JÖNKÖPING UNIVERSITY
School of Engineering

Mobile Screen Time & Well-being

Digital Well-Being, Digital Self-Control Tools, and Health Among University Students in Sweden

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Abstract

This paper examines the digital well-being of university students in Sweden and evaluates the potential impact of digital self-control tools (DSCTs). It also investigates the relationship between mobile use and mental and physical well-being. In recent years, many mobile users have been seeking ways to reduce their screen time due to associated psychological or physical concerns. However, such efforts have often been unsuccessful. As a response, DSCTs were introduced to assist them, though their effectiveness hasn't been established yet.

This study collected data from an online questionnaire and a diary study to demonstrate that university students' digital well-being is not satisfactory. It also argued that DSCTs have the potential to improve it. However, no significant correlation was found between mobile use and mental and physical well-being.

The study concludes that university students require support in enhancing their digital well-being, and that DSCTs represent a promising approach to achieving this. However, further research is needed to establish the relationship between mobile use and both mental and physical health. It should also be noted that the findings may have limited generalizability due to the small sample size and reliance on self-reported data.

Keywords: *digital well-being, DSCTs, mobile use, mental and physical health*

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1 Introduction

Since the dawn of the 21st century, mobile technologies have profoundly influenced various aspects of human life (ITU, 2017). The social implications of these technologies, particularly concerning daily social interactions and general well-being, have generated considerable interest among scholars and the public alike, mainly as adoption rates exhibit a steady increase. However, it is important to recognize that the expanding prevalence of mobile devices encompasses both advantages and disadvantages. A significant concern is that many individuals fail to leverage these devices to their full potential, which often adversely affects their lives (Khan et al., 2022). Mobile tools serve a multitude of functions, including facilitating communication with friends and family, executing professional responsibilities, and addressing urgent situations (Masthi & Yashasvini, 2012).

It is widely acknowledged that individuals across all age groups possess at least one personal mobile device (Khan et al., 2022). Masthi and Yashasvini (2012) emphasize that *"...there are five billion mobile phone subscriptions around the World*." (p.84). Another statistic indicates that individuals interact with technology by tapping and swiping over 2600 times daily (Dscout, 2016); moreover, as Deng et al. (2019) assert, individuals spend an average of three hours each day in front of their mobile devices.

However, technology use is associated with several health issues. The psychological effects of screen usage are often analyzed in modern discussions (Kaye et al., 2020). Individuals often report feeling "*lonely, irritated, insecure, and incomplete*" when they use mobiles excessively. Moreover, people experience physical ailments such as "*headache, ear pain, neck pain, and thumb pain*" (Masthi & Yashasvini, 2012, p. 87). Although many individuals recognize these changes and express a desire to reduce their device usage, they frequently encounter difficulties in doing so (Jiang, 2018). These statistics reveal individuals' lack of control over their mobile usage and emphasize the urgent need to develop interventions that promote digital well-being.

Digital well-being signifies the state of harmony or the absence of it, experienced by individuals concerning mobile connectivity, creating an increasingly urgent issue. This concept is often articulated by contrasting it with negative mobile phone behaviors or conditions that signify digital ill-being, such as technology addiction (Vanden Abeele, 2020). As a result, there is an increasing need for researchers to investigate the relationship between mobile use and well-being. More concretely, physical and mental well-being are highly affected (Thomas et al., 2022). This investigation requires additional methodologies and tools for attaining digital well-being (Roffarello & Russis, 2023). Nevertheless, existing evidence regarding the effectiveness of digital well-being applications remains inconclusive (Vanden Abeele, 2020).

This research seeks to investigate the digital well-being of university students as mobile users, as well as the potential advantages or disadvantages associated with the utilization of applications designed to cultivate a positive relationship between the user and their device.

1.1 Problem Statement

Numerous research papers discuss how individuals struggle to maintain control over their behavior when using mobile devices (e.g., Hiniker et al., 2016; Lyngs et al., 2024; Tran et al., 2019). Users frequently check their phones due to notifications or engaging content, sometimes resulting in unintended prolonged use, which adversely affects their health, work performance, and social interactions (Lyngs et al., 2024). This highlights the significance of digital well-being and the need for strategies to maintain it.

Digital distraction presents a substantial challenge for mobile users, as research indicates that, on average, only a few minutes of productivity are disrupted by about 25 minutes of screen time (Calderwood et al., 2014). However, this is not the only important aspect of mobile usage. Users' overall well-being is also impacted (Lyngs et al., 2020). Lyngs et al. (2020) emphasize in their paper that "*repeated experiences of (a lack of) digital well-being may have longer-term consequences for an individual's well-being*" (p. 945).

Digital self-control tools (DSCTs) represent a potential solution for addressing issues related to digital well-being (Lyngs et al., 2024). These applications are designed to enhance user behavior by assisting individuals in minimizing technological distractions (Biedermann et al., 2023). In recent years, developers have introduced various DSCTs to promote users' digital well-being (Roffarello & Russis, 2023). Nevertheless, their regular use and overall effectiveness remain largely underexplored (Biedermann et al., 2023). Roffarello & Russis (2023) describe this research area as "emerging" (p. 53) and emphasize the necessity for more effective tools, which are currently facing challenges. According to their findings, there is still limited knowledge about evaluating applications aimed at promoting digital well-being and whether they provide real benefits.

This study aims to explore the correlation between users' interaction with their personal mobile phones as well as their physical and mental health well-being. Additionally, it seeks to evaluate DSCTs to determine their usefulness in maintaining digital well-being.

1.2 Purpose and Research Questions

There is an increasing need to achieve digital well-being and investigate how mobile tools can help (Parry et al., 2022). Developers are creating more

applications aimed at addressing this issue, but there is still limited understanding of their impact on users' behavior and physical and mental well-being (Lyngs et al., 2024).

The purpose of this study is to examine the digital well-being of university students as mobile users and assess the potential benefits derived from employing DSCTs. It further investigates if there is a correlation between mobile use and mental and physical health well-being. The research is focused on university students, as previous studies have emphasized it as vital (e.g., Lyngs et al., 2020; Lyngs et al., 2024; Roffarello & Russis, 2023). The study concentrates explicitly on students in Sweden.

To address the outlined problem, three research questions were formulated:

RQ1: What is the current state of digital well-being of university students in Sweden?

Next, to determine if the DSCTs effectively promote the digital well-being of the tested sample, it is crucial to evaluate the time spent on the device (Roffarello & Russis, 2023) and whether it decreases when using a DSCT for a longer period. This establishes the second research question:

RQ2: Does the use of DSCTs lead to changes in screen time, and how do these changes relate to users' digital well-being?

Additionally, investigating whether changes in screen time influence mental and physical well-being is important. Therefore, the third research question is as follows:

RQ3: How does a reduction or increase in screen time affect users' mental and physical well-being?

The research questions will be addressed through data gathered from students involved in both quantitative and qualitative research methodologies.

1.3 Scope and Limitations

Because of their portability and interactive features, smartphones have been identified as the primary cause of concerns with digital well-being (Roffarello & Russis, 2023). That is why this study is limited to testing interactions with mobile phones only. Furthermore, while mobile devices provide people with access to technology at any time, they are also associated with various drawbacks (Thomas et al., 2022). Excessive screen time has been linked to poor sleep, reduced productivity, and lower achievement levels. Constant use of devices has contributed to a general decline in mood and physical well-being, alongside social pressure to maintain constant contact with others (Hiniker et al., 2016). This study will focus on examining these factors

explicitly, as they represent significant challenges for students in higher education (Thomas et al., 2022).

The sample group of university students restricts the scope of this research. More specifically, university students in Sweden, as a more limited sample group is necessary within the designated time frame. Furthermore, no prior research has been identified regarding this topic within the Swedish context.

Although this issue is relevant to nearly all mobile users, higher education students are among the most affected demographic (Genova et al., 2021), and digital distraction poses a serious problem for them (Calderwood et al., 2014). According to studies, prolonged use of mobile devices places higher education learners worldwide at risk of addiction (Alosaimi et al., 2016; Kumcagiz & Gunduz, 2016). This leads to unintended longer screen time and abandonment of work. Their energy levels and academic performance decline due to poor sleep, which also contributes to a stressful lifestyle (Attia et al., 2017; Boumosleh & Jaalouk, 2017). Lyngs et al. (2024) conducted a study with university students, revealing that they have a high motivation to adjust their smartphone use for better control. One approach to achieving this is using DSCTs (Lyngs et al., 2024).

Various third-party phone applications known as DSCTs are available to track and manage device usage (Lyngs et al., 2024). However, features in Apple and Google's operating systems also integrate DSCTs, aiming to promote digital well-being (Thomas et al., 2022). Therefore, this research is limited to DSCTs that are pre-installed on smartphones.

1.4 Disposition

This section describes the report's structure. It summarizes each chapter and how it advances the study. Each chapter builds on the previous one to guarantee coherence and clarity in the presentation of the research findings.

Chapter 1 introduces the research problem and questions, as well as the objectives of the paper. Chapter 2 provides an overview of relevant research and theoretical frameworks that guide the research. Chapter 3 presents the methodology, including data collection and analysis methods. The research findings can be found in the fourth Chapter of the paper, followed by a discussion of their relation to the study questions in Chapter 5. Chapter 6 wraps up the study by summarizing the main conclusions and suggesting areas for future work.

2 Theoretical framework

This chapter provides information about digital well-being and DSCTs as concepts. It also explores other relevant terms and testing methods used in previous studies.

2.1 Digital well-being

A variety of perspectives can be used to conceptualize digital well-being. Two of the main ones mentioned by Cecchinato et al. (2019) are medical-oriented and user-oriented. Therefore, to understand the concept of digital well-being, it is crucial to first know the definition of subjective well-being (Büchi, 2021b). Subjective or general well-being is a state of "optimal psychological experience and functioning" (Deci & Ryan, 2008, p. 1). It represents our self-assessment of the quality of our lives, encompassing health status, work environment, relationships, and social experiences.

Another essential concept is digital media. Digital media allows us to connect with people, resources, and information without the limitations of time and location (Vanden Abeele, 2020). However, it is an aspect that can significantly affect our overall well-being (Büchi, 2021b). With this understanding, the concept of digital well-being can be examined. Digital well-being refers to the subjective experience of using technology to enhance and simplify one's life without causing negative consequences (Vanden Abeele, 2020). Vanden Abeele (2020, p. 938) proposes the following definition:

> Digital wellbeing is a subjective individual experience of optimal balance between the benefits and drawbacks obtained from mobile connectivity. This experiential state is comprised of affective and cognitive appraisals of the integration of digital connectivity into ordinary life. People achieve digital well-being when experiencing maximal controlled pleasure and functional support, together with minimal loss of control and functional impairment.

To address digital well-being, a new sector of initiatives is emerging. Digital detox programs and self-help books are examples of these approaches (Vanden Abeele, 2020). Additionally, numerous digital applications have been developed to help people manage their mobile use with tools like lock-out systems and timers (Roffarello & Russis, 2023).

2.2 DSCTs

Health and productivity constraints have urged developers and device manufacturers to provide features that allow users to monitor their mobile device usage and give a more controlled relationship with their phones (Ubochi, 2019). DSCTs aim to enhance users' digital well-being by reducing distractions from mobile phones (Biedermann et al., 2023).

There are various third-party applications that serve these needs, like “Forest: Stay Focused”, “Moment” (Parry et al., 2022), “Detox”, and “OffTime” (Thomas et al., 2022). However, tech giants like Apple and Google understand that extensive use of mobile devices may lead to users feeling a lack of control (Cheng et al., 2019). That is why mobiles today come with pre-installed DSCTs - the “Digital Wellbeing” app on Android devices and the “Screen Time” app on iOS (Biedermann et al., 2023). Both applications were launched in 2018 and allow users to monitor their screen time across various categories as well as overall device usage. Furthermore, these tools provide mobile users with the opportunity to set limits on the total time spent or on specific applications (Parry et al., 2022; Thomas et al., 2022). However, Screen Time and Digital Wellbeing are not set automatically; instead, the user has to explore and configure them manually. This seems to be one factor contributing to the low usage of these DSCTs (Biedermann et al., 2023).

The Digital Wellbeing app presented by Google "can be compared to a personal control center" (Svensson, 2019, p. 37). This tool monitors device activity and records all user interactions. It automatically operates in the background, collecting data on apps and overall smartphone usage. However, simply gathering and reviewing device usage information is not sufficient for achieving digital well-being. Therefore, the Digital Wellbeing application provides metrics to help users improve their behavior. This self-control tool enables mobile users to set limits on specific apps or suggests that they take breaks. However, Google does not compel users to utilize the available metrics. Instead, users have the freedom to establish these metrics and define their limits (Svensson, 2019).

Like Digital Wellbeing, Screen Time offers support in managing certain areas of phone use, but on iOS devices. The "Downtime" option lets users set a low engagement state where the device is accessible only for selected apps. Additionally, "App Limits" allows users to establish daily limits for specific app categories, such as productivity, social, games, and entertainment. Finally, “Content & Privacy Restrictions” helps to manage what content is visible and the privacy settings on iPhones, while "Always Allowed" ensures that certain apps are always available, regardless of limitations (Ubochi, 2019).

Just like a physical activity fitness tracker, the DSCTs app tracks user behavior and assesses it against set objectives (Svensson, 2019). However, there remains a need to understand the best ways to utilize DSCTs to support users’ digital well-being (Parry et al., 2022). Since appropriate features are already available on most people’s phones, it is reasonable to explore them instead of third-party applications and investigate their impact on users’ well-being.

2.3 The Effects of Excessive Mobile Use on Physical and Mental Health

Excessive or inappropriate use of mobile technology, associated with a lack of digital well-being, can lead to several negative consequences. Thomas et al. (2022) write a long list of possible ones:

> ...insufficient sleep, lack of energy, poor academic achievement, altered psychological well-being, withdrawal, functional impairment, compulsive behavior, physiological stress, mind wandering, attention deficit-hyperactivity disorder-related behavior, nonadaptive/negative thinking styles, decreased life satisfaction (p. 2)

According to studies, the most prevalent ones among young adults are those that affect sleep patterns (Lanaj et al., 2014; Thomas et al., 2022), performance rates, and accomplishments at work (Duke & Montag, 2017; Schnauber-Stockmann et al., 2018). Additionally, constant connectivity creates social pressure to always remain in contact with friends (McDaniel & Drouin, 2019), raises safety concerns due to excessive usage, and leads to a general decline in mood and well-being (Hiniker et al., 2016). Consequently, researchers who evaluate DSCTs are gathering data ranging from direct evaluations of the tools' features to assessments of how these tools affect users' character traits and emotions, such as stress and focus (Roffarello & Russis, 2023). Screen time also appears to be critical for addressing issues with digital well-being and creating the best possible work-life balance (Thomas et al., 2022).

2.4 Smartphone Addiction

The constant use of technology and communication in today's world has led to the serious consequences of digital addiction (Thomas et al., 2022). Today, 60 percent of young adults aged 18 to 34 report using their smartphones "too much" (p. 1), and some of them may even show signs of smartphone addiction (Ge-nova et al., 2021). Researchers use different scales and questionnaires to collect measurements in this manner. The Smartphone Addiction Scale (SAS) is among the most common ones used in studies (Roffarello & Russis, 2023).

The 33-question SAS employs a six-point Likert scale for self-evaluation. Its objective is to assess smartphone addiction by self-reporting based on six variables that smartphone use may affect: disruption of daily life, enthusiasm, disengagement, relationships focused on the internet, overuse, and tolerance (Kwon et al., 2013). Together with its short version for adolescents - SAS-SV (Kwon, Kim, et al., 2013), the SAS was initially created and validated for use with people in South Korea. This scale's acceptance and popularity have increased quickly, and SAS has now been translated and verified for use in many countries (Roffarello & Russis, 2023).

3 Methods and Implementations

This chapter outlines the research design and methodological choices for the study. It motivates the reasons behind selecting specific research methods and describes the overall work process.

3.1 Sample and Data Collection

This study contained two phases: an online questionnaire and a diary study. First, the online questionnaire was conducted. Its purpose was to solve the first research question (RQ1: What is the current state of digital well-being of university students in Sweden?). The next stage of the study consisted of a diary study that aimed to answer the second and third research questions (RQ2: Does the use of DSCTs lead to changes in screen time, and how do these changes relate to users' digital well-being?; RQ3: How does a reduction or increase in screen time affect users' mental and physical well-being?).

3.1.1 Sample Selection

To this study, convenience sampling was used as it offers time- and cost-efficient ways to collect participants (Nikolopoulou, 2023a). The participants had to be university students in Sweden, but the sample demographic was non-specific regarding exact location or owned device. Since men and women frequently have identical results in similar studies (Olson et al., 2023), gender was also not considered. The only requirement was that participants have a personal mobile device.

The online questionnaire was distributed in social media groups on Facebook, Messenger, and WhatsApp, which consisted of university students studying in Sweden only. Furthermore, it was published on LinkedIn and supported by a text encouraging only participants from the examined demographic. The questionnaire also served to recruit volunteers for the diary study by providing an option to sign up.

3.1.2 Online Questionnaire

The first research method employed in this study was an online questionnaire, as it is suitable for many participants to provide answers in an organized manner (Goodman et al., 2012). Another reason for choosing this method was that it reduces the risk of error in the data collection stage. Furthermore, this research method is both time- and cost-efficient (Regmi et al., 2017), making it suitable for the scope of this study. Another essential point for employing this method was that it is practical for the participants as they can fill it out at their own time and pace (Goodman et al., 2012). The questionnaire for this study was built in Google Forms.

As mentioned earlier, the online questionnaire was expected to address the first research question. With this goal in mind, the questions were designed and split into four sections. First, the participants had to answer a demographic question regarding their age to make the research results comparable to those of previous and future studies. Second, they were asked questions about technology use, or more specifically, how much time they spent on-screen and which applications they used the most the week before. They were instructed to look up this information on their phones. Next, the short version of SAS - SAS-SV, was included. The short version was chosen to prevent the questionnaire from becoming too long. Lastly, there was an optional question. It allowed the participants to sign up for the next stage of the research - the diary study.

All questions were carefully phrased to avoid confusion for the respondents and the data analysis. The questions also ensured that respondents were provided with an option that applied to them. An example is question 3 (What are the top three apps you have used last week?). Seven possible answers were listed, but an eighth option allowed the participants to enter a different response. To increase the response rate, the set of questions was shortened in length. The questionnaire consisted of 13 multiple-choice or short-answer questions and required approximately 6 minutes to complete. All the questions can be found in Appendix 1.

3.1.3 Diary Study

The online questionnaire was followed by a diary study, as regular responses about daily experiences were expected. Also, it was important to examine events in their natural environment and shortly after they occurred. Furthermore, it suited the study as it reveals patterns along with unusual or temporary events that would be challenging to identify otherwise (Goodman et al., 2012).

The participants in the diary study were randomized into two groups: one group used DSCTs that were pre-installed on their phones, while the other served as a control group and did not use any tools. This approach was chosen for better evaluation of the results and comparison.

The participants who used DSCTs had a set limit of one hour per day on a collection of apps - Instagram, TikTok, Snapchat, and YouTube. These applications were chosen based on previous studies that suggested their excessive use by university students (e.g., Amaral et al., 2023; Villanti et al., 2017). This statement was further supported by the online questionnaire results of this study.

The diary study was in questionnaire format. The observation period was set to 21 days with everyday logs, as this is the average duration in similar studies on the topic (Roffarello & Russis, 2023). Participants had to answer the same set of questions each day, with the recommended time for completion being in the morning, no later than

lunchtime. To avoid participant fatigue, the number of questions was minimized, including only those necessary to answer the second and third research questions.

The daily entries had to capture a full day's experience, which is why participants had to log their responses the following morning. The instructions clearly stated that to make certain that no false information was entered.

This study relied mostly on structured data, but some unstructured data was gathered too. Firstly, every log included information about the total daily screen time of the participant and the top three applications used during the day. Second, the diary study included the SAS-SV with a slight change of wording on some questions so it could be addressed for the day before instead of as a general asking. Next, the perceived physical and mental well-being of the participants was tested. More precisely, their sleep, stress levels, and general mood. Lastly, there was an optional question. It gave the participants an empty field where they could share more about their device use, sleep, and emotions for the day before. It was not mandatory to not force respondents to spend more time on the study, but their voluntary answers were expected to give more insights and determine any atypical circumstances that may have influenced the answers to the other questions.

A pilot study was conducted to ensure the feasibility, reliability, and effectiveness of the testing process before the main study. The first version was tested with three participants for three days (these people were not included in the main study). Two of the participants suggested that some of the questions did not maintain consistency in the way they were asked and the answers displayed. That is why a change was made in the "Physical and mental well-being" section. The final list of all questions can be found in Appendix 2.

Google Forms was the platform used for data collection in the diary study. An online form was chosen as it facilitates data analysis (Bolger et al., 2003) and allows preview of the date and hour a response was logged.

The diary study was distributed via email. All individuals who signed up by entering their email address in the online questionnaire received a message. It included their individual link, detailed instructions, and contact information to be able to reach out if any questions arise. All participants started on the same date to ensure that their data is comparable, and all links were open for responses for 21 days.

3.2 Data Analysis

The following section contains information about the decisions on how the data was analyzed.

3.2.1 Online Questionnaire

The data from the online questionnaire was gathered and put in an Excel spreadsheet. Firstly, the mean of all ages was calculated as well as the standard deviation of the results (SD). Next, the same was done with the screen time and SAS-SV entries to understand how much time on average the Swedish university student spends on their phone and to evaluate their level of smartphone addiction risk. Additionally, the correlation between screen time and SAS-SV scores was calculated, as well as the statistical significance of the results. The logs on the three most-used apps were also analyzed and presented as percentages, showing the proportion of users for each app. Finally, the emails entered as a response to the last optional question were collected.

3.2.2 Diary Study

Analyzing the entries from the diary study, the mean and SD of screen time were calculated for each participant. Next, a group-level calculation was performed. Then, an independent samples t-test was conducted to compare the screen time of both groups logged through the full 21-day period. Next, the screen time results were analyzed on a weekly basis to identify gradual changes and patterns. Furthermore, the average SAS-SV scores were calculated for each participant and for each group. The SDs were also logged. Then, correlation analysis and statistical significance testing were conducted for the screen time and SAS-SV scores of each group. The entries from the Physical and mental well-being section were examined to analyze the correlation between screen time and mental and physical health indicators, as well as the statistical significance of these relationships. Lastly, the responses to the open-ended question were investigated to gain further insights and identify recurring patterns.

All entries were saved and analyzed in Microsoft Excel.

3.3 Validity and Reliability

To ensure the validity and reliability of the findings, several methodological considerations were taken into account during the design and execution of the research.

This study relies on self-reported data, which can introduce response bias, as participants may overestimate positive behavior or underestimate negative one. The anonymity of the participants in the study was ensured to reduce social desirability bias and encourage honest answers. To further ensure the accuracy of the findings, the diary study was designed with everyday logs to have shorter recall periods. Furthermore, external factors like academic stress, social pressure, or lifestyle changes may influence the results, making it challenging to analyze the effects of DSCTs alone. To be able to identify such factors, the diary study included an open-ended

question encouraging respondents to share more about their day, device use, and general feelings.

In addition, the small sample size may restrict the generalizability of the findings to a broader student population. To reach more students, the questionnaire was spread through social media and student groups. However, it should also be considered that participants who chose to engage in the study may already be concerned about their digital habits, introducing selection bias. To minimize this issue, participants were randomly split into two groups during the diary study.

Furthermore, the study aims to assess real-life digital habits. The awareness of being part of the study may have influenced participant behavior, potentially differing from their actual mobile use outside of the study. To better reflect real-world use, the participants were using DSCTs in their everyday environment, rather than in a controlled lab setting, and the study period was extended to three weeks to capture more natural, long-term behavior.

The use of standardized questions helps enhance reliability by reducing variability in responses, but self-reported data can introduce inconsistencies if respondents interpret questions differently. To address this issue, the study used a pre-approved scale (SAS-SV) that was already used in previous research, and the questionnaire was pre-tested before the official execution. Additionally, statistical significance testing can strengthen the reliability of the findings, but the small sample size remains a concern for generalizability. To strengthen the overall reliability of the study, both quantitative and qualitative data entries were collected from the diary study. This ensures that the conclusions are not based solely on numbers, but the broader context is understood too.

3.4 Considerations

In both the online questionnaire and the diary study, all questions were carefully phrased to be as neutral and unbiased as possible. This was important to ensure that the results were based solely on the participants' own opinions. The anonymity of the respondents was also guaranteed, so they could feel secure when sharing their opinions. Furthermore, the introduction paragraph to the questionnaires made sure that participants understood how and for what their answers were used. Only individuals who were studying in higher education were allowed to respond, which ensured that all participants were above the age of 18.

4 Results

In this chapter, the results from both the online questionnaire and the diary study are presented and analyzed. Results that answer the research questions and fulfil the purpose of the study can be found.

4.1 Online Questionnaire

The data from the online questionnaire was collected over 20 days, and the results are presented in this section. To see more detailed information, see Appendix 3.

Thirty-five people answered the online questionnaire. The participants' average age was 22.77 years (SD = 3.47). All respondents were studying in Sweden but were not necessarily Swedish.

The daily screen time of all participants ranged from 1.63 to 10.83 hours. It was calculated that the university students in Sweden spend an average of 5.9 hours (SD = 2.37) per day on their phones.

The average SAS-SV score of participants (M = 32.49, SD = 9.24) falls within the range suggested by Olson et al. (2023) as indicative of high risk for mobile phone addiction (scores between 31 and 33). Table 1 summarizes the results of all participants regarding their risk of smartphone addiction as assessed through the online questionnaire. Participants were categorized into three groups: no risk of smartphone addiction (scores below 31), high risk of smartphone addiction (31-33), and smartphone addiction (above 33), with the respective percentages displayed.

No risk of smartphone addiction (below 31)	High risk of smartphone addiction (31-33)	Smartphone addiction (above 33)
37.1% (n = 13)	14.3% (n = 5)	48.6% (n = 17)

Table 1: Risk of smartphone addiction among participants in the online questionnaire

The lowest result logged on the SAS-SV was 11, and this participant logged an average daily screen time of 3.25 hours. On the contrary, the highest was 55 with a corresponding 9.88 hours of screen time. The results of all participants on the SAS-SV associated with the corresponding screen time can be found in Appendix 4. Another interesting insight when looking into the individual questions from the SAS-SV is that on the 9th statement ("I am using my smartphone longer than intended"), 42.9% of the participants answered with “strongly agree” and 37.1% with "agree".

Further calculations were made to find what is the correlation between users' daily average screen time and their results on the SAS-SV ($r(35) = .37$, $p = .048$). The r value indicates a moderate positive correlation between screen time and SAS-SV scores. Furthermore, the p-value is less than 0.05, meaning this correlation is statistically significant. In Figure 1, the correlation between screen time and SAS-SV results is depicted.

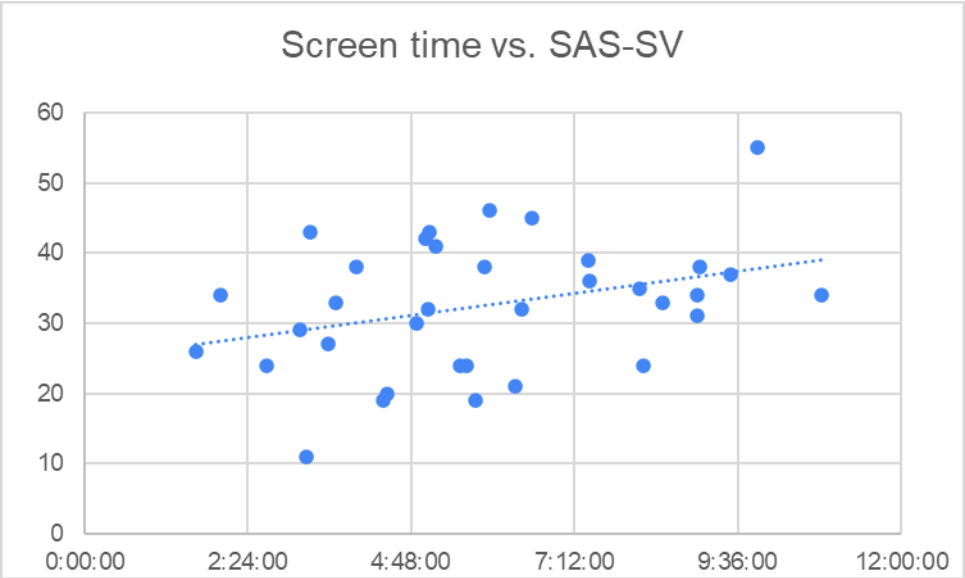

Figure 1: Correlation between average daily screen time and results from SAS-SV from the online questionnaire ($r(35) = .37$, $p = .048$).

While the results from the top apps used were not important to answer RQ1, they were taken into consideration when determining which applications should be blocked in the next stage of the study when employing DSCTs. Among the most used ones from the participants in the online questionnaire were Instagram, dominating with 77.1%, followed by YouTube, TikTok, the Web browser, Snapchat, and WhatsApp. All results in percentages can be seen in Figure 2.

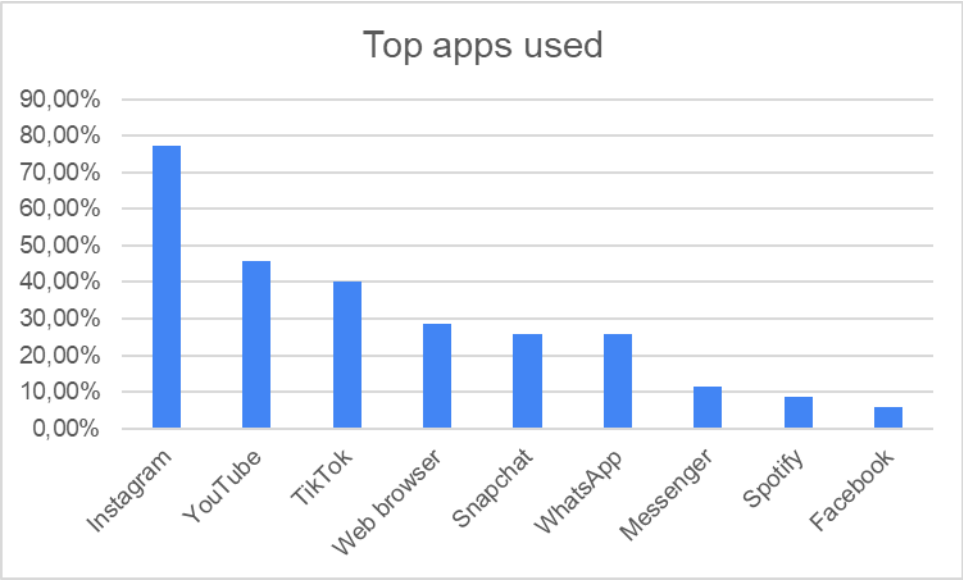

Figure 2: Top apps used by university students in Sweden (based on the question "What are the top three apps you have used last week?" in the online questionnaire).

The last question that aimed to collect participants for the diary study had 10 responses.

4.2 Diary Study

The data from the diary study was collected over 21 days with daily logs. The results are presented in this section.

Ten people participated in the diary study, but only eight were taken into consideration for the analysis and conclusions. The reason for that is that one of the participants from the group that used DSCTs was not consistent, and their responses were sometimes submitted several days apart. A participant from the Control group (who did not use DSCTs) was also excluded because the data they provided included screen time from both their phone and computer. While this may still be valuable information, it could not be compared with the results of the other participants, who only reported screen time from their mobiles.

For the 21-day period, the participants in the Main group (with DSCTs) reported significantly lower screen time ($M = 3.45$, $SD = 1.96$) compared to those in the Control group ($M = 4.37$, $SD = 2.15$). The full list of daily logs on screen time can be found in Appendix 5.

An independent samples t-test was conducted to compare daily screen time between participants who used DSCTs and those who didn't. The results indicated a statistically significant difference in screen time between the two groups ($t(132.8) = -2.92$, $p = .004$).

Furthermore, looking into the results of all participants prior to the diary study (from the online questionnaire) and throughout the three weeks of logging screen time results, all participants with DSCTs employed had a gradual reduction of daily screen time. In the results logged from respondents from the other group, no trend was observed. The results of all participants can be seen in Appendix 6. They are also depicted in Figures 3 and 4. Figure 5 compares the results of the two groups.

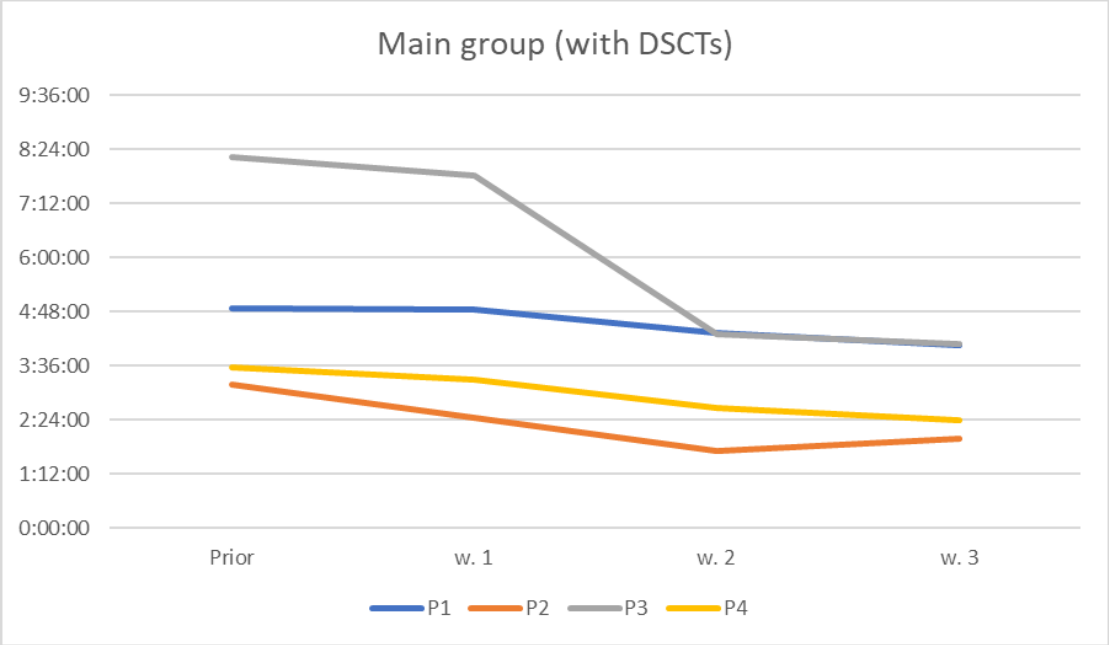

Figure 3: Daily average screen time of participants in the Main group (with DSCTs) prior to and throughout the diary study.

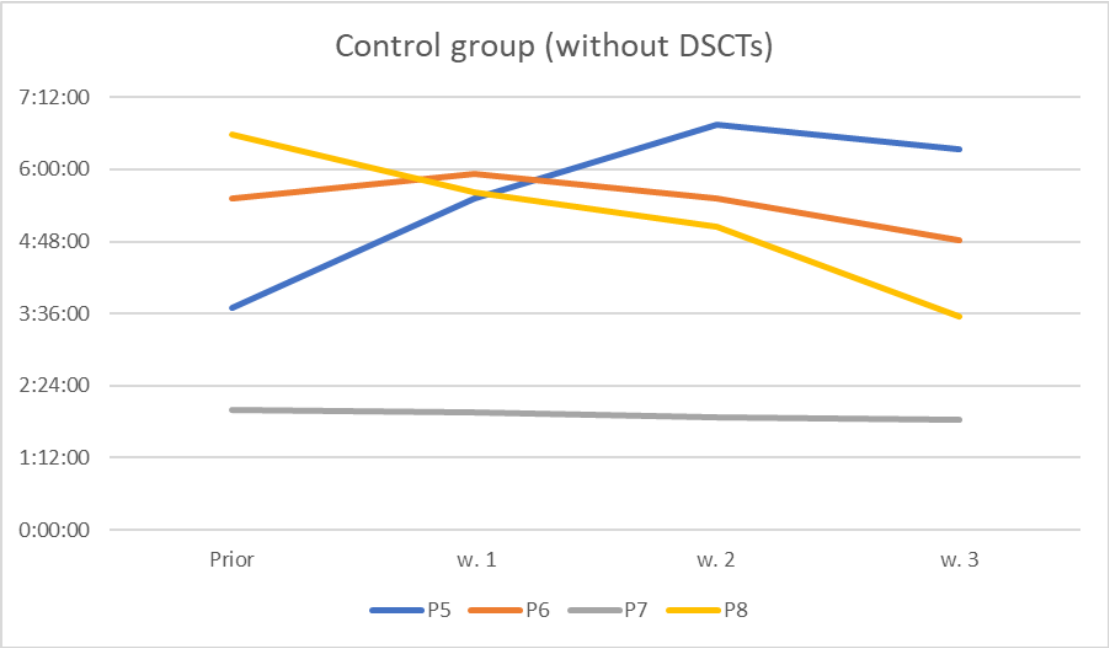

Figure 4: Daily average screen time of participants in the Control group (without DSCTs) prior to and throughout the diary study.

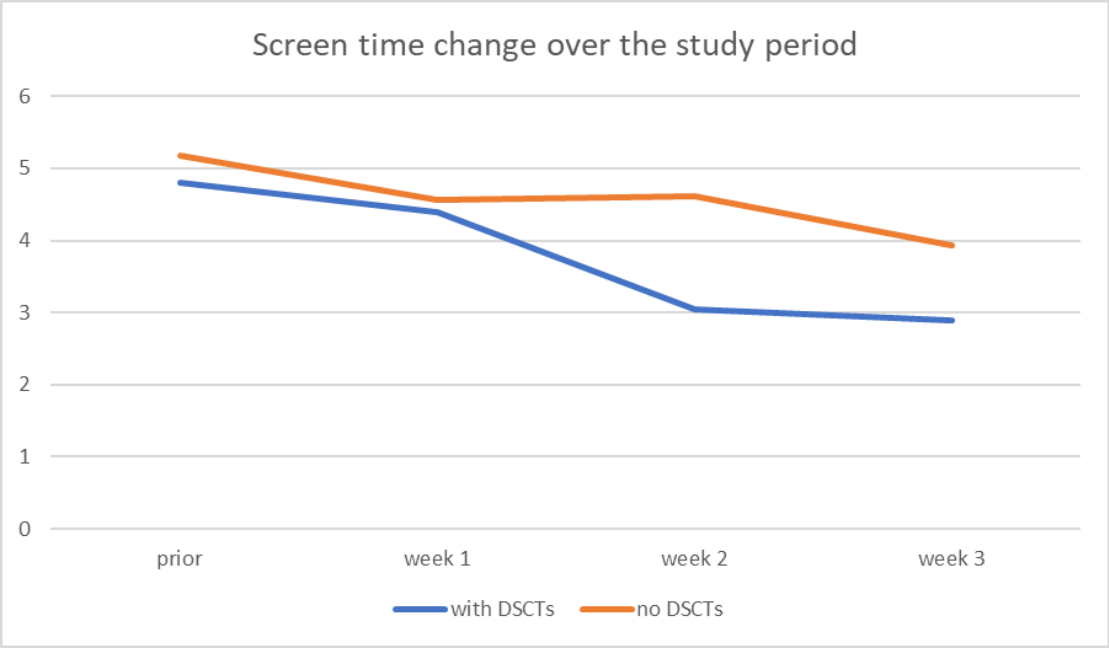

Figure 5: Comparison of daily average screen time of participants from both groups prior to and throughout the diary study.

Calculating the SAS-SV scores, the participants with DSCTs had a lower average result (M = 18.68, SD = 10.03) than the ones without (M = 24.41, SD = 7.22). Correlation analysis was conducted to assess the relationship between screen time and

SAS-SV. The results of participants with DSCTs indicated a very weak, non-significant positive correlation ($r(84) = .08$, $p = .50$). On the other hand, the results of the people that did not use DSCTs showed a moderate, statistically significant positive correlation ($r(84) = .54$, $p < .001$).

The participants in both groups also logged what are the top three apps they used every day. The results from the group with DSCTs over the 21-day period showed that they spent most time on Instagram, but the total hours spent by all participants were equal to 33.49h. In second and third place were the Web browser with 30.90h and WhatsApp with 27.93h. The participants from the other group that used no tools also had Instagram at the top of the list, but with a total of 115.53h of use. In second place was Messenger with 46.05h, and in third – YouTube with 20.99h. The results from both groups are summarized in Table 2.

Top three apps used by the Main group (with DSCTs)	**Top three apps used by the Control group (without DSCTs)**
1. Instagram – 33.49h	1. Instagram – 115.53h
2. Web browser – 30.9h	2. Messenger – 46.05h
3. WhatsApp – 27.93h	3. YouTube – 20.99h

Table 2: Top three apps used by all participants with and without DSCTs over the 21-day period of the diary study and the sum of the time spent.

The relationship between screen time and physical and mental well-being measures (sleep, stress, and mood) was examined using Pearson correlation coefficients. The results of the Main group (with DSCTs) indicated that the correlation between daily screen time and sleep is very weak, almost nonexistent ($r(84) = .02$, $p = .876$). Furthermore, the correlation between screen time and stress appeared to be very weak and negative, essentially indicating no relationship ($r(84) = -.03$, $p = .756$). The results from the analysis of mood and screen time showed a weak positive correlation, suggesting that higher screen time might be slightly associated with a bad mood ($r(84) = .20$, $p = .067$). However, the p-value is just above .05, meaning this result is not statistically significant at the conventional 5% level - but it is close. A summary of all results for the group can be seen in Table 3.

Measure	r(84)	p	Interpretation
Sleep	.02	.876	No correlation
Stress	-.03	.756	No correlation
Mood	.20	.067	Weak, non-significant trend

Table 3: Pearson correlation coefficients between screen time and physical and mental well-being measures of participants from the Main group (with DSCTs)

On the other hand, the results of the Control group showed that there was no significant correlation between screen time and sleep ($r(84) = .01$, $p = .950$). Additionally, screen time showed a small but marginally significant positive correlation with stress ($r(84) = .20$, $p = .071$), and similarly, the correlation between screen time and mood ($r(84) = .18$, $p = .102$) was also positive but not statistically significant. A summary of all results for the group can be seen in Table 4.

Measure	r(84)	p	Interpretation
Sleep	.01	.950	No correlation
Stress	.20	.071	Weak, non-significant trend
Mood	.18	.102	Weak, non-significant trend

Table 4: Pearson correlation coefficients between screen time and physical and mental well-being measures of participants from the Control group (without DSCTs)

All participants' results on sleep, stress, and mood associated with the corresponding screen time can be found in Appendix 7.

In the final open-ended question, participants provided more detailed information about their daily activities and device usage, with some responses showing recurring patterns across participants. All of the responders entered at least once that they used social media when they were tired or bored from studying, or even as a reward after a productive day. Furthermore, they mentioned that being part of the study made them more aware of how they use their phones. Participants who were using DSCTs mentioned their strategies to avoid using social media. Two of them wrote that they were going to sleep earlier to avoid aimless scrolling. One other shared that they downloaded language apps to replace the time spent on social media and ended up using them and being productive instead of scrolling aimlessly. This same participant also experimented with other social media platforms such as Threads, though these were generally described as less engaging. Participants noted that time spent on Instagram felt significantly longer and more absorbing compared to time spent on

alternative apps *(P3: "I realised that if I go to IG, time there flies. But on Threads I read a few posts and I feel it is enough."*). Furthermore, four of all respondents mentioned physical and mental well-being issues due to smartphone use that they had noticed. However, there were also responses that highlighted sleep, stress, and mood were influenced by "personal issues", "night job", "exam", "too many responsibilities", sickness, and others. Additionally, three out of four participants in the Main group (with DSCTs) noted that they will keep using the DSCTs even after the study. Quotes from the logged responses can be seen in Appendix 8.

5 Discussion

In the following section, the results of the data analysis are used to address the research questions. The findings are discussed in relation to previous research in the field, and implications are considered. Finally, the study's limitations are acknowledged, and directions for future research are proposed.

5.1 Results Discussion

5.1.1 RQ1: What Is the Current State of Digital Well-being of University Students in Sweden?

The average result on the SAS-SV suggests that university students in Sweden are at high risk of addiction to their mobiles. The results from the online questionnaire also suggest that a higher daily average screen time is associated with a higher SAS-SV score. These findings are similar to what Olson et al. (2023) found with their research. They calculated the average result on the scale for individuals in Sweden to be equal to 30, relatively close to high risk of addiction. Although it is important to note that Olson et al. (2023) did not restrict their sample group to occupation or age. Furthermore, the research was published two years ago, and it is reasonable to expect that the numbers may have increased since that time.

Cho et al. (2021) also conducted similar research and calculated that two-thirds of the participants in their study were categorized as addicted to their phones. This aligns closely with the 48.6% identified in this study, considering that 14.3% more are at high risk of addiction.

Additionally, Pinder et al. (2019) examined screen time and smartphone addiction, reporting an average screen time of nearly 5 hours and a SAS-SV score slightly above 30. Both results are comparable to those reported in this study (screen time: $M = 5.9$, SAS-SV: $M = 32.49$), although they are slightly lower. However, the sample group tested is different than the one in this study, and the data was published 6 years ago, which may account for the differences in results.

5.1.2 RQ2: Does the Use of DSCTs Lead to Changes in Screen Time, and How do These Changes Relate to Users' Digital Well-being?

The findings from the diary study conducted as part of this research suggest that the presence of DSCTs may be associated with a reduction in daily screen time. Furthermore, the statistical difference between the group that used DSCTs and the one that didn't was proven. Similarly, Foulonneau et al. (2016) conducted testing with 19 participants using a DSCT, and their results showed a significant decrease in the average daily screen time spent on mobiles. A similar testing was carried out by Kim et al. (2019), who investigated lockout mechanisms to understand their effect on

reducing mobile use. According to their findings, these techniques significantly decreased smartphone use. However, these studies utilized a different DSCT or technique in their research compared to the one employed in the present study.

Unlike the two studies discussed above, in this current research, screen time was also examined on a weekly basis. The findings suggest that DSCTs may contribute not only to overall lower screen time but also to more stable and sustained self-regulation over time.

Interestingly, the correlation between screen time and SAS-SV scores was only significant among participants who did not use DSCTs. This suggests that DSCTs may mitigate the association between total screen time and smartphone addiction risk. One possible explanation is that problematic outcomes may arise only after a certain threshold of use, which DSCT users may remain below due to their generally lower screen time. Alternatively, this difference may reflect qualitative aspects of phone use, such as the types of apps used, rather than the duration of use alone. These possibilities underscore the need for future research to examine both quantitative and contextual dimensions of screen time.

Based on the top three apps used by participants in this study, social media is most visited by university students who don't use DSCTs, as well as messaging services. Participants using DSCTs also used a social media channel the most (Instagram), but their total time spent in the app was significantly lower than that of the other group. The Web browser and a messaging service completed the list for this group.

Additionally, based on data collected from the open-ended question, it can be suggested that while DSCTs may effectively limit the use of specific apps, users may attempt to substitute these with alternative platforms, though these alternatives may not provide the same level of engagement. This behavior highlights that screen time alone may not fully explain users' digital habits or mental and physical well-being. It implies that to understand the users' digital well-being, it is important to investigate both the amount of time spent on the mobile and the type of content being consumed.

5.1.3 RQ3: How Does a Reduction or Increase in Screen Time Affect Users' Mental and Physical Well-being?

The data collected from the diary study within this current research suggests that screen time does not have a meaningful impact on sleep patterns for both users and non-users of DSCTs. This differs from the conclusions drawn by Christiansen et al. (2016), who argued that longer average screen time leads to shorter, less effective sleep, especially when the mobile is used right before bedtime. Lanaj et al. (2014) also tested a similar hypothesis and found that smartphone use at nighttime contributes to poor sleep quality the same night. Lanaj et al. (2014) also highlighted that this is especially true for mobile use and not necessarily for other devices.

The results of participants who used DSCTs suggest that stress is also not influenced by screen time. In contrast, for participants with no DSCTs, higher screen time may be associated with higher levels of stress, although the result was not statistically significant. The data collected from both groups indicated that screen time might have a mild effect on mood, but the results were not significant either. More data would be needed to confirm it confidently. However, Vanden Abeele (2020) argued that a bad digital well-being is associated with an impact on well-being outcomes.

A slightly different approach to studying smartphone use and mental well-being was taken by Van Deursen et al. (2015), who examined the correlation between emotions, stress, and smartphone addiction. They found no influence of emotions on smartphone addiction, whereas social stress was positively associated with addictive smartphone behavior. Furthermore, Thomson et al. (2022) investigated the possibility that implying DSCTs could result in a decrease in stress and anxiety and discovered a positive association.

5.2 Implications

The goal of this study was to determine the usefulness of DSCTs in maintaining digital well-being and to seek a correlation between smartphone use and university students' mental and physical well-being. The findings have several practical and scientific implications. For educational institutes, the results can guide the development of targeted student support programs, such as workshops on mindful smartphone use, aimed at reducing screen time and possible related stress or anxiety. By demonstrating the benefits of DSCTs, this research supports integrating such tools into university digital well-being programs, which have the potential to improve both student performance and their mental and physical well-being.

As this research addressed a significant gap in the literature and provided concrete data demonstrating the benefits of DSCTs, the findings can be advantageous for developers, too. This study contributed to a stronger case for the effectiveness of DSCTs, potentially influencing future designs and implementations of such tools. It strengthens the case for refining DSCT features. This could include incorporating real-time feedback on usage patterns or integrating gamification elements to enhance their effectiveness. The insights can inform a more user-centered design.

Scientifically, the results of the study provide a foundation for more extensive longitudinal research that tracks digital well-being and mental and physical health indicators. Furthermore, it provides a structured framework for evaluating the long-term effects of DSCTs. This interdisciplinary approach also encourages collaboration between technology and psychology researchers to develop more comprehensive solutions that are both technically feasible and psychologically effective.

5.3 Limitations and Future Work

While this study provides valuable insights into digital well-being and understanding the benefits derived from DSCTs, it is important to note certain limitations. Addressing these challenges in future research could strengthen the understanding of the topic.

Firstly, it is important to acknowledge that this study had a relatively small sample size, which may limit the generalization of the findings. Furthermore, it can introduce bias and reduce the statistical power of the analysis, making it harder to detect the true effect. Future studies should aim to recruit a larger participant group to strengthen the reliability of the results. Using randomized sampling methods can also help to reduce selection bias and improve external validity. To overcome the recruitment challenge and ensure a more representative sample, researchers may offer incentives, such as small rewards or certificates, after completion to encourage people to participate.

Secondly, this study relied mainly on self-reported data, which can be affected by memory bias, social desirability, and subjective interpretation. This may reduce the accuracy of the findings and limit the ability to draw definitive conclusions. Combining self-reported and objective data from digital devices or apps can improve the accuracy of future studies. This can be achieved by using smart devices to collect more precise data, including screen time, app usage, and mental and physical health entries such as sleep quality, stress levels, and mood. This approach may reduce self-report bias, providing a more comprehensive view of the impact of DSCTs and how smartphone use is related to mental and physical health. Finally, replacing active input of participants with passive monitoring by using smart devices may reduce the influence of an observer effect and lead to more natural behavior.

Future studies in this field could expand data collection to include screen time from all digital devices used by participants, such as laptops, desktop computers, and tablets, in addition to smartphones. This comprehensive approach may give more complete and accurate insights, allowing for a stronger analysis of the relationship between overall screen exposure and mental and physical well-being.

6 Conclusions

Nowadays, mobile technology has a big influence on people's lives (ITU, 2017), which can be both positive and negative (Khan et al., 2022). On one hand, it serves for easy communication and execution of professional work, but on the other hand, individuals report psychological and physical ailments when using mobiles excessively (Masthi & Yashasvini, 2012). Many of those people recognize the negative changes and want to decrease mobile use, but they fail in doing so (Jiang, 2018). That is a main reason why developers introduced DSCTs to address issues related to digital well-being (Lyngs et al., 2024). However, evidence regarding the effectiveness of those tools remains inconclusive (Vanden Abeele, 2020).

This study investigated digital well-being and whether DSCTs have a positive effect in attaining it. It further assessed a possible relation between smartphone use and mental and physical health indicators. The research was particularly conducted with university students in Sweden, and the DSCTs tested were the ones that come pre-installed with iOS and Android mobiles. Both an online questionnaire and a diary study were used to collect data. The online questionnaire aimed to give insights into the current state of digital well-being of university students, whereas the diary study gathered data over a 3-week period to assess the effect of DSCTs and search correlation between screen time and mental and physical health issues.

The results showed that university students in Sweden have poor digital well-being, with an average daily screen time of almost 6 hours. Furthermore, a large percentage of the participants showed addiction or a high risk of addiction to smartphones. Next, the benefits of DSCTs were proven by testing and comparing the results of two groups of participants - one that used DSCTs and one that did not. The results also showed that screen time correlated with smartphone addiction only among non-DSCT users, suggesting that DSCTs may decrease addiction risk by reducing screen time or altering usage patterns. Furthermore, no significant correlation between mobile use and mental and physical well-being was found.

This current study can serve as a basis for educational institutions to support students in reducing screen time and improving digital well-being. The findings can also inform developers of DSCTs in designing more effective features. Furthermore, it can be a foundation for future work in the area and a motivation for technology and psychology researchers to collaborate.

To confirm and strengthen these conclusions, future research should employ larger sample sizes and consider replacing self-reported data with objective measures by integrating data from smart devices.

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8 Appendices

Appendix 1 Survey questions

Question	Instructions	Answers	Reasons
Introductions and instructions for the questionnaire: Thank you for participating in this survey! This study is part of my bachelor's Thesis in Informatics, aiming to explore how screen usage affects daily life, productivity, mental health, and overall well-being. Your responses will remain anonymous and will be used solely for academic research. The survey should take approximately 5 minutes to complete. *Your insights are valuable, and I appreciate your time. Let's dive in!*			
Demographic			
What is your age?	None	Text field to enter the exact number	To calculate the mean of participants' ages, to know the demographics, for comparison with other studies
Behavioral			
What was your average daily screen time for last week?	You can check this on your phone - for iOS in the "Screen time" app and for Android in "Digital wellbeing". Make sure you enter the daily average and not the screen time for the full week.	Duration	To calculate the average screen time of university students in Sweden, and to find a correlation with the SAS-SV results
What are the top three apps you have used last week?	You can check the list on your phone in the same apps as in the previous question.	Checkboxes: Instagram Facebook Snapchat WhatsApp YouTube TikTok Web browser Other (opened answer)	To understand which apps are used the most by university students, to also help determine which apps to block in the diary study
Likert scale			
SAS-SV	Answer how much the following statement applies for you from 1 to 6	Likert scale from 1 to 6	To calculate participants' results on the SAS-SV and find a correlation with screen time

I miss planned work due to smartphone use	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I am having a hard time concentrating in class, while doing assignments, or while working due to smartphone use	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I am feeling pain in the wrist or at the back of the neck while using a smartphone	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I will not be able to stand not having a smartphone	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I am feeling impatient and fretful when I am not holding my smartphone	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I am having my smartphone in my mind even when I am not using it	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I will never give up using my smartphone, even when my daily life is already greatly affected by it	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I am constantly checking my smartphone so as not to miss conversations between other people on Twitter or	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-

Facebook (social media)			
I am using my smartphone longer than intended	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
The people around me tell me that I use my smartphone too much	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
Optional question			
Would you be willing to take part further in this research?	The next part will consist of a dairy study, which will take 3 to 5 minutes every day from the participants' time and will last for 3 weeks. The questions included will be similar to the ones in this survey. Enter your email if you wish to participate, and you will receive more details.	Text field to enter email address	To gather participants for the dairy study

Appendix 2 Diary study questions

Question	**Instructions**	**Answer**	**Reason**
Enter your daily screen time	For yesterday	Duration	See changes over time and create a visualization to depict it; find correlation between screen time, results from SAS-SV, and physical and mental well-being
SAS-SV	Answer how much from 1 to 6 the following statements apply to you for yesterday.	Likert scale from 1 to 6	To compare the results over time and find a correlation with screen time. To further evaluate smartphone addiction and see if the results on the scale change over time.
I missed planned work due to smartphone/ device use	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I had hard time concentrating in class, while doing assignments, or while working due to smartphone use	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I felt pain in the wrists or at the back of the neck while using a smartphone	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I couldn’t stand not having my smartphone	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I felt impatient and fretful when I was	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree	-

not holding my phone		4 – weakly agree 5 – agree 6 – strongly agree	
I had my smartphone in my mind even when I was not using it	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I didn't stop using my smartphone even when I realized it was affecting my work, studies, concentration	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I was constantly checking my phone, so I didn't miss conversations between other people on social media	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
I was using my phone longer than I had intended.	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
People around me told me I was using my phone too much	Pick a number	1 – strongly disagree 2 – disagree 3 – weakly disagree 4 – weakly agree 5 – agree 6 – strongly agree	-
Physical and mental well-being	Answers apply for the day before	Ranking from 1 to 6	To compare the results over time and find a correlation with screen time.
How did you sleep last night?	Rate your sleep from 1 to 6, knowing that 1 is perfect sleep and 6 is bad sleep.	1 to 6	To find a possible correlation between screen time and sleep. As suggested in some papers, more screen time leads to bad sleep (Christensen et al., 2016)
What was your stress level yesterday?	Rate from 1 to 6, knowing that 1 is no	1 to 6	To find a possible correlation between

	stress and 6 is high stress.		screen time and stress. As suggested in some papers, more screen time leads to psychological stress (Thomas et al., 2022).
What was your mood yesterday?	Answer from 1 to 6, knowing that 1 is an excellent mood and 6 is a bad mood.	1 to 6 + emojis showing different emotions	To find a possible correlation between screen time and mood change. As suggested in some papers, more screen time leads to a general decline in mood (Hiniker et al., 2016).
Share more (optional answer)	Share a glimpse of your day! Tell us more about your day, device use, or how you felt.	Long answer text field	To learn more insights if the participant is willing to share, but not require them to necessarily spend more time on the study; to understand if there were untypical circumstances that may have influenced the results

Appendix 3 Online questionnaire results

Questions	**Responses**
What is your age?	20(5.7%), 21(37.1%), 22(20%), 23(14.3%), 24(14,3%), 27(2.9%), 28(2.9%), 40(2.9%)
What is your average daily screen time for last week?	01:_:_ (1), 02:_:_ (2), 03:_:_ (5), 04:_:_ (4), 05:_:_ (9), 06:_:_ (3), 07:_:_ (2), 08:_:_ (3), 09:_:_ (5), 10:_:_ (1)
What are the top three apps you have used last week?	Instagram (77.1%), Facebook (5.7%), Snapchat (25.7%), WhatsApp (25.7%), YouTube (45.7%), TikTok (40%), Web browser (42.9%), Messenger (11.4%), Spotify (8.6%), FaceTime (2.9%), HBO Max (2.9%), LinkedIn (5.7%), Netflix (2.9%), VS Code (2.9%), Discord (2.9%), Notes (2.9%), Pinterest (5.7%), Disney+ (2.9%), Games (2.9%)
SAS-SV	
I used planned work due to smartphone use	**1**(7), **2**(15), **3**(4), **4**(7), **5**(1), **6**(1)
I am having a hard time concentrating in class, while doing assignments, or while working due to smartphone use	**1**(4), **2**(2), **3**(4), **4**(9), **5**(13), **6**(3)
I am feeling pain in the whist or at the back of the neck while using a smartphone	**1**(9), **2**(11), **3**(4), **4**(5), **5**(6), **6**(0)
I will not be able to stand not having a smartphone	**1**(4), **2**(7), **3**(2), **4**(8), **5**(7), **6**(7)
I am feeling impatient and fretful when I am not holding my smartphone	**1**(10), **2**(3), **3**(8), **4**(8), **5**(1), **6**(5)
I am having my smartphone in my mind even when I am not using it	**1**(7), **2**(10), **3**(8), **4**(5), **5**(0), **6**(5)
I will never give up using my smartphone even when my daily life is already greatly affected by it	**1**(5), **2**(9), **3**(5), **4**(6), **5**(6), **6**(4)

I am constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook (social media)	**1**(6), **2**(10), **3**(4), **4**(3), **5**(4), **6**(8)
I am using my smartphone longer than intended	**1**(1), **2**(0), **3**(2), **4**(4), **5**(13), **6**(15)
The people around me tell me that I use my smartphone too much	**1**(16), **2**(13), **3**(3), **4**(2), **5**(1), **6**(0)
Would you be willing to take part in the next part of the research?	10 responses

Appendix 4 Average daily screen time and corresponding SAS-SV result from all 35 participants in the online questionnaire (the highlighted results in yellow are of participants considered at high risk of smartphone addiction, and the orange ones – of participants addicted to their mobiles)

Average daily screen time	SAS-SV result
9.00h	34
5.62h	24
5.05h	32
4.40h	19
10.83h	34
2.00h	34
5.75h	19
7.42h	36
8.22h	24
3.25h	11
3.70h	33
9.03h	38
9.88h	55
3.32h	43
9.50h	37
4.00h	38
5.17h	41
6.33h	21
8.50h	33
5.02h	42
5.88h	38
6.42h	32
9.00h	31
3.17h	29
3.58h	27
6.58h	45
1.63h	26
7.40h	39
4.88h	30
2.68h	24
5.52h	24
8.17h	35
5.07h	43
5.95h	46
4.45h	20

Appendix 5 Daily logs on screen time

Main group (with DSCTs)				Control group (without DSCTs)			
P1	P2	P3	P4	P5	P6	P7	P8
5.32h	2.67h	6.62h	4.53h	5.23h	6.37h	2.53h	6.55h
3.82h	2.80h	6.02h	4.16h	7.22h	5.40h	2.25h	7.20h
3.77h	2.97h	11.37h	3.73h	6.83h	6.23h	1.63h	6.60h
4.15h	2.28h	7.98h	3.27h	7.62h	6.48h	2.17h	4.80h
5.58h	1.58h	8.12h	2.79h	3.25h	5.70h	0.98h	6.12h
6.08h	2.47h	9.83h	2.89h	3.48h	4.93h	2.00h	3.97h
5.23h	2.27h	4.98h	1.65h	4.98h	6.37h	2.05h	4.03h
4.27h	1.40h	8.32h	2.40h	7.85h	6.72h	2.35h	5.28h
3.40h	1.72h	3.03h	2.41h	6.27h	5.18h	1.42h	5.43h
5.95h	2.83h	3.13h	2.73h	6.92h	5.60h	1.52h	4.18h
3.43h	1.43h	4.83h	5.13h	6.03h	5.17h	1.42h	3.60h
4.43h	1.20h	3.15h	1.49h	3.32h	4.15h	2.85h	6.57h
3.63h	1.42h	3.78h	1.93h	8.40h	6.22h	1.72h	5.47h
5.20h	1.95h	3.85h	2.54h	8.47h	5.60h	1.87h	4.85h
2.83h	2.63h	5.43h	2.99h	7.38h	4.68h	1.72h	5.72h
3.67h	2.07h	3.18h	1.85h	5.22h	4.65h	2.62h	4.62h
4.63h	1.37h	4.93h	3.06h	3.40h	5.07h	2.10h	3.00h
5.28h	2.98h	4.03h	1.50h	7.03h	6.12h	1.38h	3.28h
4.05h	1.65h	2.20h	1.84h	10.60h	4.58h	1.70h	2.32h
2.68h	1.33h	3.85h	2.71h	8.77h	3.83h	1.53h	2.32h
5.17h	1.83h	4.88h	2.71h	1.85h	4.87h	1.72h	3.67h
M = 4.41	M = 2.04	M = 5.41	M = 2.78	M = 6.20	M = 5.42	M = 1.88	M = 4.74
SD = 1.03	SD = 0.55	SD = 2.44	SD = 1.03	SD = 2.22	SD = 0.85	SD = 0.50	SD = 1.42

Appendix 6 Daily average screen time prior to and throughout the diary study

	Main group (with DSCTs)					**Control group (without DSCTs)**			
	Prior	**w. 1**	**w. 2**	**w. 3**		**Prior**	**w. 1**	**w. 2**	**w. 3**
P1	4.88h	4.85h (SD = 1.00)	4.33h (SD = 0.92)	4:02:43 (SD = 1.13)	**P5**	3.70h	5.52h (SD = 1.74)	6.75h (SD = 1.76)	6.33h (SD = 3.06)
P2	3.17h	2.43h (SD = 2.20)	1.71h (SD = 1.48)	1:58:52 (SD = 1.75)	**P6**	5.52h	5.93h (SD = 0.67)	5.52h (SD = 0.76)	4.83h (SD = 0.79)
P3	8.22h	7.85h (SD = 2.24)	4:18:26 (SD = 1.87)	4.31h (SD = 1.05)	**P7**	2.53h	1.95h (SD = 0.60)	1.88h (SD = 0.51)	1.82h (SD = 0.43)
P4	3.57h	3.29 (SD = 1.02)	2:39:38 (SD = 1.23)	2.38h (SD = 0.67)	**P8**	6.58h	5.61h (SD = 1.37)	5.05h (SD = 0.96)	3.56h (SD = 1.17)

Appendix 7 Comparison of self-perceived physical and mental health with screen time (1- perfect sleep, no stress, perfect mood; 6 – bad sleep, high stress level, bad mood)

	Screen time	**Sleep**	**Stress**	**Mood**		**Screen time**	**Sleep**	**Stress**	**Mood**
P1	5.32h	2	3	4	**P2**	2.67h	3	3	3
	3.82h	2	3	3		2.80h	2	3	3
	3.77h	1	2	4		2.97h	4	3	3
	4.15h	5	3	4		2.28h	1	4	4
	5.58h	3	2	5		1.58h	4	6	6
	6.08h	3	2	4		2.47h	3	2	2
	5.23h	3	2	5		2.27h	1	3	3
	4.27h	3	2	5		1.40h	1	3	3
	3.40h	6	4	4		1.72h	2	3	3
	5.95h	3	2	4		2.83h	3	2	2
	3.43h	4	4	4		1.43h	1	2	2
	4.43h	2	3	4		1.20h	2	2	2
	3.63h	3	3	5		1.42h	2	1	1
	5.20h	4	4	3		1.95h	1	1	1
	2.83h	4	3	3		2.63h	1	3	3
	3.67h	2	2	5		2.07h	3	1	1
	4.63h	2	2	5		1.37h	3	5	5
	5.28h	4	4	4		2.98h	2	3	3
	4.05h	3	2	5		1.65h	2	2	2
	2.68h	3	2	4		1.33h	3	2	2
	5.17h	3	2	2		1.83h	2	3	3
		M = 3.10; SD = 1.14	M = 2.67; SD = 0.80	M = 4.10; SD = 0.83			M = 2.19; SD = 0.98	M = 2.71; SD = 1.23	M = 2.71; SD = 1.49
P3	6.62h	3	3	1	**P4**	4.53h	2	5	5
	6.02h	1	2	2		4.16h	2	6	5
	11.37h	2	4	5		3.73h	1	5	6
	7.98h	2	2	2		3.27h	3	6	2
	8.12h	1	1	2		2.79h	1	6	1
	9.83h	1	1	2		2.89h	4	6	3
	4.98h	1	1	2		1.65h	1	2	3
	8.32h	6	6	5		2.40h	1	6	2
	3.03h	2	5	3		2.41h	3	6	3
	3.13h	1	4	3		2.73h	1	1	1

	4.83h	1	1	2		5.13h	2	6	2
	3.15h	2	1	1		1.49h	1	1	1
	3.78h	1	1	1		1.93h	1	1	1
	3.85h	1	1	2		2.54h	1	2	3
	5.43h	2	2	1		2.99h	4	5	5
	3.18h	1	2	3		1.85h	6	5	3
	4.93h	2	2	2		3.06h	4	6	3
	4.03h	1	3	2		1.50h	4	6	2
	2.20h	1	2	1		1.84h	3	1	1
	3.85h	1	2	1		2.71h	6	1	3
	4.88h	1	3	2		2.71h	2	2	2
		M = 1.62; SD = 1.16	M = 2.33; SD = 1.43	M = 2.14; SD = 1.15			M = 2.52; SD = 1.63	M = 4.05; SD = 2.20	M = 2.71; SD = 1.49
P5	5.23h	3	5	3	**P6**	6.37h	2	3	3
	7.22h	1	2	1		5.40h	1	3	2
	6.83h	1	4	1		6.23h	3	3	2
	7.62h	2	5	3		6.48h	5	3	2
	3.25h	2	6	4		5.70h	1	2	2
	3.48h	2	5	4		4.93h	3	3	3
	4.98h	2	5	3		6.37h	2	3	2
	7.85h	1	4	2		6.72h	2	3	2
	6.27h	2	3	3		5.18h	5	3	2
	6.92h	3	3	2		5.60h	2	4	3
	6.03h	1	1	1		5.17h	2	2	2
	3.32h	1	2	2		4.15h	4	4	3
	8.40h	1	1	1		6.22h	1	2	3
	8.47h	1	2	2		5.60h	1	2	2
	7.38h	2	1	3		4.68h	1	3	2
	5.22h	2	2	2		4.65h	2	2	2
	3.40h	1	1	1		5.07h	5	4	2
	7.03h	2	3	3		6.12h	2	6	5
	10.60h	4	3	4		4.58h	4	3	3
	8.77h	4	4	4		3.83h	3	2	2
	1.85h	2	4	4		4.87h	5	2	2
		M = 1.90; SD = 0.94	M = 3.14; SD = 1.56	M = 2.52; SD = 1.12			M = 2.67; SD = 1.46	M = 2.95; SD = 0.97	M = 2.43; SD = 0.75

P7	2.53h	4	3	2	**P8**	6.55h	5	4	3
	2.25h	3	3	5		7.20h	3	3	2
	1.63h	2	3	2		6.60h	2	5	3
	2.17h	2	4	2		4.80h	2	1	1
	0.98h	1	4	2		6.12h	2	1	2
	2.00h	2	2	2		3.97h	1	2	2
	2.05h	3	3	2		4.03h	1	1	1
	2.35h	3	4	2		5.28h	4	2	2
	1.42h	2	2	3		5.43h	1	2	1
	1.52h	3	3	2		4.18h	3	1	1
	1.42h	3	2	1		3.60h	1	1	1
	2.85h	3	1	2		6.57h	4	3	2
	1.72h	3	2	1		5.47h	2	3	2
	1.87h	3	1	2		4.85h	1	2	2
	1.72h	3	2	2		5.72h	5	2	1
	2.62h	2	2	2		4.62h	5	2	2
	2.10h	2	2	2		3.00h	1	1	1
	1.38h	1	2	2		3.28h	2	1	1
	1.70h	4	2	2		2.32h	1	1	1
	1.53h	4	2	2		2.32h	1	1	1
	1.72h	3	1	2		3.67h	3	2	1
		M = 2.67; SD = 0.86	M = 2.38; SD = 0.92	M = 2.10; SD = 0.77			M = 2.38; SD = 1.47	M = 1.95; SD = 1.12	M = 1.57; SD = 0.68

Appendix 8 Quotes from the open-ended question entries of the diary study

The study made participants more aware of how they use their mobiles
P1 "I am now aware that social media has an impact (and probably a negative one) on my life but have never actually made any changes to my habits before."
P2 "I felt that because of setting the limits I was more conscious of using my phone…"
P3 "I realized that since we set the time limit, I was thinking more about how I spend my time on the phone… I was more conscious of whether I am spending it scrolling or rather checking the most important news." "The experiment made me think about how I use my phone – it definitely made me more conscious about it."
P4 "During the whole day I avoided opening the apps that are limited, I always had this in the back of my mind."
P5 "Checking my screen time has become a habit, and it made me more aware of how I spend my time on the phone."
P6 "The study made me think more about my screen time and phone usage."
P7 "I think I have become more conscious about my phone usage."
P8 "Being part of the study made me more aware of my screen time…"
Social media is used a lot when tired from studying/ working
P1 "…I was studying, I let message notifications interrupt my studying because I found the conversation more entertaining than focusing on my tasks."
P2 "I feel like I was opening Instagram to just distract myself from how boring the content I had to study was." "I used Instagram … sort of as a treat that the studying and stress were over and I could do whatever I wanted."
P3 "I mainly opened the social media apps when I got tired from studying or annoyed by it"
P4 "I was studying … so I was using my phone more often, because I got overwhelmed."
P5 "I studied in the library for about 5 hours and multiple times felt like picking up my phone when getting tired of focusing on studying." "I couldn't concentrate that well in a lecture and stayed on my phone a lot."
P6 "Yesterday I was working on the thesis and used my phone for scrolling and texting." "I could have studied more, but instead I was scrolling TikTok."
P7

“I was studying quite a lot, but it was hard to keep that motivation up, so I spent an hour scrolling on my phone (Pinterest)… It was really hard to stop and go back to studying.”
P8 “I used my phone a bit more for scrolling than usual. This was when i felt tired of studying or working.”
Ways to avoid social media (apps with limits)
P2 “… I choose to go to sleep early rather than scrolling.”
P3 “I downloaded 2 new apps - Duolingo and Glossika (both for learning languages). I decided that I want to learn a new language, and in my free moments, I could try to spend time on these apps instead of on Instagram.”
P4 “Whenever I wanted to open Instagram, I opened something else. For example, I called my sister. Not using social media motivates me to call my friends more often.” “I went to sleep earlier so that I don't use up my minutes of the next day.”
P6 “I decided to delete TikTok because I was using it too much” (day 12)
Recognized effects of mobile use on physical and mental health
P2 “I left my phone at home by accident … then whenever I wanted to do something on my phone, I couldn't, and I was reminded how dependent I am on my phone in my everyday life.”
P3 “To my surprise, I was feeling frustrated every time I clicked on the Instagram app, and the limit was there. I realized that sometimes I opened the app even without thinking about it, it was such a natural gesture that my hand did. And when I couldn’t go to Instagram, I automatically wanted to switch to Facebook - but that was forbidden too. I can’t believe I say it, but it really did make me feel anxious.”
P7 “… it did make the back of my neck hurt”
P8 “I had some pain in the wrist at night, and I realized that I have experienced that before as well but never paid attention.” “I had a lot of time on the phone ... My eyes were tired at night, and I couldn't go to sleep for long”
Factors other than screen time that influence physical and mental health
P2 “My mood, sleep and stress level were influenced by some personal issues and not so much my phone usage. It really wasn't my day.” “I feel like I was tired and sleep-deprived because of my night job which influenced my mood.”
P3 “Exam in the morning, so quite a stressful day.”
P4 “The whole day I had big issues with my mental wellbeing, and I was talking to my best friends all day … it was so bad that it had to be solved.”

“I was stressed the whole day, had a lot to do and felt that I had too many responsibilities, so I needed to be present.”
P5 “I was a bit anxious regarding various things like schoolwork.” “Yesterday I was extremely anxious because of my job interview and general thoughts about money.”
P7 “My sleep was pretty bad because I am currently sick, and my throat and stuffed nose was bothering me.”
P8 “I was stressing out a bit for not pleasant things happening.”
Participants from the group with DSCTs will continue using them after the study
P1 “I'll keep the one-hour limit on my phone at least for now”
P2 “I think I might stick to the restriction because of its positive effect”
P3 "I think I will keep the restrictions"