Does mindfulness reduce the effects of risk factors for problematic smartphone use? Comparing frequency of use versus self-reported addiction. Addictive Behaviors, 108, 106435.
Reja, U., Manfreda, K. L., Hlebec, V., & Vehovar, V. (2003). Open-ended vs. close-ended questions in web questionnaires. Developments in applied statistics, 19(1), 159-177.

Riessman, C. K. (2008). *Narrative methods for the human sciences*. SAGE Publications.

Roffarello, A. M., De Russis, L., Lottridge, D., & Cecchinato, M. E. (2023). Understanding digital wellbeing within complex technological contexts. International Journal of Human-Computer Studies, 175, 103034.

Rogers, Y., Sharp, H., & Preece, J. (2011). *Interaction design: Beyond human-computer interaction* (3rd ed.). Wiley.

Rooksby, J., Asadzadeh, P., Rost, M., Morrison, A., & Chalmers, M. (2016, May). Personal tracking of screen time on digital devices. In Proceedings of the 2016 CHI conference on human factors in computing systems (pp. 284-296).
Rowley, J., & Slack, F. (2004). Conducting a Literature Review. Management Research News, 27(6), 31–39.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Ryan, R. M., & Deci, E. L. (2007). Self-determination theory and the promotion and maintenance of sport, exercise, and health. Self-determination theory in exercise and sport, 1-19.
Ryu, S., Jang, H., & Oh, H. (2022). Smartphone usage patterns and dietary risk factors in adolescents. The Journal of Nutrition, 152(9), 2109–2116. https://doi.org/10.1093/jn/nxac098
Sahu, M., Gandhi, S., & Sharma, M. K. (2019). Mobile phone addiction among children and adolescents: a systematic review. Journal of addictions nursing, 30(4), 261-268.
Salazar, K. (2024, January 15). Contextual inquiry: Inspire design by observing and interviewing users in their context. Nielsen Norman Group. https://www.nngroup.com/articles/contextual-inquiry/
Salehan, M., & Negahban, A. (2013). Social networking on smartphones: When mobile phones become addictive. Computers in human behavior, 29(6), 2632-2639.
Sauro, J., & Lewis, J. R. (2016). *Quantifying the user experience: Practical statistics for user research* (2nd ed.). Morgan Kaufmann.
Scheuren, F. (2004, June). What is a Survey?. Alexandria: American Statistical Association.
Schwarz, N., Groves, R. M., & Schuman, H. (1998). Survey methods. *The handbook of social psychology*, *1*, 143-179.

Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. International Journal of human-computer studies, 74, 14-31.

Sela, A., Rozenboim, N., & Ben-Gal, H. C. (2022). Smartphone use behavior and quality of life: What is the role of awareness?. PloS one, 17(3), e0260637.
Shakoor, F., Fakhar, A., & Abbas, J. (2021). Impact of smartphones usage on the learning behaviour and academic performance of students: empirical evidence from Pakistan. Int. J. Acad. Res. Bus. Soc. Sci, 11(2), 862-81.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Houghton Mifflin.

Sharma, V., & Tiwari, A. K. (2021). A Study on User Interface and User Experience Designs and its Tools. *World Journal of Research and Review*, 12(6), 41–44.

Sharp, H., Rogers, Y., & Preece, J. (2015). *Interaction design: Beyond human-computer interaction* (4th ed.). Wiley.
Shoukat, S. (2019). Cell phone addiction and psychological and physiological health in adolescents. EXCLI journal, 18, 47.
Sigman, A. (2012). Time for a view on screen time. Archives of disease in childhood, 97(11), 935-942.
Simonsen, J., & Robertson, T. (Eds.). (2013). Routledge international handbook of participatory design (Vol. 711). New York: Routledge.
Sinha, G., Shahi, R., & Shankar, M. (2010, November). Human computer interaction. In 2010 3rd International Conference on Emerging Trends in Engineering and Technology (pp. 1-4). IEEE.
Small, M. L. (2011). How to conduct a mixed methods study: Recent trends in a rapidly growing literature. Annual review of sociology, 37, 57-86.
Snyder, C. (2003). Paper prototyping: The fast and easy way to design and refine user interfaces. Morgan Kaufmann.
Soegaard, M. (2024, March 8). UX Storyboards: Ultimate Guide. Interaction Design Foundation - IxDF. https://www.interaction-design.org/literature/article/ux-storyboards
Solis-Moreira, J. (2024, February 20). How long does it really take to form a habit? Scientific American. https://www.scientificamerican.com/article/how-long-does-it-really-take-to-form-a-habit/
Spinuzzi, C. (2005). The methodology of participatory design. Technical communication, 52(2), 163-174.
Subba, S. H., Mandelia, C., Pathak, V., Reddy, D., Goel, A., Tayal, A., ... & Nagaraj, K. (2013). Ringxiety and the mobile phone usage pattern among the students of a medical college in South India. Journal of clinical and diagnostic research: JCDR, 7(2), 205.
Tamura, H., Nishida, T., Tsuji, A., & Sakakibara, H. (2017). Association between excessive use of mobile phone and insomnia and depression among Japanese adolescents. International journal of environmental research and public health, 14(7), 701.
Tashakkori, A., & Teddlie, C. (2010). *SAGE Handbook of Mixed Methods in Social & Behavioral Research* (2nd ed.). SAGE Publications. https://doi.org/10.4135/9781506335193

Terry, G., Hayfield, N., Clarke, V., & Braun, V. (2017). Thematic analysis. In C. Willig & W. Stainton-Rogers (Eds.), *The SAGE Handbook of Qualitative Research in Psychology* (pp. 17–37). SAGE Publications.

Tiller, H. (2021). Analysis of the function time limits within the IPhone feature screen time. In Conference in interaction technology and design (p. 141).
Thaler, R. H., & Sunstein, C. R. (2008). Nudge: Improving decisions about health, wealth, and happiness. Yale University Press.
Thatcher, J. B., Wright, R. T., Sun, H., Zagenczyk, T. J., & Klein, R. (2018). Mindfulness in information technology use. MIS quarterly, 42(3), 831-A14.
The Social Cognitive Theory. (n.d.).
https://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories5.html

Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation, 27*(2), 237–246. https://doi.org/10.1177/1098214005283748
Thomée, S., Eklöf, M., Gustafsson, E., Nilsson, R., & Hagberg, M. (2007). Prevalence of perceived stress, symptoms of depression and sleep disturbances in relation to information and communication technology (ICT) use among young adults–an explorative prospective study. Computers in human behavior, 23(3), 1300-1321.
Tondello, G. F. (2016). An introduction to gamification in human-computer interaction. XRDS: Crossroads, The ACM Magazine for Students, 23(1), 15-17.
Tosi, F. (2020). From User-Centred Design to Human-Centred Design and the User Experience. In: Design for Ergonomics. Springer Series in Design and Innovation , vol 2. Springer, Cham. https://doi.org/10.1007/978-3-030-33562-5_3

Tourangeau, R., Rips, L. J., & Rasinski, K. (2000). *The psychology of survey response.* Cambridge University Press. https://doi.org/10.1017/CBO9780511819322
Toxboe, A. (2024, May 26). Self-Determination Theory. Learning Loop. https://learningloop.io/glossary/self-determination-theory-sdt

Twenge, J. M., & Campbell, W. K. (2018). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventive Medicine Reports, 12*, 271–283. https://doi.org/10.1016/j.pmedr.2018.10.003

Use Screen Time on your iPhone or iPad - Apple Support. (2024, September 16). Apple Support. https://support.apple.com/en-us/108806#:~:text=With%20Screen%20Time%2C%20you%20can,in%20your%20Family%20Sharing%20group.
Vago, D. R., & Silbersweig, D. A. (2012). Self-awareness, self-regulation, and self-transcendence (S-ART): a framework for understanding the neurobiological mechanisms of mindfulness. Frontiers in human neuroscience, 6, 296.
Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences, 15*(3), 398–405. https://doi.org/10.1111/nhs.12048
Vanden Abeele, M. M. (2021). Digital wellbeing as a dynamic construct. Communication Theory, 31(4), 932-955.

Višnjić, A., Veličković, V., Sokolović, D., Stanković, M., Mijatović, K., Stojanović, M., ... & Radulović, O. (2018). Relationship between the manner of mobile phone use and depression, anxiety, and stress in university students. International journal of environmental research and public health, 15(4), 697.

Vredenburg, K., Mao, J. Y., Smith, P. W., & Carey, T. (2002, April). A survey of user-centered design practice. In Proceedings of the SIGCHI conference on Human factors in computing systems (pp. 471-478).
Wang, A., Wang, Z., Zhu, Y., & Shi, X. (2022). The prevalence and psychosocial factors of problematic smartphone use among Chinese college students: a three-wave longitudinal study. Frontiers in Psychology, 13, 877277.

Wang, C., Geng, L., & Rodríguez-Casallas, J. D. (2021). The role of nature-deficit disorder in the associations between mobile phone overuse and well-being and mindfulness. Current Psychology, 1-12.
Wang, F., & Hannafin, M. J. (2005). Design-Based Research and Technology-Enhanced Learning Environments. Educational Technology Research and Development, 53(4), 5-23.
What is Brainstorming? 10 Effective Techniques You Can Use. (2024, November 30). The Interaction Design Foundation.
https://www.interaction-design.org/literature/topics/brainstorming?srsltid=AfmBOooiYrFULdyTELa3Y6geKksiIiTtzMnscTSgpFNnDVr-a3RjhdmE
What is Design Thinking? (2024, November 30). The Interaction Design Foundation. https://www.interaction-design.org/literature/topics/design-thinking?srsltid=AfmBOoq0mZWh6caQBDtHDonxGj5HHnv0EVw1LyLPsKon7rhRi0GA95er

What is Paper Prototyping? (2024, November 30). The Interaction Design Foundation. https://www.interaction-design.org/literature/topics/paper-prototyping
Wood, L. C., & Reiners, T. (2015). Gamification. In Encyclopedia of Information Science and Technology, Third Edition (pp. 3039-3047). IGI global.
Wood, R., Dixon, E., Elsayed-Ali, S., Shokeen, E., Lazar, A., & Lazar, J. (2021). Investigating Best Practices for Remote Summative Usability Testing with People with Mild to Moderate Dementia. ACM Transactions on Accessible Computing, 14(3), 1–26. https://doi.org/10.1145/3460942
Wright, K. B. (2005). Researching Internet-based populations: Advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. Journal of computer-mediated communication, 10(3), JCMC1034.

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications.

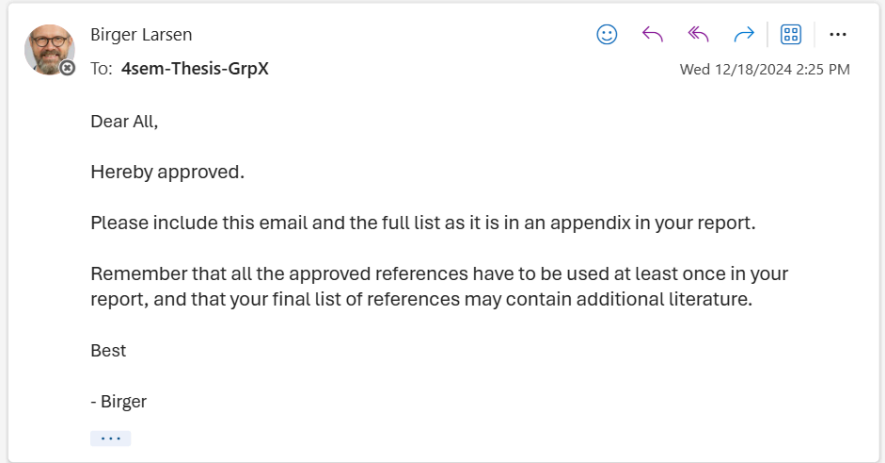
Zhang, K., Lu, X., Zhang, X., Zhang, J., Ren, J., Guo, H., Zhu, Z., Yang, H., Yuan, G., Jin, G., Du, J., Shi, H., Hao, J., Sun, Y., Su, P., Yang, L., & Zhang, Z. (2023). Effects of Psychological or Exercise Interventions on Problematic Mobile Phone Use: a Systematic Review and Meta-analysis. *Current Addiction Reports*, *10*(2), 230–253. https://doi.org/10.1007/s40429-023-00471-w
Zhang, K. Z., Chen, C., & Lee, M. K. (2014). Understanding the role of motives in smartphone addiction.
Zhang, M. R., Lukoff, K., Rao, R., Baughan, A., & Hiniker, A. (2022, April). Monitoring screen time or redesigning it? Two approaches to supporting intentional social media use. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (pp. 1-19).
Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. Theory into practice, 41(2), 64-70.
Zimmerman, D. H., & Wieder, D. L. (1977). The diary: Diary-interview method. *Urban Life*, 5(4), 479–498. https://doi.org/10.1177/089124167700500406

Zimmermann, L. (2021). “Your screen-time app is keeping track”: consumers are happy to monitor but unlikely to reduce smartphone usage. Journal of the Association for Consumer Research, 6(3), 377-382. https://doi.org/10.1086/714365

Zimmermann, L., & Sobolev, M. (2023). Digital strategies for screen time reduction: A randomized field experiment. *Cyberpsychology, Behavior, and Social Networking, 26*(1), 42–49.

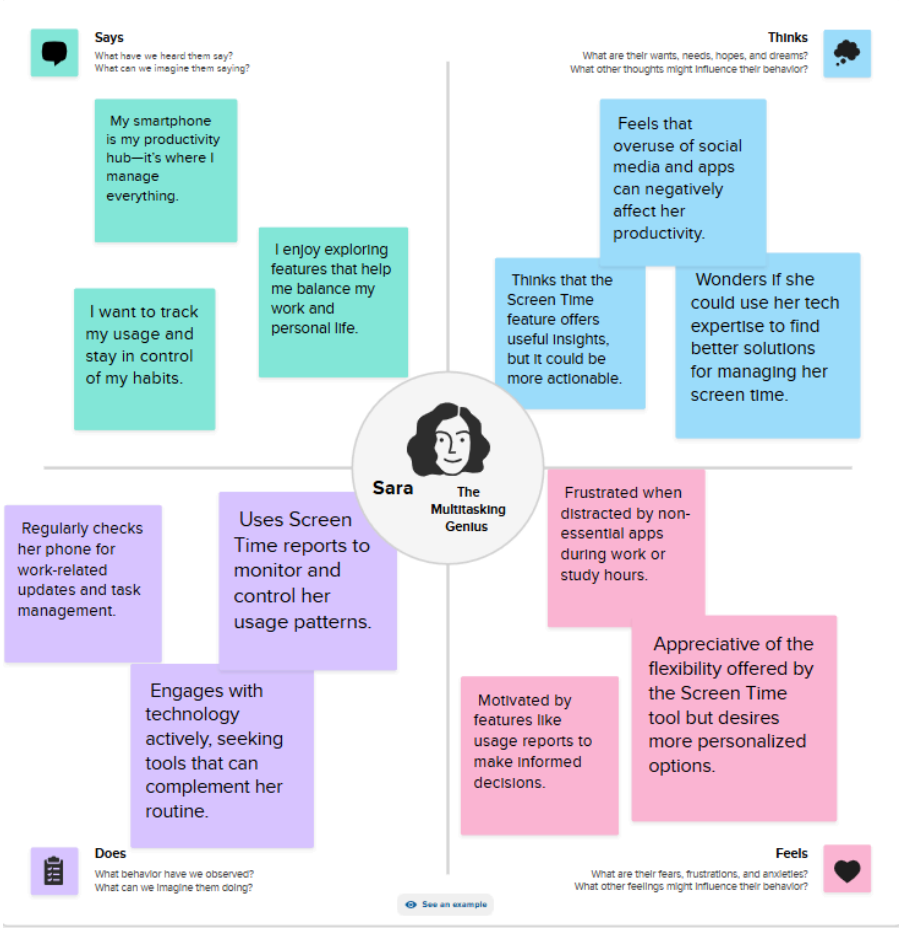
10. Appendix

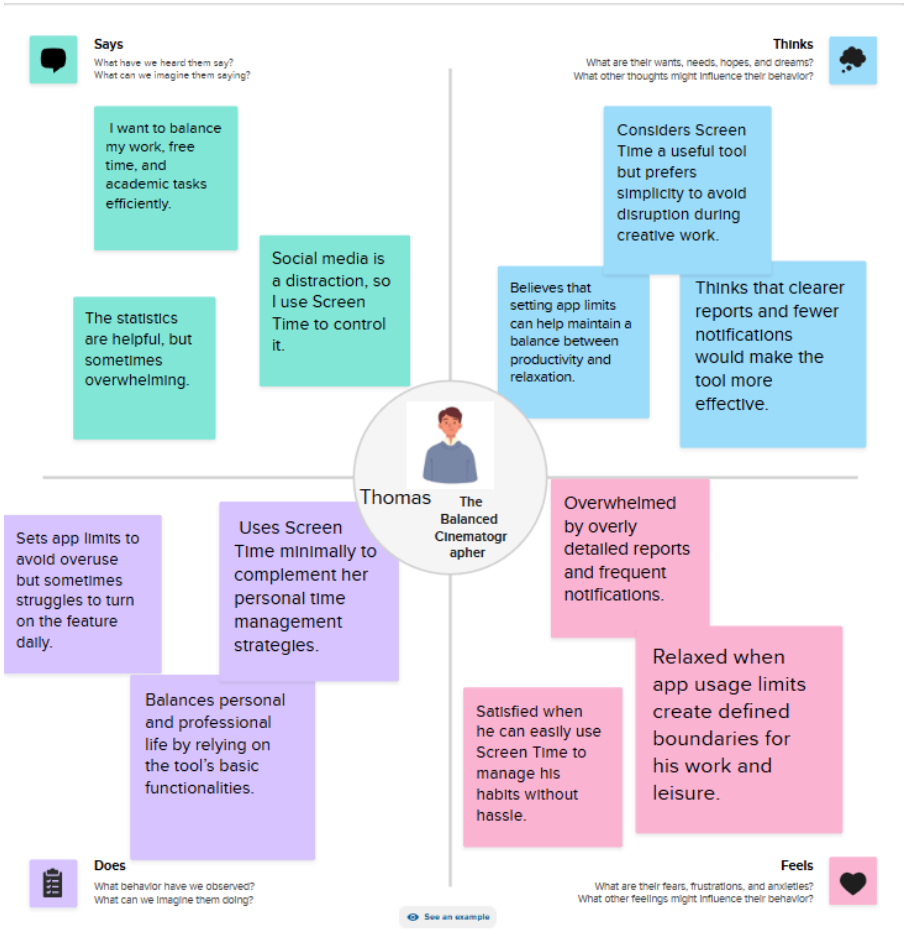
Literature Approval

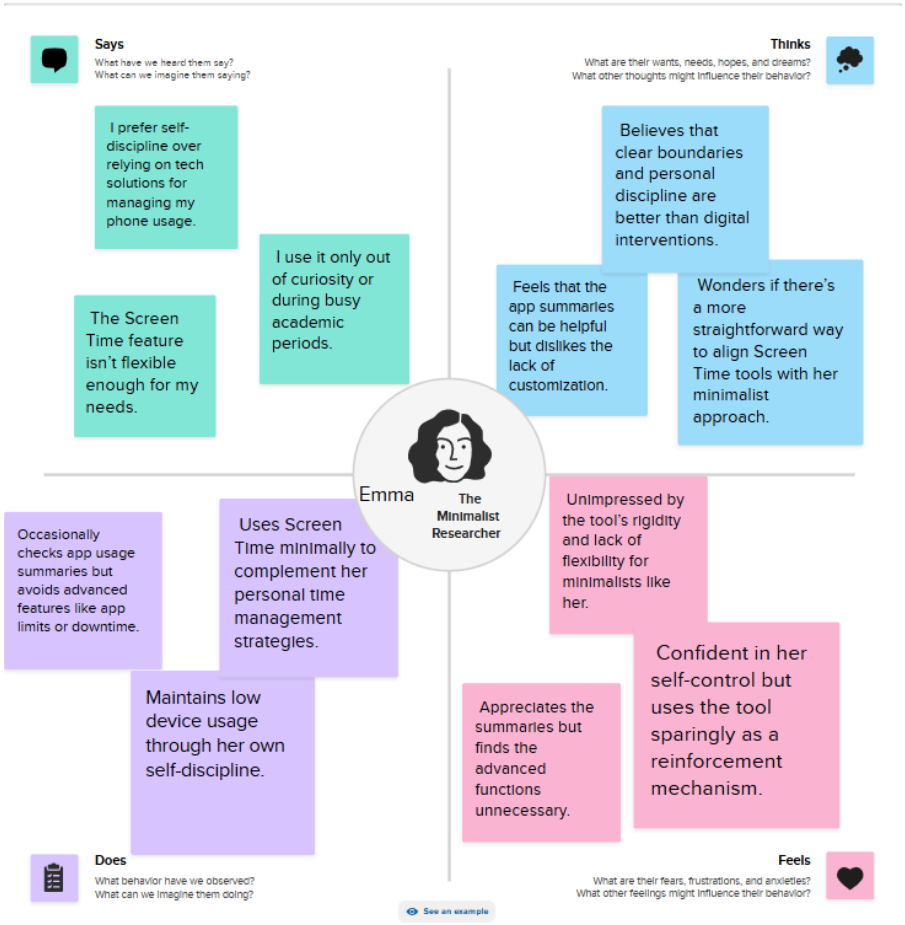


Literature Approval List: Literature List
Survey: Survey questionnaire
Interview Data Audio & Transcript
interview note
Contextual Inquiry
Prototype-1
Prototype-2
Prototype Testing Analysis
Timeplan

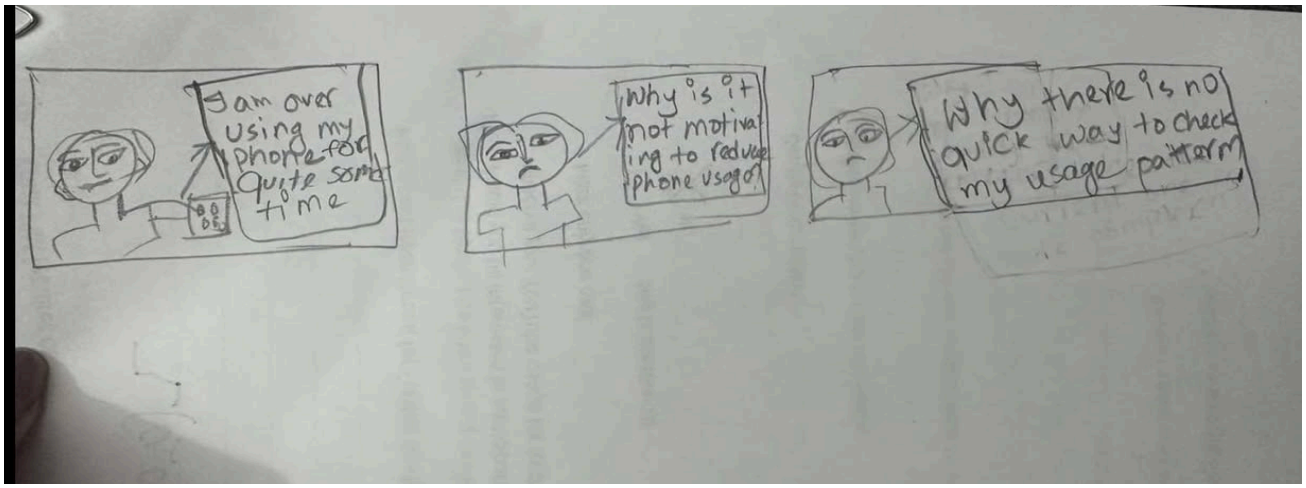
Empathy Map

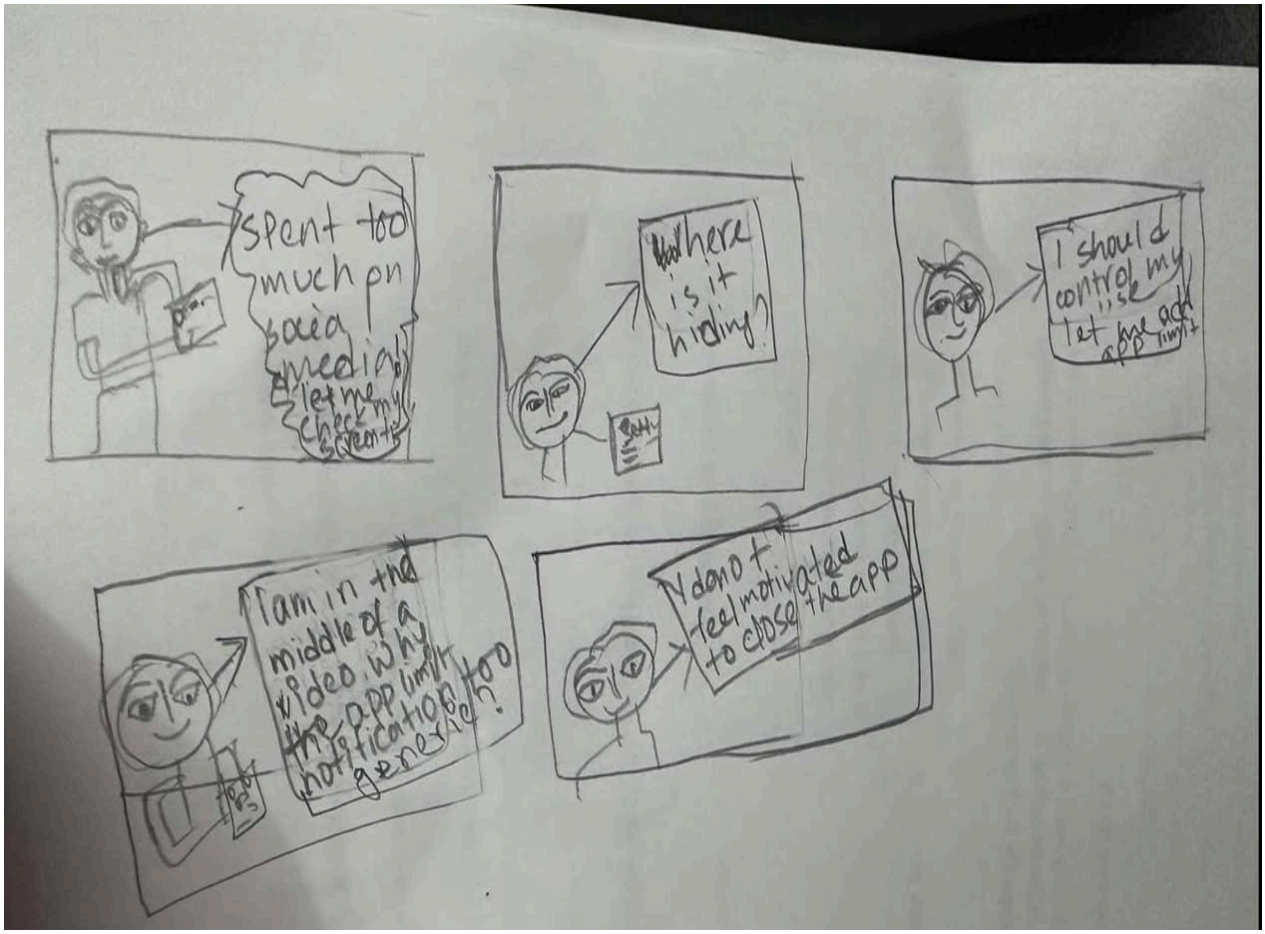

Says
What have we heard them say?
What can we imagine them saying?
My smartphone is my productivity hub—it's where I manage everything.
I enjoy exploring features that help me balance my work and personal life.
I want to track my usage and stay in control of my habits.
Thinks
What are their wants, needs, hopes, and dreams?
What other thoughts might influence their behavior?
Feels that overuse of social media and apps can negatively affect her productivity.
Thinks that the Screen Time feature offers useful insights, but it could be more actionable.
Wonders if she could use her tech expertise to find better solutions for managing her screen time.
Sara
The Multitasking Genius
Regularly checks her phone for work-related updates and task management.
Uses Screen Time reports to monitor and control her usage patterns.
Engages with technology actively, seeking tools that can complement her routine.
Frustrated when distracted by non-essential apps during work or study hours.
Appreciative of the flexibility offered by the Screen Time tool but desires more personalized options.
Motivated by features like usage reports to make informed decisions.
Does
What behavior have we observed?
What can we imagine them doing?
Feels
What are their fears, frustrations, and anxieties?
What other feelings might influence their behavior?
See an example


Says
What have we heard them say?
What can we imagine them saying?
I want to balance my work, free time, and academic tasks efficiently.
Social media is a distraction, so I use Screen Time to control it.
The statistics are helpful, but sometimes overwhelming.
Thinks
What are their wants, needs, hopes, and dreams?
What other thoughts might influence their behavior?
Considers Screen Time a useful tool but prefers simplicity to avoid disruption during creative work.
Believes that setting app limits can help maintain a balance between productivity and relaxation.
Thinks that clearer reports and fewer notifications would make the tool more effective.
Thomas
The Balanced Cinematographer
Sets app limits to avoid overuse but sometimes struggles to turn on the feature daily.
Uses Screen Time minimally to complement her personal time management strategies.
Balances personal and professional life by relying on the tool's basic functionalities.
Overwhelmed by overly detailed reports and frequent notifications.
Satisfied when he can easily use Screen Time to manage his habits without hassle.
Relaxed when app usage limits create defined boundaries for his work and leisure.
Does
What behavior have we observed?
What can we imagine them doing?
Feels
What are their fears, frustrations, and anxieties?
What other feelings might influence their behavior?
See an example

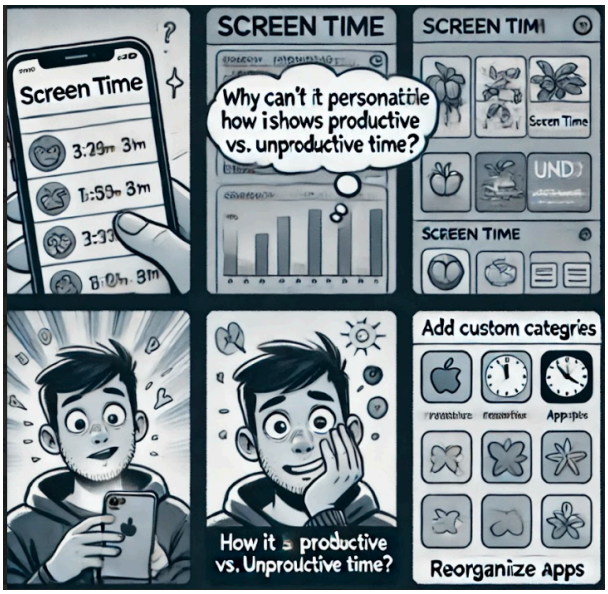


Storyboarding



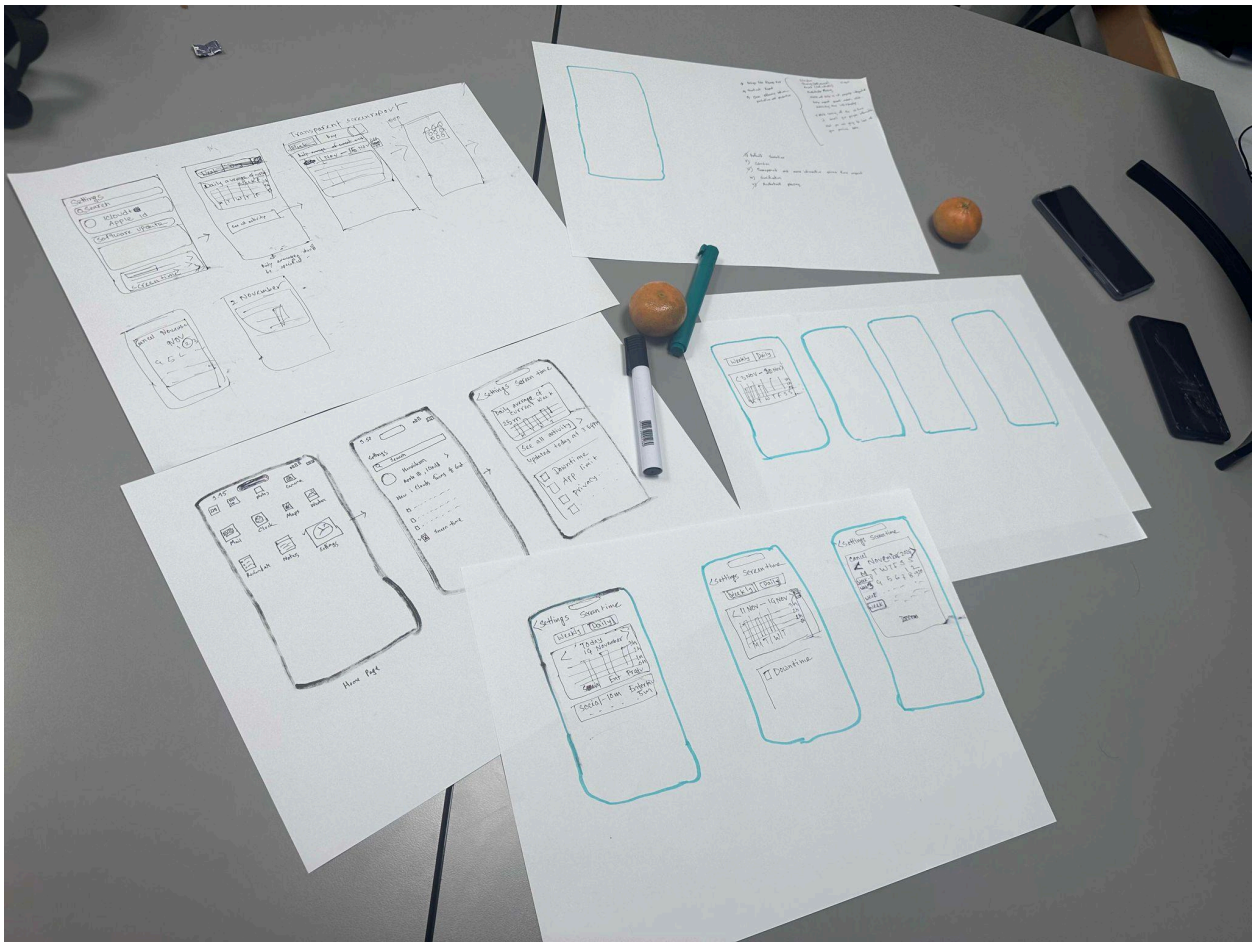

spent too much on social media
let me check my screen time
where is it hiding?
I should control my let me add app limit
I am in the middle of a video, why the app limit notification too generic?
I don't feel motivated to close the app

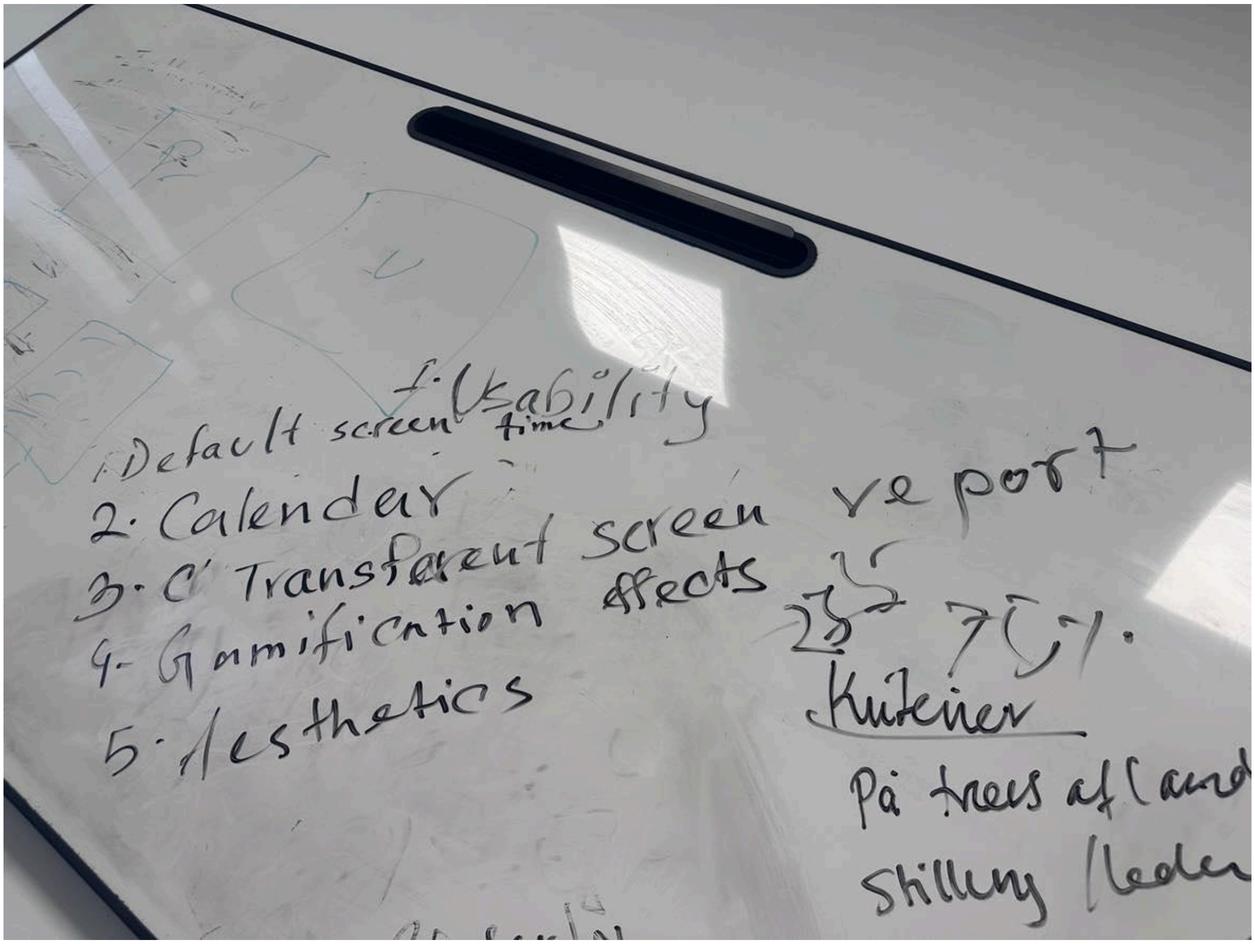

LE'U'VE SO MUCH TO DOD USTAIGE
A MUCH TO DO
SCREEN TIME
I'VE BEEN MUCH TO TODAY.
Screen Time
hour
hour
Screen Time you used 1 hour on social today.
LET'S BEG CONTROL
I'VE BEEN TOO MONG
Soccus
LET'S SEE MUCH MUCH I'M SPENDING ON MY PHEDIA TODAY.
INSTAGRAN
FOCUS MODE
Screen Time


Screen Time
SCREEN TIME
Why can't it personatile how ishows productive vs. unproductive time?
SCREEN TIMI
Screen Time
SCREEN TIME
Add custom categries
How it s productive vs. Unproductive time?
Reorganize Apps

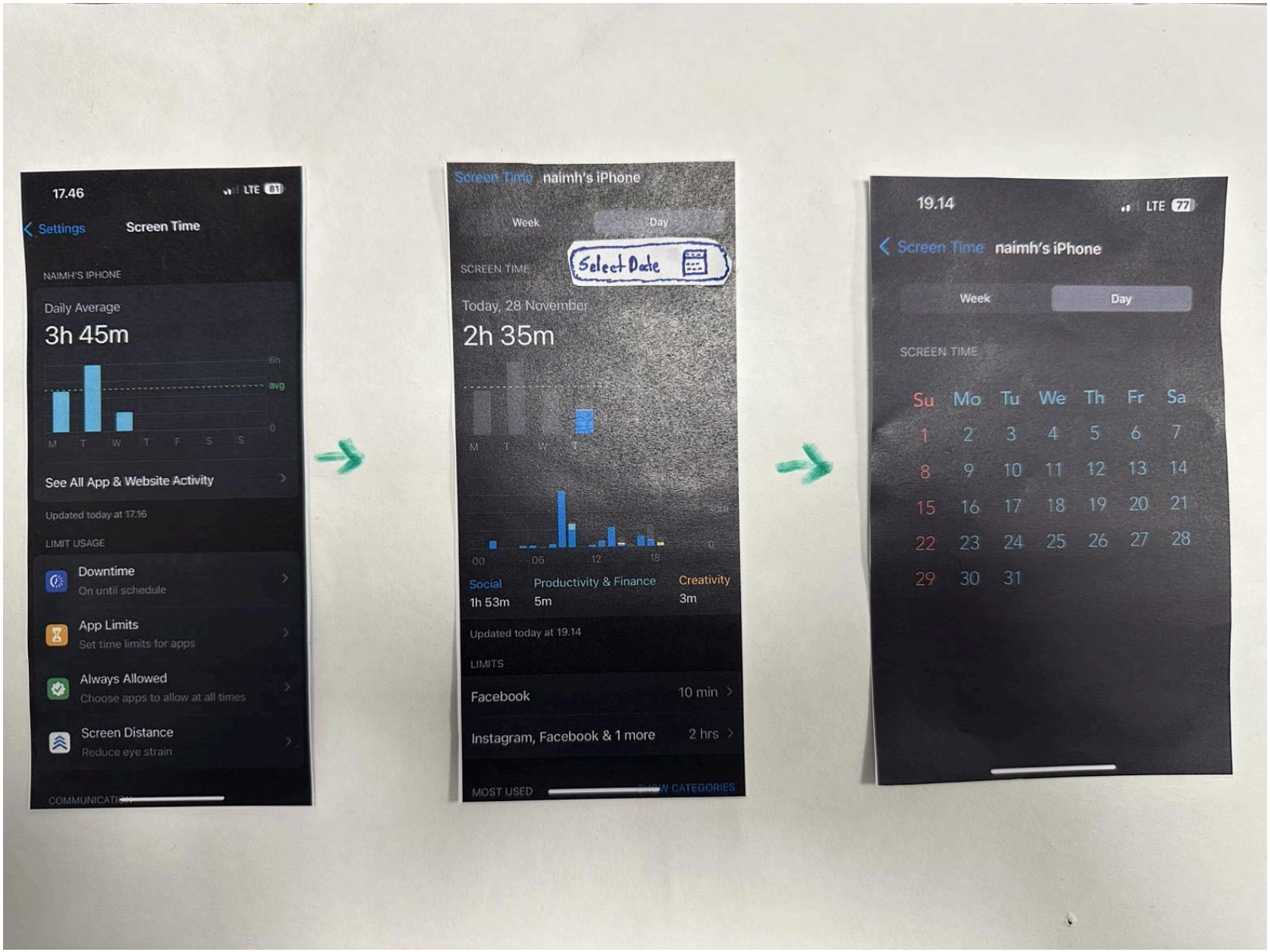

SCREEN TIME SETTINGS
APP LIMITS
APP LIMITS
APP LIMITS
APP LIMITS DOWNTIME
WHY CAN'T I CUSTOMIZE THIS MY SPECIFAC NEEDS?
SET LIMITS BASED BO NY
APP LIMITS
APP LIMITS
ONE-SIZE-ALL
SCREEN TIME
SET LIMITS BASED BASED OF MY HAPS TO TOR SESPIE- MY NEEDLE?
DOWNTIME
ADJUST NOTIFATIONS TO SUIT T TUIR SUSTOSDULE

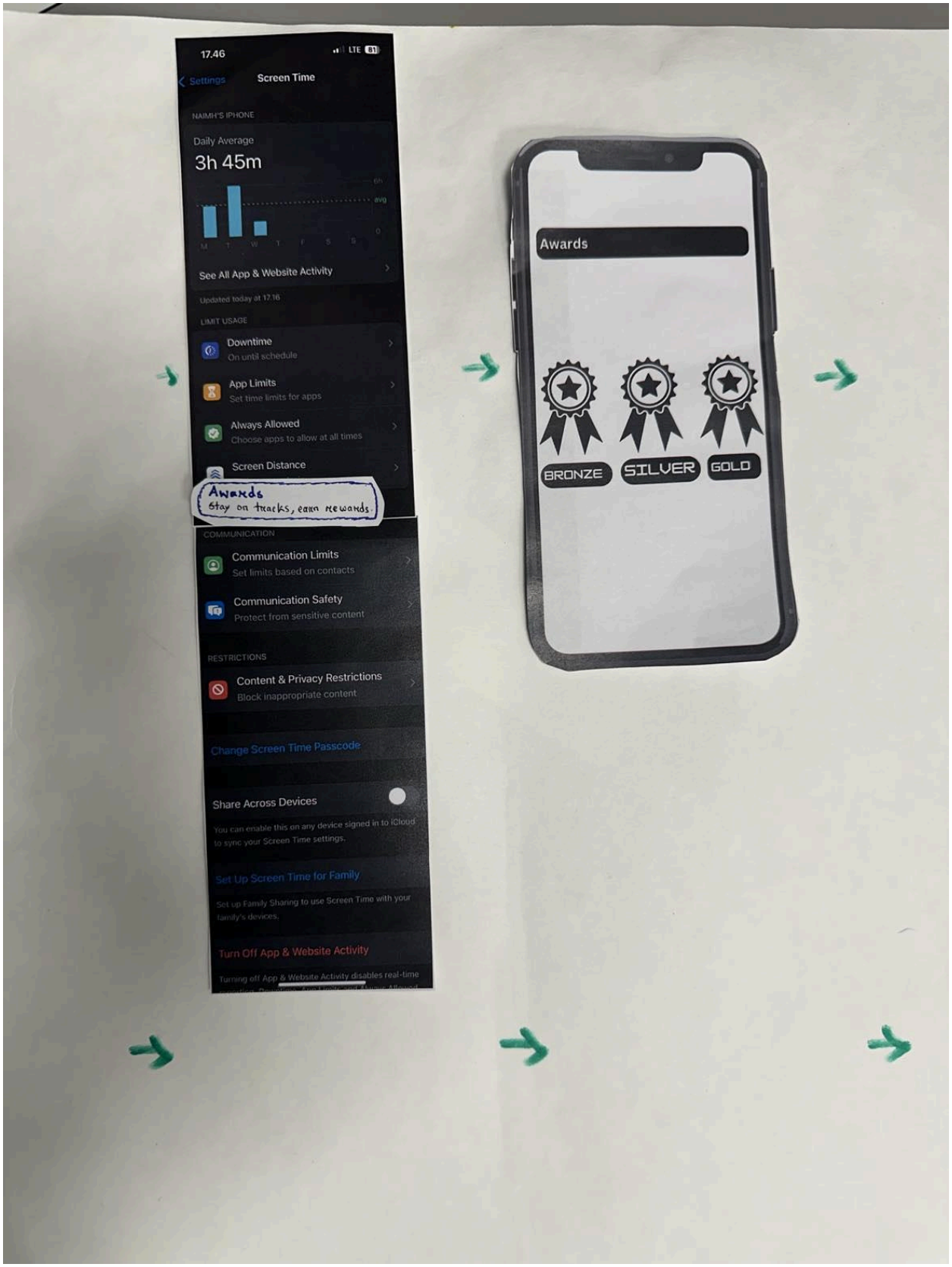

HOW BARE B MORE MINDFUL ABOAGE ABOUT 30 MINUTES TODAY?
SCREEN TIME
SCREEN TIME
Set a daily goal for app·medlo apps 30 minutes today.
ACTOIBLE TIPS
DODDLY TIPS
GREAT JOB!
Social Medio ustegion
30
Reduse social app usegaige today?
YO MOST USED APPS for 30 MINUTES TODAY?




1. Usability
1. Default screen time
2. Calendar
3. Transparent screen report
4. Gamification effects
5. Aesthetics
Kutener
På tvers af land
stilling / leder


Settings
MD Naim Hossain
Apple ID Suggestions
Airplane Mode
Wi-Fi
Bluetooth
Mobile Service
Personal Hotspot
Notifications
Sounds & Haptics
Focus
Screen Time
Screen Time
Daily Average of Current Week
3h 45m
See All App & Website Activity
Downtime
App Limits
Always Allowed
Screen Distance
App Limits
App Limits
Instagram, Facebook & 1 more
Add Limit
Choose Apps
All Apps & Categories
Social
Games
Entertainment
Creativity
Productivity & Finance
Education
Information & Reading
Health & Fitness
Utilities
Shopping & Food
Travel
Other
Choose Apps
Search
All Apps & Categories
Social
Facebook
Instagram
WhatsApp
Messenger
LinkedIn
Telegram
Messages
FaceTime
Meet
Meetup
Facebook
Time
0 hours 0 min
Block at End of Limit
Facebook
Facebook
Time
0 hours 10 min
Customise Days
Block at End of Limit
Facebook


17.46
LTE 81
Settings
Screen Time
NAIMH'S IPHONE
Daily Average
3h 45m
6h
avg
0
M T W T F S S
See All App & Website Activity
Updated today at 17.16
LIMIT USAGE
Downtime
On until schedule
App Limits
Set time limits for apps
Always Allowed
Choose apps to allow at all times
Screen Distance
Reduce eye strain
Screen Time naimh's iPhone
Week
Day
SCREEN TIME
Select Date
Today, 28 November
2h 35m
M T W T
00 06 12 18
Social
1h 53m
Productivity & Finance
5m
Creativity
3m
Updated today at 19.14
LIMITS
Facebook
10 min
Instagram, Facebook & 1 more
2 hrs
MOST USED
19.14
LTE 77
Screen Time naimh's iPhone
Week
Day
SCREEN TIME
Su Mo Tu We Th Fr Sa
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


17.46
LTE 81
Settings
Screen Time
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Daily Average
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6h
avg
0
M T W T F S S
See All App & Website Activity
Updated today at 17:16
LIMIT USAGE
Downtime
On until schedule
App Limits
Set time limits for apps
Always Allowed
Choose apps to allow at all times
Screen Distance
Awards
Stay on tracks, earn rewards.
COMMUNICATION
Communication Limits
Set limits based on contacts
Communication Safety
Protect from sensitive content
RESTRICTIONS
Content & Privacy Restrictions
Block inappropriate content
Change Screen Time Passcode
Share Across Devices
You can enable this on any device signed in to iCloud to sync your Screen Time settings.
Set Up Screen Time for Family
Set up Family Sharing to use Screen Time with your family's devices.
Turn Off App & Website Activity
Turning off App & Website Activity disables real-time
Awards
BRONZE
SILVER
GOLD


Settings
MD Naim Hossain
Screen Time
3h 45m
App Limits
Choose Apps
Facebook
Time
0 hours 10 min
Customise Days
Block at End of Limit
Time Limit
You've reached your limit on Instagram.
OK
Ignore Limit