The Constant Connectivity Conundrum

Experiences of multitasking and interruptions

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Abstract

Many people are more or less constantly connected through mobile technology today. This provides opportunities, but also makes people vulnerable for interruptions and prone to engage in multitasking, when full focus might be needed. Smartphone usage is common especially among younger people, making it interesting to investigate constant connectivity’s effect on learning. Previous studies have focused on quantifiable results regarding the effect on learning, such as impact on grades, but has not investigated the qualitative aspects. This thesis investigates students’ experiences regarding interruptions and multitasking through a three-part study. The results show that the impact is very context dependent and phone usage is occasionally not reflected upon. Further, the result indicates that being expected to always be available and respond quickly could be perceived as a problem. The findings presented in this thesis can contribute with important design implications for devices to enable single-task focus and avoiding interruptions.

Keywords: Interruptions, multitasking, smartphones, learning

1. Introduction

Almost everyone in the Western part of the world is more or less constantly connected today. We have constant access to technology, making us available at almost any time, place and in any situation. This does, of course, provide a lot of possibilities. We are no longer bound to our offices or our homes for performing certain activities, but can do almost anything whenever and wherever. We can easily have daily contact with friends who are not in the same city, country or continent. We have access to seemingly unlimited amounts of information, if we have a question, an answer can almost always be found through a search engine in a matter of a few seconds. We can watch events taking place in an entirely different part of the world in real time. At the same time, there is also a negative aspect of this phenomenon. Constant connectivity can induce reoccurring interruptions that have negative consequences for the individual. Interruptions can cause people to divert their attention from tasks which require full focus. In the book “The Distracted Mind”, authors Gazzaley and Rosen claim that interruptions and multitasking are affecting our “safety, cognition, education, workplace and our relationships with family and friends” (Gazzaley & Rosen, 2016, p. xiv). The authors base the claim on the idea that as the world around us becomes more filled with electronic devices that are competing for our attention, we become less able to focus on one matter at a time. In addition to this, it becomes more difficult for us to filter irrelevant inputs from relevant ones, making us more vulnerable to interruptions and more prone to multitask. In turn, making us less rarely focus on one single matter for a longer period of time (ibid).

Meanwhile, mobile technology, such as smartphones, makes us able to stay connected and accessible in almost every possible situation can create problems which we have not experienced before, leaving us less equipped to handle it. A situation in which there might be
a clash between the need for focus and constant accessibility is when learning. Studies suggest that the constant division of attention might result in shallow learning and that the material will not be processed as thoroughly as if studied in a situation where the person’s focus is fully undivided (Ophir, Nass & Wagner, 2009). This can be a particular issue for people studying at university level, as students have to manage their time to great extend and take responsibility to plan their individual work as well as attending occasional lectures. Previous research within the area of learning and multitasking has investigated if there is a connection between GPA (grade point average) and usage of social media (Rosen, Carrier & Cheever, 2013), as well as the impact of multitasking on laptops during lectures (Bellur, Nowak & Hull, 2015), suggesting that multitasking does affect learning in a negative way. In addition, the effect of interruptions during reading as well as in class has been investigated (Conard & Marsh, 2013; Bowman, Levine, Waite, Gendron, 2009), where interruptions in class were deemed as having a greater negative impact. However, one aspect of this which the previous research has not investigated in depth is the experiences of the people trying to balance constant connectivity with their everyday lives. This aspect can provide insight into why people choose to engage in multitasking and what can be done to prevent this, as well as what causes the interruptions to occur.

2. Research question
As stated above, previous research within this area has primarily been focusing on exploring a correlation between multitasking in classrooms and GPA results (Bellur, Nowak & Hull, 2015). However, one thing which can be of great importance in aid understanding the issue of detrimental multitasking in these settings is the individual experiences of trying to balance constant connectivity with their smartphone usage and studying, especially in situations where a lot of individual work is required. This has not been investigated to any greater extent in previous studies. Therefore, the question I am aiming to answer in this study is how people perceive multitasking and interruptions due to smartphones, primarily while studying but also in their everyday lives, and in what ways this is currently managed.

3. Related research
In order to understand the situation investigated, it is important to understand previous research within this area. This will be done through first a brief explanation of the position that Skolverket, the Swedish National Board of Education, has taken regarding IT in schools and some of the perceived advantages and challenges this has brought with it. Thereafter, there will be a very basic explanation of the cognitive functions behind learning. After this, the concepts of multitasking and interruptions will be explained, followed by what research has been carried out in this area in relation to studies. Thereafter different methods available for managing interruptions and multitasking induced by smartphones will be presented.
3.1 Digital transformation of education

The classrooms today are very different from fifty, or even twenty, years ago, with the digitalization of schools being a very current topic in many countries. In order to understand the situation of technology in classrooms today, both in elementary schools as well as at university level, it can be of value to understand the guidelines given regarding this for elementary school, as these can heavily impact the habits regarding technology of the younger generation. Skolverket (The Swedish National Agency for Education) has presented two goals to be fulfilled by 2022, which are as follows: that all children will have developed what Skolverket refers to as “adequate digital competence”, and that the school system is characterized by “taking advantage of the opportunities that the digitalization presents in order for the digital tools and resources to help in improving the results and make the organization more efficient” (Skolverket.se, 2017).

These goals are quite vaguely formulated and do not give any clear and concrete ways of how to achieve them, but still presents some important ideas regarding the digital transformation in schools: it is viewed to be an essential part of today’s society and should therefore be included in the formal education given by schools. Due to this, almost every school today, including kindergartens, are offering tablets and laptops to their students in order to avoid a technical divide due to socio-economic backgrounds, while also allowing students to bring their own devices with them for using in the education (Skolverket, 2015:00067). In the younger years of school, tablets and laptops can be used for playing educational games and drawing, while in the later years, it is more used for searching for information for different topics and writing reports (ibid). This has also been influencing the education in such a way that source criticism is heavily emphasized in Swedish schools today, to make the students more aware of where they are getting their information and how to exercise critical thinking in different ways when evaluation said information (ibid).

In the guidelines provided by Skolverket it is possible to distinguish a very positive approach from the government’s side to the use of digital artefacts in the education - the goal is for the students to be able to search for and gather information on topics while applying a critical attitude towards the material that they find. However, researchers note that the positive effect is very dependent upon in which way the digital tools are used rather than just the introduction of them in the classroom setting (ibid). A report from Riksdagen (Riksdagen, 2015/16:RFR18) regarding the digitization of the classrooms and its effect on the education states that the increased use of digital tools in the classroom will present more challenges for teachers in terms of trying to get the students to stay focused and avoiding distractions. Furthermore, two thirds of teachers interviewed in the above-mentioned report from Skolverket regarding IT usage in schools reported that they experience students’ usage of smartphones and social media to be disturbing their teaching (Skolverket, 2015:00067). This is not the intended use suggested by Skolverket, but nevertheless occurs and poses a problem. In addition to this, about half of the teachers in elementary school and high school are requesting more education in this field, IT in learning, to become more skilled at using IT as a pedagogic tool. At the same time, many of the Swedish high school students, 28%, report that they are experiencing their own usage of social media and texting as disturbing their focus, while 16% report that they are being disturbed by other classmates engaging in these activities (ibid). At the moment, it is up
to the schools to decide by themselves how to handle this problem, but teachers are allowed to confiscate smartphones if they are perceived as interruptive to the class (ibid). Some schools, such as Engelska Skolan, have chosen to take on a more preventative approach through issuing a ban on all smartphone usage during school hours, meaning that all phones must be turned off while the students are within the school area (Åkergren, 2016(a)). However, this approach is questioned by the social media expert Deeped Niclas Strandh, who is of the belief that it is better to teach the children and teenagers to take responsibility for their smartphone behaviour rather than trying to solve the problem by banning them completely. He argues that this is because phones can have a function of facilitating learning in schools through enabling the students to e.g. search for information and that students instead should learn to use them responsibly. He further argues that it will not make that much of a difference, since the phones still are present outside of schools, therefore only making it an inconvenience for students and teachers rather than a solution to the problem (Åkergren, 2016(b)).

These findings show that there are still some obstacles tied to trying to implement technology in the classroom, both for the younger and older students, and that these obstacles are among other things tied to social media and its negative influences on the students’ ability to focus. It also shows that there are some differing views on how to handle the problem of technologies interrupting the focus of the students. But in order to further understand in what way this can pose a problem in relation to learning on a more fundamental level, it can be necessary to understand the cognitive functions of learning.

### 3.2 Learning

Learning is usually considered to be the activity of gaining knowledge and skills through focusing on an activity and registering information gained through this activity, such as e.g. listening to a lecture (Schunk, 2012). New knowledge and skills are considered to be acquired through focusing on this newly acquired knowledge and thereby understanding it. Transferring acquired knowledge from the short-term memory to the long-term memory, which is the process of memorizing, is greatly enhanced when focusing on the task at hand (ibid). Dividing your attention between two or more tasks can therefore affect the ability to learn. This could potentially be a problem today where interruptions and multitasking are common phenomena.

According to cognitive and behavioural theories, environmental conditions play a big role in students’ learning (ibid). Examples of traditional environmental inputs in this setting has been the classroom environment, where the teachers explain and students listen and learn. However, the classroom environment today can be very different from the one fifty or even twenty years ago, as there is not only a teacher calling for attention, but also technological devices, such as laptops, smartphones, tablets etc., which might affect the learning. Education on a university level often involves a lot of individual work outside of the organized lectures and classes, meaning that the students themselves need to take a lot of responsibility for their learning. Individual studies can contain reading, solving of given problems, etc.

It is not only the environment and how the material is presented that is significant for learning. What also matters is the students’ approach to the material that is studied (ibid). To be able to understand this, it is also important to understand the cognitive aspect of learning process itself.
The process of learning concerns, extremely simplified, transferring received input, may it be auditory, visual or sensory, to the short-term memory, also referred to as the work memory, to then be transferred to the long-term memory in order to store the input as acquired knowledge (ibid). However, our brains are constantly subject to different inputs, thereby making it necessary to be able to filter between useful and useless input. In order to do this, the brain first has to receive the input and filter it in order to deem that it is important and should be stored in the working memory (ibid).

However, as our brain is subject to input all the time, there are ways in which the brain can filter between input that is perceived to be trivial and what is to be considered as important (ibid). The input therefore needs to be deemed to be important and meaningful for the situation. This illustrated by Schunk in the following quote: “Part of what makes perception meaningful is that the brain’s reticular activating system filters information to exclude trivial information and focus on important material (...) This process is adaptive because if we tried to attend to every input we would never be able to focus on anything” (ibid, p. 43). Here we can see that the brain’s filters are working to distinguish between important and irrelevant information in order to be able to focus on what is considered to be important for the situation at hand. These filters for what is and what is not important is, as mentioned, adapted according to the situation in order to filter out inputs that are irrelevant at the moment (ibid). The inputs which are considered as important are then transferred to the working memory where, if not rehearsed or transferred to the long-term memory, it is discarded after a few seconds because it is deemed to be unimportant. For the information to be stored, there “must be a neural signal to do so; that is, the information is deemed important and needs to be used” (ibid, p. 45). This means that the learner must be focused and attentive towards what is being studied in order to actually be able to understand and remember the material. Schunk also emphasizes the role of the learner’s attitude towards the material being studied, as in that the beliefs and values of the student affects the way that they will understand and make use of the material. However, there are also other, external factors which also affects the attention of the student, as illustrated in the quote below:

“There are several factors that influence this filtering. Perceived importance, such as teachers announcing that the material is important (...) is apt to command student’s attention. Novelty attracts attention; the brain tends to focus on inputs that are novel or different from what might be expected. Another factor is intensity; stimuli that are louder, brighter, or more pronounced get more attention. Movement also helps to focus attention. Although these attentional systems largely operate unconsciously, it is possible to use these ideas for helping to focus students’ attention in the classroom, such as by using bright and novel visual displays. (ibid, p. 43).

Schunk in this quote suggests how these features, the novelty and the stimuli, can be used in order to facilitate learning. However, these things can also be considered to be best representing how a smartphone or a laptop used in a classroom environment can steal the attention of the learner: how it’s stimuli, activated when a notification is to be displayed, can
promise the learner novelty and seem more appealing than focusing on the printed and static text in a book. To the student an incoming message from a friend may seem more interesting to pay attention to rather than a listening to a tedious lecture on a difficult topic. It may not even be the checking of the message that is breaking the attention of the student - it can also be simply the signal of the incoming message, with the flashing LED-light or the vibration in the pocket, which signals that something has happened. This especially applicable when discussing topics which may seem difficult or boring to the student, which is supported by Gazzaley and Rosen in the following quote regarding why people do engage in multitasking despite that it is perceived to make it more difficult to complete tasks: “A common explanation that is offered in response to this question is that it is simply more fun and rewarding to engage in multitasking compared to single tasking” (Gazzaley & Rosen, p. 12). This can pose a problem especially regarding individual studies, where the person is to do an assignment they do not find very interesting, as the engaging in multitasking or responding to interruptions might be even more tempting.

3.3 Multitasking and interruptions

3.3.1 Multitasking
The Merriam-Webster dictionary offers the definition of multitasking as “the performance of multiple tasks at one time” (Merriam-Webster, 2017). However, while could be claimed to be the most commonly accepted definition of the phenomenon, it is often claimed that the perception of this as two or more tasks being performed at the same time is not that accurate and that the term “task switching” would be more appropriate (Gazzaley & Rosen, 2016). This indicates that we do not actually perform these tasks simultaneously, but rather switch between them at a fast pace. The term multitasking is derived from the field of computer science and is inspired by the way in which powerful computers are capable of processing two or more tasks at once. This has inspired the term to be used for task switching in human activities, despite the fact that the human mind is claimed not to be capable of such activities (ibid).

The topic of multitasking is very current today, and has been a topic of discussion in both work environments as well as in learning environments, where the latter one will be discussed in an own section. Regarding multitasking in work environments, earlier takes on this has been to attempt to facilitate for employees to be able to switch between different tasks as smoothly as possible. For example, at the beginning of the introduction of ICT in work environments, the focus was more directed at facilitating multitasking and thereby suggesting design implications to enable this for the workers (Mark, Gonzales and Harris, 2005). Here, researchers often advocated for creating office environments where the multitasking would be intuitive and seamless, enabling the workers to switch between tasks without any greater efforts or disturbances in their work flow. However, the latter trends in this area has rather been focusing on turning the trend away from this and instead encourage employees to focus on one task at a time. This is possibly due to the fact that studies have indicated that despite the perceived feeling of getting more work done at the same time, multitasking actually can lower people’s performance, making them complete the tasks slower than if only focusing on one at a time (Gazzaley & Rosen, 2016). In a study carried out by Travis Bradberry (2014) it is
suggested that multitasking is lowering the multitasker’s IQ, and that multitasking can even cause permanent brain damage. However, the performed study is very small and has not undergone any peer review, thereby making the evidence supporting these claims quite weak. Due to this, further research is needed in order to be able to confirm or reject these statements.

Veen and Vrakking (2006) coined the term “Homo Zappiens” in a research article to emphasize the constant switching between tasks that multitaskers often engage in. They suggest that the so called “digital natives” are more skilled regarding being able to multitask and quickly switch between different assignments, due to having grown up with technology closely intertwined with their everyday environment. This is assumed to have given them a better understanding of technology in general, as well as being better at adopting new technologies. This idea of digital natives is though questioned by Smith, Skrbis and Western (2012), who claim that there are many other factors which determine a person’s technological fluency and that can be more credited to young people simply having an easier time to learn and adopt new things than old people. Furthermore, they claim that despite being earlier adopters compared to older users, there is no support for that younger users would have a better understanding of the purely technical aspects of new technology. A study carried out in 2009 also questions the assumption of the so called digital natives being better at multitasking, where the authors compare multitasking choices and perceived difficulties between groups of younger and older participants. Here the authors conclude that despite the younger participants being more prone to multitask, there were no significant differences between which tasks the participants would choose to multitask and how difficult they rated the multitasking situations to be (Carrier, Cheever, Rosen, Benitez & Chang, 2009).

There is also a perception of being able to improve one’s multitasking abilities. However, despite many claiming to be good at multitasking, studies have shown that heavy media multitaskers are actually worse at multitasking than persons who do so less frequently. The assumption is that frequent multitaskers are worse at filtering out irrelevant input and distinguishing this from relevant input, than persons who engage in multitasking more seldom (Ophir, Nass & Wagner, 2009).

But if multitasking is potentially harming, why do people still engage in this behaviour? The reason as for why people choose to multitask can, according to Gazzaley and Rosen (2016), simply be that people find it to be more fun and entertaining than focusing on one thing at a time. Gazzaley and Rosen further suggest that boring and easy assignments can be perceived as more fun when carried out at the same time as something more fun and a bit more distracting. This indicates that multitasking or task-switching does not necessarily have a purely negative impact on the assignments being carried out, since the person might enjoy their work more than if only carrying out the one single task.

Multitasking can be seen as trying to combine the core activity with other, perhaps less relevant, activities, such as watching a movie, conducting a chat conversation with a friend, listening to music, browsing a web page or scrolling through the Facebook feed. The core activity can in this case be seen as the activity which is supposed to be conducted, whether it is listening to a lecturer, reading course literature, or participating in a group work. The multitasking occurs when the person trying to divide their attention between this core activity
and something else, acting more or less as a distractor, that possibly has been caused by an interruption.

### 3.3.2 Interruptions

The topic of interruptions has previously been researched in the office context, relating to the phenomenon of work fragmentation – a term here defined as “a break in continuous work activity” (Mark, Gonzales & Harris, 2005, p. 321). This has been a topic of discussion for a long period of time, but especially after the introduction of ICT devices in office environments. This presents a lot of occasions for the workers to experience interruptions during their work days. The software company The Atlassian makes the claim that employees spend a lot of their days trying to deal with interruptions (The Atlassian, 2017) - for example, that workers on average check their inbox for incoming emails 36 times per hour, and are subject to on average 56 interruptions per day. Furthermore, it is estimated that after handling a new email, an employee will need about 16 minutes to be able to refocus on a new task. This view is further supported in an article by González and Mark (2004), claiming that information workers on average spend three minutes with one task before switching to a new one, prompted either by an internal or external interruption. A few studies have claimed though that interruptions do not affect the quality of the carried-out work per se, but rather contribute to the person completing the assignment quicker. However, this is claimed to often come at the cost of the person experiencing increased stress and frustration (Mark, Gudith & Klocke, 2008).

Gazzaley and Rosen (2016) claim that research regarding interruptions usually does categorize an interruption into one of two categories: internal or external. The external interruptions occur due to something happening in the surroundings of the person which causes them to divert their attention from the task at hand – such as someone calling their name, a notification of an incoming email or a phone ringing. An internal interruption occurs when the person is distracted or diverts the attention on their own – for example, through acting on a thought or an impulse (ibid). An example of an internal interruption is for example the impulse of habitually checking one’s Facebook feed to see if something new has happened, despite a lack of notifications. The Daily Mail published an article in 2014, based on a survey performed by the software company Kana in which it was suggested that British young adults, between the ages of 18-24, check their phones approximately every 10 minutes, regardless if there has been any indication of an incoming notification or not (Daily Mail, 2014). Furthermore, many of the participants in the study had allegedly reported feeling uneasy or anxious when not being able to check their phones for incoming messages or notifications. This study is however only cited in newspaper articles, such as the one in the Daily Mail, and is no longer available through the company itself, thereby making it difficult to assess the validity of the study. Thereby, these claims become questionable, as there is no possibility of investigating in what way the participants were recruited or the method of carrying out this study. However, assuming that the result presented can hold true to some extent, this feeling of anxiety due to being away from one’s phone is believed by Seung-Hyun Lee (2015) to stem from a “growing culture of impatience and instant gratification”. Lee claims that the constant connectivity present today is causing people to expect prompt answers to their requests and messages, making them more impatient than earlier. This can cause them to create internal interruptions to check their phones to see if something has happened, despite a lack of indication of that
But what happens when the impatience and need for instant gratification is combined with studies on a higher level, where there can be a strong need for being able to plan and distribute one’s own time?

3.3.3 Previous research regarding multitasking and interruptions in classroom settings

The previous research on this topic has to a great extent concerned attempting to find if there is any statistical support for multitasking and interruptions having an impact on learning. This has been done through studies where researchers have tried to get an idea of how multitasking affects learning, by performing controlled experiments in order to investigate the impact of this (Downs, Tran, McMenemy & Abegaze 2015; Bellur, Nowak & Hull, 2015). These experiments were performed through assigning people to different groups which performed the same general task but under varying conditions. The results from these studies show that there is an indication that multitasking on laptops in class inhibits learning compared to when focusing only on listening and processing the information presented or taking notes using pen and paper. This also held true for people not using laptops themselves, but just sitting close to people who were multitasking on their laptops, as this also caught their attention and distracted them from fully focusing on the presented material (Sana, Weston, Cepeda, 2013).

The possibility of a negative correlation between social media use and grade point average (GPA) has also been investigated. However, the results in these studies have been contradicting, as some claim that there is a negative connection between high social media usage and lower GPA (Rosen, Carrier & Cheever, 2013), while others suggest that the type of activities that people perform on social media has a greater impact than merely social media usage itself (Junco, 2012). People only using social media for purely social purposes had a lower GPA than people using social media in order to gather and share information with other students. This is further supported in a study by Bowman et al, in which the authors claim that “When students use IM to help with their academic work, some studies have found that it enhances online participation in classes”. However, the authors continue by stating that despite this fact, most students use IM and similar functions rather for social than educational purposes (2009). There has also been research regarding learning in relation to media multitasking, where participants have been watching TV while doing homework (Ophir, Nass & Wagner, 2009). This has indicated that the people exposed to media while trying to do homework learns the material in a shallower way and aren’t able to analyse it to the same extent as students who have given the material their undivided focus.

One study which examined the effect of instant messaging (IMing) during reading suggested that the impact of the interruptions of the IMing was not significant at all, but that the only notable effect was that the interruptions caused the participants in this group to take longer to finish reading the material (Bowman, Levine, Waite, Gendron, 2009). This indicates that in situations where people by themselves can control the processing of the material and have the time to go back and re-read the material, interruptions can indeed cause a delay of the activity, but do not seem to have a negative impact on the learning in itself. However, the structure of a lecture is often significantly different from this, as it means that the missed information due to an interruption is gone, unless it is repeated by the lecturer. Thereby interruptions in a lecture setting can have a greater impact on the learning than when being subject to them in a setting...
when the person is able to control the material by themselves. Furthermore, another study has also indicated that the student’s interest level also plays a very great role in the learning of the material (Conard & Marsh, 2013), based on yet another study where the effect of interruptions on learning was controlled. Here, researchers found that people who had an interest in the presented material were less likely to respond to the presented interruptions than less interested students.

Being aware of the difficulties which interruptions and multitasking can present in educational settings, especially where responsibility is on the individual students, it can be of value to know what tools can be used in order to prevent this from occurring.

3.4 Downshift or off switch?

As mentioned above, technology and constant connectivity is becoming more and more common in our everyday lives. Nowadays, there is however a slight shift towards encouraging slowing down. For example, as mentioned above in the beginning of the introduction of ICT in work environments, the focus was more directed at facilitating multitasking and thereby suggesting design implications to enable this for the workers (Mark, Gonzales and Harris, 2005). Currently it is instead possible to distinguish a shift towards encouraging downshifting and single-task focus. This can be indicated through the launching of the tablet “reMarkable”. The tablet, to be launched in September 2017, is designed to work as a reading device, while also allowing for handwriting and sketching, advertising itself with the words “no tablet has fewer functionalities than reMarkable” (getremarkable.com), continuing to compare itself to a classic notepad. The selling pitch is here the lack of functions which is a conscious design choice.

There have also been several applications launched in order to facilitate single-task focus and avoiding distractions when engaging in different tasks where full focus is desired, for example Pomodoro Timer, Forest etc. The Pomodoro Timer is based on the Pomodoro Method, a time management method launched by Francesco Cirillo during the 1980’s, where the person using the method is structuring their work into 25-minute-long segments with short breaks in between (MindTools, 2017). Forestry instead uses a gamification approach, where the user is rewarded for the amount of time they are staying away from using their phone with trees or bushes growing in the application. The longer the person is not using the phone, the taller the tree becomes. If the person however uses the phone before the given time is up, the tree or the bush in progress dies. Furthermore, there are applications designed for blocking applications which are perceived to be time consuming, such as AppDetox, where the user can list applications which they want to be unable to access. The user can choose to limit the usage to e.g. one hour per day, or maybe to block them between the times when they are at work to keep from being distracted by these. There are also apps for closing the phone completely, thereby blocking the person from using their phone at all for a given amount of time, such as Digital Detox. One example of a device that takes this concept of the user being able to block themselves from their smartphones a bit further is “The Cell Lock-Up” – a small cage in which multiple phones can be locked for up to 60 minutes at a time. These different devices and applications thereby offer different levels of breaking the habits by being able to either completely blocking themselves from using their phone or just being able to filter out different
applications. The common denominator is the acknowledging of the almost addictive effect smartphones and especially social media can have on people, providing tools to help breaking habits when will-power might not be enough. This can also be exemplified in the social phenomenon of phone stacking, though this is more of a social activity. Phone stacking occurs when for example a group of friends gather for a social event and decide to stack their phones in the middle of the table to avoid being distracted by these during the course of a dinner. There can also be some sort of penalty associated with being the first person to pick their phone from the stack (Foodbeast, 2012). The underlying idea behind the phenomenon is described on the website Techopedia as following:

Simple activities like phone stacking reveal some of modern tech’s most important user issues related to the pervasiveness of online or digital interaction. With popular social media platforms and increased hardware versatility, people are becoming more linked to their devices and less interactive with their physical environments. Phone stacking is geared toward transforming this equation into a voluntary method of limiting device interaction. In the future, activities and ideas like phone stacking may generate various solutions presented by device manufacturers and interface designers. (Phone Stacking, Techopedia)

In this description, the problematic side of the more widespread connectivity is framed; it is argued that this type of activity is pinpointing that the pervasiveness of devices can have a negative impact on the users through them being too engaged in these in social situations. By limiting people’s possibilities to physical interaction with the devices, they are forced to turn their attention to the people they are socialising with. However, since this is done through a gamification approach to the problem, this might be more encouraging for people to engage in than when it is perceived to be a forced or involuntary activity.

Apart from these applications, there are also the functions which are built into almost every phone, such as the silent mode to avoid being disturbed by notifications from incoming calls or texts. There is also the possibility to turn off notifications from applications which may be experienced to be distracting, and flight mode to stop all incoming texts or phone calls.

All of these above-mentioned approaches to the problem, except to some extent the phone stacking, do however call for the person in question to recognize their behaviour as something that is affecting their lives in a negative way, and making the active choice to rely on these applications and devices to break that behaviour. Thereby this might not be applicable in an educational setting, as the attending students may not recognize this to be a problem to them, and thereby also may be unwilling to use these. But how is it possible to make people aware of a problematic smartphone behaviour?

Another aspect of the more widespread technology and the possibility to bring technology everywhere is the phenomenon of “self-tracking”, or what is also referred to as “the quantified self” or “lifelogging”, where people are trying to become more aware of their activities and their performance within these by tracking and logging these. Typically, this is applied in order to quantifying things such as exercise, food intake, heart rate or sleep tracking, and the purpose is usually to improve them as much as possible (LiveScience, 2017). However, with the right
technology, this approach could be applied to other things as well – such as becoming more aware of one’s smartphone usage. A possible approach to recognizing one’s usage of the smartphone as problematic is to log the time of phone usage and evaluate this, which is what is done in the conducted study described below.

4. Method

There have been many studies researching the connections between multitasking and interruptions in classes or while studying, as well as making a connection to a student’s marks. However, another important aspect of this phenomenon is the experiences of the students, as this can also provide very important insights regarding the issue. That is what the conducted study is aiming to investigate.

4.1 Structure of study

The study was carried out in three different steps: first the respondents filled out a survey containing background variables such as age, gender and study level. Furthermore, the participants were asked about if they owned a smartphone, in order to ensure that they were actually able to participate, and also about for how long they had owned their current phone. This was done in order to see if people having newer phones were more prone to checking them often or being more frequent users than people having older phones, as the novelty might encourage them to explore them. They were also asked about how they perceived their smartphone habits. The questions were as following: How many applications they would estimate that they use per day and per week, an estimation of number of times they look at their phones per day, how many applications they have the notifications turned on for and what types of notification they use (sound, vibration and/or visual). This survey was sent out in order to establish the respondent’s perceptions of their smartphone usage before the study started, in order to compare to the actual results during the deeper interview at the end of the study. Some of the questions required for the participant to give an own, short answer, while others were questions where the participants had to choose from given responses.

A possibility would have been to include in this survey is a question regarding an estimation of the amount of time that the respondents spend on their phones per day. This question was however consciously omitted due to the assumption that it would be preferable if the participants’ usage was not in any way affected by any preconceptions from their responses in the initial survey.

Thereafter, the respondent installed the application for gathering data on their phones and allowed for it to run in the background and collect data for two weeks. After this, the respondents were contacted for scheduling a semi-structured interview. During this interview, the respondents reflected on the data they had gathered and also asked the questions presented in Appendix 1. However, as this interview was semi-structured, there was much room for elaborations and own thoughts.

The results and conclusions presented in this thesis are thereby based on these three steps: the initial survey, the data collected from the application and the interviews which each of the respondents. All of the participants were informed of that their collected and submitted data would be anonymous in the presented result. As the interviews were recorded and transcribed,
which the persons were informed of prior to the interview, as well as that the recordings would only be accessible for the interviewer.

### 4.1.1 Monitoring app usage

The method of monitoring participants’ app usage has been used before in research, e.g. in a study performed by Ferdous, Osmani and Mayora, where data regarding participants’ app usage was used in attempt to determine the perceived stress levels at the participants’ workplaces (Ferdous, Osmani & Mayora, 2015).

The advantages of using an app for this purpose is the possibility of gathering large amounts of information without the need of shadowing the participants. This allows for more participants being able to take part in the experiment, thereby giving the researcher the chance for collecting more data without spending too much time doing field research. The use of an application also makes the data collection very smooth and non-intrusive for the users, as in that there is no need for them to carry around e.g. a camera or some other device for capturing their activities. This enables for them to collect the data without having to go through any extra efforts in doing so.

The negative aspects of performing this type of data collection is that the researcher becomes very dependent on the design of the application in the sense that some of the design choices can result in an exclusion of information that could be relevant to the researcher. Depending on the capacity of the users’ phones, it could also cause these to become slower, resulting in irritation for the respondents and therefore causing a disturbance in their natural behaviour. The knowledge of the data collecting can also cause in the respondents becoming more aware of their habits and through that also cause them to change their ways.

In order to get a better understanding of this problem, a study containing 9 participants was carried out, in part through the monitoring of their smartphone usage and in part through a self-estimation survey and interviews regarding their experiences in combination with reflections on the collected data.

### 4.1.2 App Usage

App Usage is an Android based application which gathers data about the application usage on the device on which it is installed. The application tracks which apps are being opened, how many times, at what times and for how long. The application is created by Sam Lu/AZSoft Technology, which have also developed other app managing applications which aim to helping in order to free up space on your phone, managing 3G-connection in order to make your battery last longer, etc. They have also “been selected as a Google I/O 2011 Developer Sandbox partner, for its innovative design and advanced technology.” (AZSoft, Android). The application is free to download, but uses advertising for making money, and it is also possible to pay to upgrade it in order to get more features and get rid of the advertisements.

The reason for choosing an Android based application is that the Android operating system is used on a wide variety of smartphones, such as Samsung, Sony, HTC, Fairphone, etc., thereby allowing for a wide variety of participants.

The advantages of using an application that is already created and distributed through Google Play is that the app is tested, that possible bugs have been reported and removed and that the higher the rating is, the more reliable it will probably be meaning that it will be able to
function on many different versions of the operating system and be less prone to problems such as crashes or system failures, as it has already been tested. The advantage of using one that is available on Google Play is also that it is possible to check the ratings and see what opinions people have of it – to see if it slows down the performance of the phone etc. This makes it easy to find if there are any common problems associated with it. Another reason for choosing this application is that it is less time consuming than building one solely for this purpose.

The advantages of using an app which is created specifically for this purpose are among others that it can be designed to fit the research project primarily and thereby building functions that are solely aimed at fulfilling this. However, this can be very time consuming and would require a lot of testing in order to detect different bugs and errors within the program, as these things can severely disturb the results. Furthermore, it would require for many decisions from the researchers which can affect the study – such as which platforms and what operating system versions should be included in this. Failing to take these things into consideration can result in an unexpected exclusion of certain user groups and thereby limitations to the study.
Above (Figures 1-5) are screenshots from the application App Usage, showing which types of data can be gathered and tracked through this application, which includes time tracking, phone checks and tracking of usage time for each application. In the bottom-right corners of the bar chart views there is also information about the average use per day. The application also provides the option of setting up an “overuse notification” for applications, in case the user wants some extra help with keeping track of how much time they put into their app usage. This will prompt a notification when a person is using an application for more than the set time of a day, informing them that they have reached their limit. This function was not used during the two weeks of data gathering.

4.2 Meta-function of the study
Another function of this method of study is to see how this type of tool can affect the way people reflect around their smartphone usage in general and how they perceive this type of tool to be helpful in doing so. By also including questions regarding how they perceived the tool and whether they could see any benefits of using it in the deeper interview, it can also provide an insight into how people think about their smartphone usage and whether they can identify any issues related to that and in what contexts. Therefore, this study can also investigate how this tool can be beneficial not only for the researchers but also for the respondents. This can further inspire future research as it can highlight different aspects of the issue.

4.3 The participants
The participants were found partly through asking students from undergraduate programs at the Informatics department and by posting a request on Facebook. Out of the people signing up, 10 persons in total completed the survey and started using the application. One dropped out during the duration of the study, meaning that 9 interviews were performed. 3 out of the 9 participants were women. The ages of the participants ranged between 18-40, with most participants, 44,4%, being between the ages of 25-30. Most of the participants, 66,7%, were studying on a bachelor’s level, 22,2% on a master’s level and 11,1% was studying a program not applicable to this type of scale. The posting on Facebook did however enable for people not present in the same location to participate in the study, as two people living outside of Sweden were part of the group of respondents. This was made possible by conducting the interviews with these participants via Skype.

4.4 Method for Data Analysis
The analysis of the collected data was carried out in three different steps; first analysing the data from the initial survey, secondly analysing the data collected through the application and last by analysing the data from the interviews. As the data from the initial survey was gathered through Google Forms, the result was presented in diagrams generated by the tool (shown below). As this step was carried out in order to get background data on the participants as well as to make them reflect more on their smartphone usage, the result is presented quite briefly, highlighting the average and the extremes. A way of improving this step and generate better results from it would be to e.g. contrast the data against actual smartphone usage to better see the contrast between this and the perceived values.
The second step was carried out through identifying the means and the median values of the number of screen checks and usage time, as well as identifying the extremes (the lowest and highest values) of each. This was then compared to the results of previous studies, especially the numbers presented in the article from the Daily Mail (2014), building on a survey performed by a software company. Despite the lack of clarity and thereby uncertain validity due to the inability to access the actual study, the numbers presented can still provide an interesting contrast to the result gained from the data gathering in this study.

The presented responses from the interview were selected and analysed using the questions asked to the respondents in the initial survey, the gathered data, as well as the results presented in related research within these areas as a basis. The discussion is therefore divided into the three parts according to the division of the related research, where the respondents’ answers are analysed and discussed in relation to each of these sections. In addition to this, responses which were considered to be interesting in relation to the topic or highlighting aspects of the issue not previously discussed were also included in a more general section of the discussion, as this could provide a basis for further research within this area. The selection was also made in a way that common themes for respondents were selected and analysed – things which were mentioned by all participants and therefore deemed as relevant.

4.5 Criticism against method
As described above, the application features a banner on the phone on which it is installed, displaying to the user how many times the phone has been checked that day, as well as the total usage time for this day. This can be very problematic when using the application in order to try to monitor a user’s normal smartphone usage, as it will make them more aware of their usage and reflect around it, thereby distorting their normal behaviour pattern. However, this can be the case in almost all types of research where participants’ devices are being monitored since the participants are more or less aware of this to some extent. This can though be turned into an advantage, as it can allow for the participants to constantly be reflecting on their phone usage, thereby giving the researcher the opportunity to gather more qualitative data concerning the participants’ experiences and feelings. Depending on the area of interest for the study, this can be even more important than getting objective data on the participant’s normal usage.

In addition to this, the people participating in this study did so through voluntarily taking part in the study, which might be a concern regarding bias through that these people might be belong to a group that to some extent already have thought about their smartphone usage. The bias is also in that due to the type of medium the question was posted on; the people can be assumed to be social media users on at least one type of platform. By using Facebook in order to search for respondents, people not using social media were excluded to some extent.

Furthermore, the app does not count time that is spent with on the phone when the screen is locked, meaning that it does not account for time spent e.g. listening to Spotify or to a podcast. It does however account for time spent with the screen on despite the user not actively doing anything. Here, it is shown in the result in that one of the participants claimed to sometimes not hearing the alarm, meaning that the app had registered the alarm clock as being used for more than an hour during a few days because it was keeping the screen “awake” until
it was turned off. This will of course create some inconsistencies in the data, but is difficult to avoid due to the nature of the application. A further development of this experiment could be to build a more intelligent app which can distinguish between active and passive use by for example using eye tracking.

Using a method such as a thematic analyse or grounded theory could have provided a more powerful basis for the analysis of the interviews with the participants. The presented results are however based on the data provided by the survey, the application and the findings from previous research within this area.

The disadvantages of using the existing application in this case is that the application is aimed more towards the users rather than the research aspect of it. An example of this is that it is showing a banner on the drop-down screen where it informs the user of the number of times they have used their phone today, as well as the number of times that the person has checked the phone by activating the screen. This is very probable to influence the users in their usage behaviour, and would have been very preferable not to have included, as some might experience it as intrusive and therefore could have opted to drop out of the study because of this. However, all the other applications which were also considered for this experiment did have the same problem, without offering the advantages of certain features also presented by this application, e.g. being able to export the gathered data.

The decision to use an app provided by a third party also means that your research becomes dependent on someone else's work, meaning that if there are any problems in the application used for conducting the study, this cannot be solved by the researchers alone. Furthermore, there might be errors within the collected data that the researcher is unaware of.

5. Results

The following section presents the collected data from the different parts of the study, where each section refers to each part of the study. These results will be further discussed and analysed in the following discussion part. When presenting information from individual respondents the gender neutral “they” and “their” will be used to protect the anonymity of the participants as far as possible.

5.1 Data from self-estimation survey

The first question in the initial survey, apart from the questions regarding background variables, regarded for how long the respondents have owned their current phone. The reason for asking if they had bought their phone recently was to see if there might be any differences in usage depending on for how long the participants had owned their phones, so that the people with the newer phones were still exploring them and their functions, which could make them more prone to using them more frequently – the attraction of novelty. There was an even
division between people who had owned their phones for less than 6 months and the ones who had owned their phones for 6 months to a year, with 33.3% each (Figure 6).

Figure 6 Pie chart of the amount of time the respondents have had their phones

The following question regarded the number of applications that the respondents used per day. The reason for investigating this was to be able to see if the persons who reported using a lot of applications also had a higher number of phone checks or time spent on their phone, compared to persons using a low number of applications. Another thing which could be investigated through this was how many were using applications without actually thinking about it, maybe in order to e.g. buy a bus ticket or check their account, where the app use is only a tool for being able to perform an action. The results here varied quite a lot, with 2 apps per day being the lowest and 20 being the highest, with the estimated average use somewhere in between as 5 people estimated their daily usage to 10 applications per day (Figure 7).

Figure 7 Bar chart of the number of applications the respondents use daily
The next question regarded the number of applications the respondents estimate that they use per week, as the day-to-day usage can vary a lot depending on what activities they undertake that specific day. There could also be that persons might use some apps mostly during their free days or weekends, such as a bus app for going downtown on a Saturday or a nightclub app for signing up on a guest list for free entrance. Here, the responses ranged from 5 as the lowest to 30 as the highest, with 15 being the average (Figure 8).

![Figure 8](image)

**Figure 8 The number of applications respondents estimate that they use per week**

The following question regarded the number of times that the participants would estimate that they look at their phone today, here formulated as the number of times per day that they look at their phones to see if they have received a notification or something similar. This question had pre-defined responses which the respondents could choose between. The highest number was 50+ times per day, which 55.5% chose as their answer (Figure 9). In hindsight, it would have been preferable to reduce the lower amount in order to instead add more higher number options to get more nuanced responses, as it would have been more providing for the analysis and discussion.

![Figure 9](image)

**Figure 9 Pie chart of how many times per day the respondents look at their phones**

The next question in the survey concerned the number of applications they had notifications turned on for. The reason for asking this was that this could to some extent be used to predict whether the persons were experiencing notifications to be a disturbance to them, since they would have to make the active decision of deactivating these. Here, the respondents were asked...
to estimate it through giving a free-text answer, meaning that a diagram for this would not be giving a good overview as the responses are both in numbers as well as in text. The responses ranged from 4, as the lowest number of applications that they had the notifications turned on for, to “a lot. Maybe 15”, as the highest, as well as the response “Too many, I think it’s everyone”.

The last question concerned what types of notifications they use, that is what type of stimuli they use for the notifications, where they could choose between visual, sound or vibration. For this question, the respondents were able to choose more than one answer in case they use two or more in combination with each other. The responses here show (Figure 10) that almost all, 7 out of 9, respondents usually use the visual, while 6 out of 9 uses the vibration.

![Figure 10 The types of notifications the respondents usually use](image)

5.2 Data from app
The participants used the application for two consecutive weeks and thereafter submitted their data. The data gathered from the app tracking of the participants regarded the usage time of their phones, and the number of times they checked their phones. The median value of phone checks per day among the participants was 63, while the mean value was 83 checks per day. Based on this average number of checks per day, it is possible to see that the average number of checks per hour (assuming that the persons are awake for 16 hours per day) is 5.19, giving that the persons check their phones a bit less than every 10 minutes. Regarding the median value for the number of hours spent on the phone per day, it amounted to 2 hours and 31 minutes. As for the average time of use per day, it amounted to 2 hours and 56 minutes per day in total. The differences between the individuals participating in the study was quite big, as the user with the lowest number had an average of approximately 18 phone checks per day and 23.43 minutes of usage time per day. Meanwhile, the highest user had 158 phone checks per day and an average usage time of 6 hours and 30 minutes.

5.3 Information from interviews
The interviews were conducted as semi-structured interviews, where the respondents were asked some basic questions which were the foundation of the interview, but where there also was a lot of room for own reflections and to elaborate on their answers. Through this, the interviews had the same base, but went in different directions depending on their answers and
what they found to be most interesting to discuss. The questions which served as the basis of the interview are included in appendix A. A few common themes from the interviews were identified, which were as follows:

About half of the respondents remarked on their usage being higher than they would have initially thought, while the other half did not express any particular surprises based on the collected. There was a slight tendency among the respondents who had higher phone usage to be more negative towards their result and perceive it as something negative, as illustrated in the following quote:

[15:22:30] Interviewer: “So you’ve been using this app for the last two weeks now... do you have any initial reflections?”
Respondent: “I’ve been spending so much time with my phone, I was initially shocked. It’s too much, I feel like it’s a waste of a lot of time”
Interviewer: “What do you mean with ‘waste of time’?”
Respondent: “I feel like I don’t do anything productive, that I’m only on Facebook or Instagram when I could study or do something else than just being on social media”

Interview with respondent RS.

In the quote from this interview, it is possible to see that the person experiences their usage of social media as non-productive compared to for example studying or doing something else, without using the phone. Similarly, another respondent said that they do not want their free time to be wasted on just sitting with their phones, just scrolling through social media or browsing websites (interview with respondent FP). Furthermore, when asked, most of the respondents did not see interactions with people via social media to be equal to interactions in real life, and viewed the social media to be inferior in comparison, despite still constituting interactions with other people. One of the participants said that they felt a bit guilty when they spent their time “checking the phone instead of focusing on my kids and playing with them” (interview with respondent CW), but that they view it as a way of unwinding after a long day at school or work and also an opportunity to connect with friends and family who they are unable to see every day.

Regarding how intrusive the application was as a tool, all of the respondents reported thinking about it the first day, due to the status bar constantly showing, and that it affected their usage during that day, but after that, they got used to it and were using their phones as normal. Some claimed that they forgot about it completely until receiving the report for the previous day usage, and that also that after a while blended in with the other received notifications.

Regarding multitasking while studying, most of the respondents reported that they do not keep their phones nearby while studying, especially not when using their laptops. However, a few of the respondents often keep Facebook open in one tab when using their laptops. This is in order to being able to get in touch with people, which can be relevant to their studies such as i.e. discussing something related to what they are studying at the moment, discussing group work or organizing study groups. The respondents doing this claimed that they find themselves
to be quite good at filtering out unnecessary distractions which might occur. One of the respondents reported that they usually keep this tab up in order to not have to wonder if someone has e.g. sent them a message on Facebook, since they can see if someone has done so, which makes it easier to fully focus on their work. They also reported perceiving themselves as able to quickly switch between their work and checking messages, including responding to shorter ones, without experiencing a significant interruption in their work. However, if the messages are longer and completely irrelevant to their task at hand, the person usually reported choosing to respond to this later, as they experienced it to take too much time from their work. As for multitasking during lectures, only one respondent admitted to doing so. When asked about the type of multitasking, the respondent said that they usually engaged in “easy” multitasking, which they did not perceive as interfering with listening to the lecture. In this case, the person did not experience having any problems playing Minecraft during a lecture, as opposed to reading an article meanwhile.

One of the interview questions regarded the preferred study environment of the respondents. There was a great variation between these. One respondent claimed that they feel that they study the best when having the TV on in the background with the sound turned off, when reading or writing for example, so that they are not bothered by the sound but still have something to look at when taking a break from studying. A second respondent said that they try to watch TV while studying sometimes, but often fail while doing so because they get caught up in the TV show, while yet another respondent reported not being able to have anything slightly intrusive nearby as they experienced that this would be a potential distraction. About half of the respondents reported listening to music while studying, though all of them also claimed to consciously choose instrumental music so that they would not be distracted by any lyrics. Another common thing among the respondents was that the majority of them, 6 out of 9, reported being more easily distracted when they found the work at hand to be tedious or simply boring and that they then found themselves more prone to be distracted by other, less relevant, things such as news articles posted on Facebook or similar things. If the work at hand is perceived to be more interesting, the respondents instead reported it to be easier to focus on and being more capable of ignoring distractions. None of the respondents reported using any specific type of study technique, apart from having identified the preferred study environment. Furthermore, despite all of the respondents being full time students and therefore expected to put around 40 hours of work into their studies, only one person reported doing so. The other respondents varied from 10 – 30 hours per week, including lectures, with an increased number of hours closer to when an assignment is due or an exam is to be taken.

As for where people keep their phones while studying, there was a division between people who keep them close by or people who put them away. However, out of the people who do not keep their phones close by, a majority of these reported that they instead keep Facebook open in a tab in their browser. Out of the people keeping their phones close by when studying, all reported turning off the sound and vibration in order to not be interrupted, but checking for visual notifications from time to time. One respondent reported doing so due to their work situation, as they work as an on-call translator for the Immigration Board and can get a job request with very short notice. When asked about how they feel about having to constantly
keep an eye on their phone and knowing that they will be interrupted in their studies, they respond as in the following quote:

[13:19:22] Interviewer: “But if you always have to keep track of your phone to look for the job requests, how does that work when you are studying?”

Respondent: “At first I thought it was really annoying to always have to keep track of it, especially since I think it’s really disturbing to have the sound on, I really hate it, so that’s why I don’t have that but only the visual notification. But after a while I got used to it, so I don’t think it’s a problem anymore”

Interviewer: “But what about if you get other notifications which don’t concern work, are you able to ignore those?”

Respondent: “It depends on who is writing, if it’s something important then I check it, if it’s not, then I’ll wait. But sometimes it’s hard to know, especially if I’m doing something boring, then I’ll probably check even if it’s not that important [laugh]”. (Interview with respondent MB)

In the quote above, the respondent is claiming to have gotten used to having to keep track of their phone while studying, meaning that the focus is always slightly divided between these two tasks. There is also a connection back to the interruptions having a greater impact if they appear in a context where the person is studying something that they find boring or uninteresting, as mentioned above.

Regarding the usefulness of using an application like this to track the smartphone usage, the respondents who were the most frequent smartphone users, thereby spending more time using their smartphones, were more likely to reporting positive opinions regarding using the application. Only one of the high usage participants felt that they had no use of it. However, this person also reported not perceiving their usage to be a problem since they did not experience there to be any interference with their everyday life. A few of the participants said that they would probably keep using the application in order to be able to keep tracking their smartphone usage. One participant said that they appreciated the application since it made it easier for them to see exactly what their time was put into and could perhaps make it easier to cut down on what they perceived to be unproductive usage. Among the ones reporting that they would not, the most prominent reason was that they felt that they simply did not experience having any use for it after the ending of the experiment. The reason for asking about this was to evaluate the tool itself, but also to investigate how people felt about actually being able to see how much they spend using their phones as this could differ from their own perception.

A lot of the participants reported also using their phones in order to check for the time, as wristband watches have become a bit unnecessary since most people are carrying around phones in their pockets anyway. This also created a high number of screen waking during one day. However, when checking the time through using their phone, the participants were also able to see if there are any new messages or notifications, which opened up for a potential interruption or diverting of their attention from the task at hand.
One of the participants said that they were surprised by how much time they actually did use their phone, since they sometimes did it without reflecting on it. This person also said that they feel a bit stressed out any time they leave the home without their phone, because it might hinder people from reaching them if something happens. When asked about their feeling if they themselves cannot get hold of a person due to them leaving their phone at home, they said that unless it is urgent, they don’t experience it to be too much of an inconvenience.

[10:31:10] Interviewer: “But why do you think it is so important to be able to be reached at all times? I mean, before mobile phones became common, it wasn’t possible”

Respondent: “Yeah, but I mean if my girlfriend or my family, if something happens and they need to reach me, I feel like they might get worried if they can’t. And also, if plans change, I have a lot of meetings since I’m part of some organizations, and we often have lunch meetings and sometimes people cancel with very short notice, and I don’t want to go there and wonder where everyone is. I’m also part of a floorball team from work and we play every Thursday evening, but once I showed up and was the only one, because I wasn’t part of their text group where they had decided to cancel it on the same day. For that reason, I think it might be good to always be reachable, because plans can change with short notice.”

Interview with respondent FP.

In this quote, the respondent expresses their thoughts on why they think it is stressful to leave the home without their phone. This person’s answer mainly concerns being able to be reachable for other people, and not so much being bored without the phone or experiencing any practical issues due to e.g. not being able to check the bus times or their bank balance. The person also mentions the problems which can occur due to quick changes of plans and how not being reachable can result in missing out on information and thereby showing up alone or missing out on a meeting which has been moved.

6. Discussion
The following section will regard the results from the different parts of the study in relation to the related research.

6.1 Learning & IT in schools
As expressed in the section regarding learning, focus is beneficial in order to be able to properly process the inputs and store it as information. The persons participating in the conducted study are students at a university level, and are therefore expected to take a lot of own responsibility for their studies, as well as planning and distributing their study time by themselves. This also in some cases mean studying material which they might perceive as completely irrelevant or uninteresting in a setting where they are free to distribute their time as they want. As previously
mentioned, Schunk highlighted the importance of the attitude of the learner towards the material, which is also supported in the section regarding the impact of interruptions on learning and how personal interest in the presented material affects this (Conrad & Marsh, 2013). This is further supported in the respondents’ accounting for it being more difficult to disregard interruptions when trying to focus on material which they perceive to be boring or uninteresting, as they are more likely to divert their attention from what they are doing. In addition to this, as described by Schunk, novelty does attract attention, which can be a reason to why smartphones can have such a powerful impact regarding distracting people when they are already having a difficult time trying to stay focused. It can always present novelty through e.g. social media apps, newsflashes and games, at any time and any place. It also presents the stimuli described to appeal to people’s senses, such as sound, vibration and flashing LED-lights, or simply by activating the screen when receiving a notification. Of course, this is designed in order to catch people’s attention and interrupt them in what they are doing to inform them of that something has happened and that they should pay attention to that. This causes an interruption in the person’s work flow, where they are required to decide whether to either respond to or ignore the notification. As described above, this will have a greater impact on persons studying material which they are not particularly interested in, as they may be having a more difficult time trying to resist responding to interruptions in this situation.

Furthermore, results from previous research within this area are indicating that interruptions and multitasking are stating greater problems when occurring in class than during individual studies. Multitasking has proven to affect both the persons engaging in the multitasking as well as peers nearby (Skolverket 2015; Sana, Weston, Cepeda, 2013). The fact that it is not only limited to the persons engaging in it should be a great motivation for trying to curb this problem. But does the solution have to be to completely ban smartphone usage during school hours, as done by Engelska Skolan? As advocated for by Strandh, a preferable option could be to instead try to help children and teenagers use their smartphones responsibly and to adapt their behaviour according to the situation they are in. Something to consider in relation to this is the fact that many young adults reportedly feel anxious or uneasy when being away from their phones, as presented in the study by Kana (Daily Mail, 2015). Completely banning phones might actually therefore create another problem, where students are unable to focus due to not being able to access their phones. This presents a catch 22, where on one hand there is the inability of focusing due to electronic devices constantly calling for attention, while on the other hand the inability to focus due to not being able to access the electronic devices. An attempt at changing the general smartphone behaviour might also affect the way in which people interact with their phones during their free time, thereby addressing the issues that for example phone stacking is trying to solve, as stated by Strandh (Åkergren, 2016 (b)). However, it is unclear how this change in behaviour would actually be carried out, thereby calling for further investigation.

Connected to this, as stated by Skolverket, IT is a tool which is very necessary in today’s society and can present great opportunities. Among other things, providing tablets and laptops to all students can be a way of compensating for socio-economic differences, as it allows for students to gain access to information, less restricted by e.g. parents’ economic resources or geographic location. However, these tools can also facilitate a lot of interruptions and
distractions when not used in the correct way, not only to the person using them, but also to their nearby peers, as mentioned by both students and teachers in the report from Skolverket (Skolverket, 2016). A way of trying to manage this and curb the multitasking and interruptions could be to further research the way young people handle IT compared to adults. For example, children and teenagers are more prone to multitasking (Carrier, Cheever, Rosen, Benitez & Chang, 2009), and might not be as skilled in filtering out irrelevant input, as their brains are still not fully developed (Gazzaley & Rosen, 2016). A very important part of this is to find a way of managing these types of interruptions and tendencies to multitask while still being able to take advantage of the opportunities which IT can present in educational settings. A way of doing this could be by using devices which filter out distractions and interruptions by for example limiting the number of functions provided, in accordance with the idea behind reMarkable.

The reason for investigating the usage of IT in elementary schools today in relation to this study has been to understand the reasoning behind the guidelines for IT usage provided by Skolverket and also understanding the problems currently present in schools. Even though this study has focused on university students, the situation can be in some ways comparable, with interruptions and multitasking occurring inside and outside the classroom, affecting the learning process. To understand how the problem is seen and addressed in elementary schools, there is also a possibility of understanding how to take on similar problems in other situations resembling this one.

6.2 Interruptions

As one of the respondents mentioned in the interview, there might be a perceived need of constant connectivity and accessibility in today’s society, which in its turn might also cause interruptions – both external and internal. As described in the study performed by Kana, cited in Daily Mail, British young adults allegedly check their phones every 10 minutes during their awake time – a number close to the one resulting from the data gathering in this study. This without even having received any notification (Daily Mail, 2014). On the same note, another one of the respondents claimed that they found it more distracting not knowing whether someone had contacted them or not than having Facebook open in the background when using their laptop for studying. This despite the potential risk of being distracted by irrelevant notifications. A possible explanation for this is that the visual interruptions are easier to handle when already reading, as they do not present any disturbance in focus through presenting new stimuli, but rather diverts the focus slightly. As seen in the study, most of the respondents prefer visual notifications over sound, and one of the respondents claimed to always have the smartphone on mute, as they found the notifications to be too intrusive when having the sound turned on. Another possibility could also be that visual notifications and vibration are perceived to be less disturbing for the surrounding environment. As previously stated regarding interruption times for office workers handling emails, interruptions can result in long recovery times (The Atlassian, 2017). Some of the participants reported trying to avoid this issue by assessing the received messages or notifications and judging whether it should be dealt with right away or if it could wait, where longer messages were usually saved until later. This does however still present an interruption and there will still be a need for time for
resuming the original assignment. The participants however did experience this to be a good method for coping with this as it could also allow for them to take a minor break from their work as well as being able to provide a quick response, but still did not experience that this shortened the recovery time, thereby allowing them to return to the assignment quicker. However, this still poses the question regarding why people feel the need to always be aware of if someone is trying to contact them?

A possible reason for this could be that people have grown accustomed to always being ready to give quick replies. This is in line with a claim made by Seung-Hyun Lee regarding that we are living in growing culture of impatience and instant gratification, where people are growing more and more impatient, which he believes to stem from the constant connectivity enabled through smartphones (Lee, 2015). Due to this, some people might feel that they need to always be ready to respond to a question in order to not keep other people waiting as this might cause them inconvenience. Another aspect of this issue was pointed out by a respondent, who reported of plans changing quickly and that people are expected to be constantly reachable and therefore also be more adaptive to these changes. This can possibly also cause internal interruptions, as the persons might feel that they always have to check to see if something already decided on has changed. This problem could possibly be solved by developing a way for allowing certain communication to be let through in certain situations, where quick responses are expected, while filtering out other. However, this aspect of the problem can possibly be better investigated through research regarding how technology affects social codes between people, rather than through the area of interruptions alone.

6.3 Multitasking

Regarding the multitasking aspect, few people reported multitasking in the media-multitasking sense. Only two of the participants reported having the TV on in the background, mostly to have something on in the background. Their reasoning behind having the TV on in the background is due to the fact that they wanted something happening around them, to be able to take a short break through looking up at the TV, which is in accordance with Gazzaley and Rosen’s claim regarding multitasking in order to have more fun and make the task seem more enjoyable (Gazzaley and Rosen, 2016). The fact that the respondents reported being more prone to multitask when performing an assignment which they found tedious or boring also further supported this. Many of the participants claimed that they sometimes listen to music, but that this often depends on the complexity of the assignment. Most were prone to choosing instrumental music or where “there aren’t too many things happening” in order to not get distracted by the music while studying, which shows an awareness of the level of multitasking that they perceive themselves as capable of, where they have identified a limit between functioning and distracting. This is also applicable to the respondent who reported not having any problems playing Minecraft during lectures, but finding it difficult to read at the same time. However, as stated by Ophir, Nass & Wagner, people are prone to overestimate their multitasking abilities, especially when frequently engaging in this, meaning that despite the respondents not reporting experiencing any problems while doing this, they could still experience obstacles while engaging in this, though minor ones (Ophir, Nass & Wagner, 2009). This could also hold true regarding the respondents’ claims of being able to handle short
messages while actually engaging in something else, without any greater problems – it might be their belief but not the reality. Furthermore, as the multitasking can make the assignments seem more fun, the persons might experience that any difficulties presented through this might be compensated for by the assignments seeming more enjoyable than when not engaging in multitasking.

In addition to this, many of the respondents also reported using social media in order to facilitate group work, such as having discussions with classmates around issues related to school work, sharing material or organizing study groups. As suggested by earlier studies, social media in combination with studies is not a bad combination per se, but the impact of social media on studies is very dependent on for what purpose it is used (Junco, 2012). Though, most of the respondents did not report multitasking in class, but rather only engaging in this when studying by themselves. The respondents did not give any reason for this difference, though a possible explanation could be the more severe impact that multitasking and interruptions have when trying to follow a presentation of material compared to when being able to control the processing of the material by themselves. Another possibility could be that it is partly due to respect for the person speaking, in the way that the participants do not want to seem uninterested in the lecture.

6.4 Tracking of app usage, reflections and possible solutions to problems

All participants reported being aware of the application when first installed, and keeping track of the time and number of phone checks, but stopped noticing this after the first initial days. Some claimed to try to disregard it, despite this not being explicitly included in the instructions, as part of the study was to try understanding people’s thoughts about this as a tool. As for the phone usage, most people were unaware about for how much time they actually did use their phones, as most had underestimated this, believing it to be lower than it was. As this question was not included in the initial survey, it is however impossible to compare the result to an estimation. Among the persons who viewed their usage as being “too high”, all were positive towards using App Usage in order to track what they were doing with their time and through that initiate a change. This is in line with the thought behind “the quantified self”, in the way that the persons logged their activities and from that could see if they experienced that they needed to improve in some way – in this case regarding smartphone usage. It is however unclear if they viewed becoming aware of the problem as enough, or if they would have a need more tools, such as the one presented in the part regarding related research, in order to handle the problem. Regarding the number of phone checks per day, most people were also a bit surprised by that, but regarded them as more reasonable when they realized that the high number could be due to it replacing the function of a watch. Here, there was a possibility to compare against the survey. However, as the highest possible response to choose was 50+ checks per day, and most of the respondents were a bit above this number, the design of the survey in this case hindered any more nuanced responses regarding this.

Something to keep in mind regarding the study is the fact that the participants in this study were volunteers, with most participating after responding to a post on Facebook. Despite the
post not describing the study in detail, it gave the information of involving smartphone usage in some way. This can indicate that the participants have had considerations regarding their smartphone usage in some way and therefore were interested in participating in the study. This may very well make the result less representative than if the participants had been consisting of a randomized sample rather than a convenience sample.

As for the study itself, the method provided a lot of useful data for investigating the issue. This partly due to the data gathering through the application, which provided a lot of data without the researcher or the respondent having to go through too much inconvenience to gather it. This, in combination with the interviews, provided the opportunity to get a very wide insight into the issue, both regarding quantifiable data as well as qualitative aspects. As for the initial survey, the questions asked in it were a bit more difficult to compare to the data gathered through the application, as it was not possible to get statistics over e.g. how many applications were used per day without going through each person’s data day to day. Thereby it did not fulfil the initially planned purpose. However, a way in which it did contribute, except for providing background variables regarding the participants, could be that it inspired the participants to become more aware of their smartphone usage and reflect more upon it. This can in turn have made it possible for them to give more thought-through answers during the interview.

What can be problematic regarding this issue in general is that technology is a very big part of society and people’s everyday lives, thereby making it very difficult to break these habits since it is an inevitable progress in society. This is severely limiting the ability of being able to completely detox from technology, as many interactions with e.g. banks or administrative authorities are carried out through this, thereby in some ways forcing people to have interactions with this. What can be interesting to note in this context is that most smartphones provide the function of silent mode or being unreachable as something active, a manual setting which the user has to actively choose, thereby making being reachable the passive natural state of being. Another aspect of this phenomenon is that research in this field can easily end up slightly behind, as the technological advancements are quite quick, and that it can be difficult to foresee what the drawbacks can be in advance. Yet another aspect can be that many of the technologies have great advantages while still presenting disadvantages, which will be a bit further elaborated in the next section.
6.4 Model for interference between activities

Something mentioned both during the interviews as well as in the related research was the use of social media in order to organize group work, share school material and interact with classmates. In some ways, social media facilitates this, as it is often seen as the natural way of contacting and interacting with people, and it is convenient to organize both study groups and class groups there to discuss material. However, it can also create a lot of opportunities to get distracted and side-tracked from the original, or core, activity. The model above (Figure 11) demonstrates how the core activity can be supported by a side activity, which provides support for the task performed in the core activity. However, the side activity is active in a setting where it has a lot of characteristics which are overlapping with a distracting activity. By engaging in the side activity, the user can easily go over from the side activity to instead engaging in the distracting activity, resulting in the user becoming distracted and diverting from the core activity. A possible way of overcoming this could be to design in order to be able to isolate the parts of the side activity which supports the core activity, to avoid the distractions presented by the irrelevant parts of the side activity. Another possibility is to provide tools which are presenting the same functions as the supportive parts of the side activity, but not providing the distractions. However, this requires for the users to adopt the new tools, which can be quite difficult – especially for people not experiencing a problem in the current situation.

7. Conclusions

Due to the small sample of the population group, the conclusions presented cannot be generalized to a whole population group. Despite this, they can provide a good indication for future research in terms of providing guidelines for what could be further investigated. What is possible to conclude from this study is on one hand that some phone usage might be subconscious or due to habit, and that some people are quite unaware of how often they are using their phones. It can also be due to the fact that many services are provided through using the phone, such as carrying out bank errands or buying a bus ticket, which can also contribute to the high usage. Every checking of the phone does however provide an opportunity for an interruption. Using an app to track phone activity can therefore provide interesting insights, both for the researchers conducting the study, but also for the persons participating in the
study, assuming they have access to their collected data. A problematic aspect regarding using this approach to change a behaviour is though that the persons voluntarily need to make the active decision of using this type of tool in order to become more aware of their usage. This does however also spark the question regarding if something is a problem if the user themselves do not perceive it to have a negative impact on their life. As it is possible to see in related research and reports from teachers and students though, a person’s usage might also have a negative impact on the surrounding. The reason for the high phone usage might in part be due to the feeling of expected constant connectivity and reachability, where people are always checking to see if something has happened or if someone has contacted them, as reported by the respondents.

Furthermore, interruptions and multitasking can impact learning, but will have different effects depending on the setting. For example, interruptions during self-studies are experienced as less intrusive than interruptions during lectures, as the person can compensate for the interruption when reading or writing. Multitasking on the other hand will have a negative impact on the performance, but can also be used to make a tedious assignment seem more fun and thereby encourage the person to actually perform it. Related to this, the impact of social media usage is more complex than simply being good or bad. Many of the respondents reported using Facebook for organizing group work and similar things related to studies, but sometimes getting distracted by other, irrelevant posts. A possible solution to this problem could be to design for people to be able to categorize different types of interactions as important or less important, meaning that the important ones will be allowed even when the person is studying. This function is already available through some smartphones, but could also be applicable to certain social media. By facilitating this, there is a chance of reducing the number of internal interruptions regarding checking for notifications and messages, as well as filtering out unnecessary external interruptions. In addition to this, there are tools available for people wanting to detox from their phones but experience that the habit is too deeply rooted to be able to do that using only their willpower.

However, it might be that the best solution to the problem is a change of people’s behaviour regarding smartphones, as taking small detox sessions might only give a temporary relief. The need for using technology makes it very difficult to completely avoid it, thereby always presenting a risk of falling back into old habits. Of course, these types of detox tools could possibly serve as a type of support in the process of changing one’s behaviour. However, it is today not exactly clear how this change of behaviour would actually be carried out, meaning that further research is needed.

As for in the way in which participants handle interruptions today, it appeared to, for some of the participants, concern finding some type of balance between allowing for the least intrusive type of interruption, while for some still being able to stay in touch with people and being able to give quick and direct responses. Others managed this by completely staying away from their smartphones, as they did not experience any need of being constantly available. Regarding multitasking, the participants who admitted to sometimes engaging in this claimed to manage this by choosing to multitask on a level which they feel that they are capable of handling. This meaning not combining tasks which are too demanding, thereby not experiencing any major interference between activities. Something which is important to keep
in mind is however that this is the participants’ perception, which does not necessarily mean that the multitasking does not affect their task performance.

7.1 Future research

For future research, a possibility would be to perform a longer study, where the participants are using the application for a longer period of time, enabling the researchers to possibly distinguish changes over time, such as for example if the usage increases or decreases closer to an exam. This could also be combined with self-reporting of mood, to see if people are more prone to using their phones when they for example are stressed or feel lonely. In addition to this, it could also be possible to offer this to enable people to change their smartphone behaviour, if they are experiencing it to be a problem, and also provide the different tools for the so called “detoxing”. Following this, a follow up could be performed, in order to see if the changes have been temporary or long lasting. If the changes are temporary, further research could concern establishing what else is needed in order to make the change longer lasting. Another development of this could also be to investigate what could be considered to be a “healthy” smartphone behaviour and identify what aspects are needed to enable this in for example classrooms or at work. This is of course very difficult to establish, as it may be very subjective. It could also be interesting to try to further investigate the experience of always needing to be available and what implications this type of social pressure can have for individuals as well as for society.

Regarding the method of the study, an interesting development of the usage of an application for tracking phone usage could be to develop one which can collect data less aimed at the users and more adjusted to the study, as this can enable for more in depth research of the topic, as the above-mentioned changes in usage. It could also enable an easier insight into when people are more prone to use their phones and what types of applications they do use at those times, as the investigation of this through App Usage would have been very tedious and time-consuming. The method could also be developed in order to also be able to use for e.g. laptops and tablets, in order to get a more overall idea of how different devices affect us regarding these matters.

The findings presented in this thesis can also contribute to design implications of future applications and devices in order to design for avoiding interruptions and distractions at times when full focus is needed. However, in order to do so, more studies need to be carried out containing more participant to enable getting more nuanced views and opinions. It can also be interesting to follow the development of such devices as reMarkable to see the public reception and conclude whether or not there is a perception of a need for these and in that case what motivates people to buy these.
**Literature list**


Appendix 1

Questions for interview of respondents

1. What are your initial reflections when looking at the gathered data?
2. Was your usage higher or lower than what you would have estimated before starting using this app?
3. Did you change your behaviour regarding your phone usage in any way after installing the application? If so, in what way?
4. How did you feel about tracking your app usage?
5. What do you feel about the data gathered from this?
6. Do you see any patterns in your usage?
7. Do you think this can affect you in your everyday life?
8. How many hours per day do you usually study?
9. Do you have any strategy for when you are studying? /Describe your typical study environment? (study at home/at school/at library, having electronic devices around/mostly reading books, noises/quiet)
10. What do you usually do with your phone while you are studying? Other electronic devices?
11. Do you think that this type of app/way of tracking your phone usage can be beneficial in some way?
12. Have you reflected on your phone usage previously?
13. Do you believe that your way of studying has changed in any way since you started using a smartphone?