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Symptoms of digital addiction of Estonian primary school students

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ABSTRACT

The goal of the present work was to map Estonian primary school students' ratings of symptoms of digital addiction and to determine both class and gender differences. The sample included 5493 primary school pupils from 46 schools in Estonia participating in the 2022 Student Survey conducted by the Centre for Educational Innovation at Tallinn University. The results indicated that the digital addiction symptoms scores were highest among 8th and 9th graders. Girls and those students who did not disclose their gender, scored higher than boys on digital addiction symptom statements. Symptoms of digital addiction showed a moderate positive correlation with screen time on both school days and weekends, as well as with school burnout. There was a weak negative correlation between digital addiction symptoms and feeling refreshed in the morning. Since only a relatively small group of students showed a few symptoms of digital addiction and maintained a healthy pattern of using digital devices, policymakers need to develop digital addiction prevention measures or programs within the educational system.

Keywords: Symptoms of digital addiction; screen time; school burnout; refreshed from sleep in the morning

Introduction

Different digital tools, and in particular the internet, have transformed the way young people live, learn, interact and participate in society[19]. Since the onset of the Covid-19 crisis, the time spent on digital devices and media has increased[41]. As the constant use and carrying of digital devices has become a social norm, people often do not realise that they may be experiencing symptoms of digital device overuse[59]. Studies have shown that excessive use of digital devices over a prolonged period can lead to behavioural addiction[13,31], similar to other addictive disorders[27], developing because of habit formation and self-control problems[2]. The findings of a meta-analysis conducted by Meng and colleagues (2022) also showed that the crisis exacerbated the prevalence of digital addiction symptoms.

The propensity to overuse devices increases with the age of students[54], and it is the primary school age group, 15-16 year olds, who are the most prone to become addicted due to overuse[28]. Girls have also been found to be the most vulnerable group of young people[48].

Previous studies have shown that recreational screen time is associated with changes in children's mental health problems and health status[5]. Prolonged use of digital devices affects students' sleep, leading to sleep disturbance[34], and sleep deprivation in turn negatively affects students' physical and psychological health[22] and their ability to concentrate on learning at school[38]. Furthermore, it has been found that online addiction can be one of the negative consequences of burnout in schools[57]. School burnout is associated with school dropout and predicts later excessive internet use [6]. Pupils with low academic performance have higher levels of digital addiction symptoms[37]. At the same time, habitually frequent use of digital devices affects students' academic performance[16], disrupting students' attention and focus on learning[13]. As a student's academic performance increases, the prevalence of digital addiction symptoms decreases[58].

In Estonia, during the pandemic, schools implemented distance learning[23], and students spent more time using screens, so this topic requires additional research and mapping of digital tool usage. This study aims to map Estonian primary school students' ratings of digital addiction symptoms and to identify differences based on class and gender. It also seeks to explore the relationships between digital addiction symptoms and screen time, school burnout, and feeling refreshed in the morning. Data for this study were collected through a larger e-survey conducted across Estonian schools in early 2022, during a period when periodic distance learning was still in effect.

THE CONCEPT OF DIGITAL ADDICTION

In the current study we define digital addiction as a broad term that encompasses a range of digital devices and activities[3] and includes addiction to the internet, social media, smartphones, digital devices, including video games, and other digital technologies[29]. Being preoccupied with the use of digital devices or media means being unable to reduce use and justifying ever-increasing use, which in turn has a negative impact on school life and relationships and sleep[18].

The concept of digital addiction is relatively new in the field of mental health, and it has not yet been formally recognized as a disorder[46]. To date, digital addiction has been officially recognised by the World Health Organisation as a global problem, citing that excessive online activity and internet use lead to an inability to manage time, energy and attention during the day and cause sleep disturbance and insomnia[26]. Addiction to smartphones and social media among school students has been the subject of much research in recent years, and the prevalence of these addictions is the fastest in recent years[39].

Digital addiction is described as the compulsive need to use devices to an extent that interferes with everyday life and prevents you from doing the things that matter[56]. Often people fail to control their time use of digital devices and media, using devices more than they should[18]. Thus, digital

addiction refers to the compulsive, prolonged and uncontrolled use of digital devices and related activities, with detrimental effects on the user's psychological and physical health[1,39].

Digital addiction is classified as a behavioural addiction[32]. Similar to any other addiction[64], it can be classified as either passive (watching TV) or active (playing computer games)[21]. It is important to highlight that the characteristics of the technology contribute to addictive tendencies[21]. The more interactive the application, the greater the development of addictive behaviours[65]. Modern apps often contain algorithms designed to increase people's temporal use and liking of the app to a level that leads to addiction[45]. Overuse of the internet has an impact on the dopamine system[24], leading to repeated use, or compulsive overuse of digital tools. A recent meta-analysis concluded that a large proportion of people might be affected by at least one subtype of digital addiction, either internet, social media, smartphone or gaming addiction[39]. Thus, the study of digital addiction is currently topical and relevant worldwide[29].

Digital addiction is habit-forming and partly due to problems with self-control[2] and excessive use of digital devices in turn has a negative impact on school life[35]. In the case of students, the boundary between problematic and purposeful use has been found to cross at the point where the student becomes disengaged from relationships because of device use, and other areas of life suffer because device use dominates over other activities[34]. Students with symptoms of digital addiction who have longer screen time have lower subjective well-being scores than teens with lower symptoms of digital addiction who use digital devices for less time[52].

However, the overuse of digital devices and digital addiction are difficult to measure, as neither time criterion alone nor digital addiction scale scores are sufficient to define addictive tendencies. It can be defined through two interrelated components, i.e., emotional reactions to digital media and behavioural symptoms of addiction, i.e., compulsive use in different settings, and if the person experiences symptoms of addiction along with difficulties in living and coping at school[52].

One way of defining digital addiction is in terms of the time spent online and the fascination with the online world[10,59]. For example, in China, students with addictive features use devices for 8 hours a day[62]. Pupils with an online addiction may spend nearly three times as much time online as those without[15]. In a recent study of digital addiction among Estonian teenagers, a cluster analysis found that students with digital addiction symptoms used digital devices for an average of 5 hours on weekdays and 7 hours on weekends[52]. Time use of devices was also high in a study four years earlier, which found that only 33% of teenagers used screens at a healthy rate of 2 hours per day[55].

The time spent with electronic devices with a screen, watching television and playing a video game, are called "screen time"[40]. However, there are conceptual issues concerning the definition and measurement of screen time. Screen time measurements are likely to contain a significant amount of measurement error. There are a variety of self-report measures used to assess screen time. Some studies have examined overall 'total screen time' within a specific period, such as a week or a day, while others ask participants to estimate their screen time, differentiating between weekdays and weekends or school days and non-school days[30]. In the current study, we have also used self-assessment and differentiated between school days and non-school days.

RELATIONSHIP BETWEEN SCHOOL BURNOUT AND DIGITAL ADDICTION

Student burnout in school is linked to a number of different components, such as loss of interest in school activities, overwhelming learning demands, feelings of incompetence and pressure from teachers or parents to perform, and overload from homework[4]. School burnout has been found to be related to problematic use of social media[61] and with online addiction[57]. Internet addiction can be one of the negative consequences of school burnout, as it reduces commitment to studying for

exams, doing homework and actively participating in school lessons[57].

Salmela-Aro et al. (2017) have found that school burnout is reciprocally related to excessive internet use, i.e. when a student feels burnout or exhaustion at school, excessive internet use increases and engagement in school decreases. Also vice versa - spending too much time online increases the three components of student burnout, i.e. feelings of incompetence, exhaustion and cynical attitudes towards school[50]. In addition, Seema and colleagues (2022) have found relations with digital addiction and school burnout and perceived learning difficulties of Estonian teenagers.

ASSOCIATIONS OF SLEEP QUALITY WITH DIGITAL ADDICTION

The construct of sleep quality has a common core, yet the perceived good and poor sleep quality have distinct characteristics that have been measured with different scales. The most important sleep quality components for research and practice seem to be feeling refreshed (or not) in the morning and the continuity of sleep throughout the night[36].

Excessive use of digital devices over long periods is associated with excessive feelings of fatigue, increasing the risk of anxiety, sleep disturbance and symptoms of depression[7,34,48]. A link has been found between social media use, sleep disturbance and inadequate sleep[33]. Sleep deprivation leads to problems with memory and performance, and in adolescents in particular, disrupted sleep can lead to poorer performance at school[38]. Young (1996), a researcher of internet addiction, has also pointed out that excessive use of various internet applications and computer gaming addiction, leads to sleep deprivation, as people stay up later and feel tired in the morning. Similarly, the quality of sleep of young people is affected by the use of mobile phones and devices in the bedroom before bedtime with Internet use and turning-off time[8]. A recent DigiGen study reported that students are aware of negative consequences and experience physical problems such as fatigue, eye and headaches from excessive device use[19].

GENDER DIFFERENCES IN DIGITAL DEVICE USAGE PATTERNS

Boys' and girls' interests and reasons for using the equipment are different[51]. Girls are more likely to use digital devices for social media, socialising, listening to music and sending messages, i.e. mainly for socialising[11]. For example, levels of smartphone absence anxiety or nomophobia are higher in girls[51]. Boys prefer to play games using different apps, mainly using computers and tablets, and thus have higher levels of computer game addiction than girls[12]. Compared to girls, they also rate internet use higher[57]. However, there are also opposite results, with girls having higher addiction rates compared to boys, using devices for 3-6 hours per day, mainly for social media[48]. The same result was found in a digital survey of Estonian teenagers, with girls showing more digital addiction symptoms than boys[52]. A recent Portuguese study found that girls have statistically higher scores of internet addiction symptoms than boys[44].

OBJECTIVE AND RESEARCH QUESTIONS

The goal of this study is to map Estonian primary school students' ratings of symptoms of digital addiction and to identify any class and gender differences. It also aims to find correlations between the following constructs: digital addiction, screen time, school burnout and assessment of feeling refreshed in the morning.

Research question 1: What are the average primary school pupils' perceptions of their use of digital devices in 2022?

Hypothesis 1 (H1): The mean score of digital addiction among Estonian primary school pupils in 2022 is similar to or higher than the score found in the previous Estonian study at the beginning of the COVID-19 crisis[52].

Research question 2: What are primary school pupils' perceptions of their use of digital devices by grade?

Hypothesis 2 (H2): Students in grades 6-9 will have different ratings of their digital media use[11], with each higher-grade level showing an increase in ratings of addiction symptoms[28].

Research question 3: What are primary school pupils' perceptions of their use of digital devices by gender?

Hypothesis 3 (H3): Students' ratings of digital device use will differ based on gender[39], with girls showing higher ratings of digital addiction symptoms compared to boys[44,48].

Research question 4: What are the associations between school burnout and feeling refreshed in the morning with their perceived digital addiction symptoms and screen time?

Hypothesis 4 (H4): Higher ratings of digital addiction symptoms and increased screen time is associated with higher school burnout[50], and is linked to feeling less refreshed in the morning[7,34,48].

Methods

SAMPLE

The initial sample of the survey included 5493 pupils from Estonian primary schools who participated in the 2022 Student Survey conducted by the Centre for Educational Innovation (CIE) of Tallinn University. A total of 46 schools from all over Estonia participated. Based on the survey questions and the purpose of the study, young people with non-responses and non-logical answers were eliminated from the sample, which totalled 301 pupils. The final sample consisted of 5192 students, of 2365 boys (45.6%) and 2526 girls (48.6%) and 301 students (5.8%) responded „other/do not want to disclose" to the gender question. Of these, 1256 pupils (24.2%) were in year 6, 1536 (29.6%) in year 7, 1310 (25.2%) in year 8 and 1090 (21.0%) in year 9. The mean age of the students was 13.8 years (*SD* = 1.19).

DATA COLLECTION

The study uses data from the Student Survey 2022 conducted by the Centre for Educational Innovation (CIE) of Tallinn University. The data collection took place between 17 January and 28 February 2022. All Estonian schools were invited to participate in the survey, and the participation was voluntary, but paid for by the school. Invitations and information on participation were sent to schools that had previously participated in the school survey or had cooperated with Education Innovation, and information on how to register was also made available on the CIE website. A link to a questionnaire was sent to each school, which took on average 30 minutes to complete. The questionnaire for the student survey consisted of 12 different thematic blocks, of which only one part has been used in this work: digital use and addiction and related topics. The questionnaire consisted of both open and closed questions. The survey was conducted using the Qualtrics survey environment. The students' responses were anonymous and the data are confidential. The current study is linked with a master thesis[60].

MEASURING INSTRUMENTS

Digital Addiction Scale for Teenagers (DAST)[52] was used to assess the symptoms of digital addiction. This self-report scale has two names and can be used in two ways: as the DAST (Digital Addiction Scale for Teenagers) questionnaire to screen for symptoms of digital addiction and as the UDDS (Using Digital Devices Scale) questionnaire to distinguish between healthy and addictive digital device use and to use the questionnaire for reflection with students. The questionnaire used in this work describes a person's behaviour and self-perception in relation to the use of digital devices. The scale consists of ten statements, of which six statements assess emotional dependency (e.g. "I feel anxious when I don't know what my friends are saying on social media.") and four statements assess continuous or behavioural use habits (e.g. "I use my digital device to play games or chat in the evening before I go to bed."). The scale is used in this work as a single construct, i.e. all 10 statements together (Cronbach's in this sample α = 0.86). The statements were scored using the Likert 7-point frequency scale, where 1 = never, 2 = rarely, 3 = somewhat rarely, 4 = so-so, 5 = somewhat often, 6 = often, 7 = very often. Summary score of ten items or the total score up to 23 points are considered as a healthy using pattern while a summary score above 48 points shows digital addiction[52].

School Burnout Inventory is an adapted and shortened Estonian version of the School Burnout Inventory[49]. In the current study we used five items on a 7-point Likert scale (ranging from completely disagree to completely agree). Sample: 'I feel a lack of motivation for my schoolwork and often think of giving up'. Cronbach's alpha was α = .85.

To assess the sleep quality indicator "refreshed from sleep in the morning", the following single question was asked: *"Now think about the last two months. How often have you felt well rested in the morning after getting up?"*. The scale response options were as follows: 1 = Always or almost always; 2 = 5 to 6 times a week; 3 = 3 to 4 times a week; 4 = 1 to 2 times a week; 5 = Very rarely or never. The scale was in reverse to other scales, since smaller numbers indicated higher frequency. Therefore, the answers were reversed.

Two single questions were used to map time use of digital tools[52]. "How many hours do you usually spend using digital devices on a school day (before and after school); How many hours do you usually spend using digital devices during a non-school day (weekend, school holidays)? These were the open-ended questions and the student had to write the answer in figures. There were students who gave some unrealistic answers like 24/7. We considered logical up to 17 h of screen time during school days and 20h during non-school days and we removed the outliers.

DATA ANALYSIS

Data were analysed using the statistical software IBM SPSS Statistics. Descriptive statistics were used to answer the first and second research question and analysis of variance (ANOVA) was used to compare differences between grade levels and genders of students.

To answer the fourth research question, correlational analysis was used to analyse relationships between variables of digital addiction, screen time, school burnout and feeling refreshed in the morning.

Results

STUDENTS' RATINGS OF DIGITAL ADDICTION SYMPTOM STATEMENTS

Primary school students' ratings of statements describing symptoms of digital addiction (see Table 1). Students rated the use of their digital devices to play games at night before going to bed as highest (M = 4.57, SD =1.95). Students also reported using their device for longer than they had originally planned (M = 4.45, SD = 1.63). The lowest rated use of digital devices was during school hours (M = 2.83, SD = 1.68). The arithmetic mean of the digital addiction symptom summary score (M = 35.02 SD = 11.28), revealed that the average students were estimated to experience digital addiction symptoms a little more than the average result on the scale, since the scale minimum was 10 points and maximum 70 points. In the current study 13% of student's (N=676) DAST scores were 48 points or higher, showing digital addiction, while only 15.7 % (N=814) were 23 points or less, and form the healthy range. The cut points are fixed in the original DAST development study[52].

Table 1. Descriptive statistics for student ratings of digital addiction symptoms.

Items	Mean	Std. Deviation
1. I feel bored if I cannot use my digital device	4.34	1.47
2. I feel uneasy when I do not know what my friends are saying on social media	2.93	1.65
3. I am grumpy if I cannot use digital devices	3.09	1.56
4. I end up spending more time using my digital device than initially planned	4.45	1.64
5. As soon as I put my device away, I feel the urge to use it again	3.38	1.61
6. I keep an eye on the digital device even when I talk to someone	3.12	1.70
7. I use a digital device while eating	3.36	1.84
8. I keep an eye on my digital device during lessons	2.83	1.68
9. I play or chat on my device while walking on the street	2.95	1.66
10. I play or chat on my device when in bed before falling asleep	4.57	1.95
Digital addiction summary score Mean	35.02	11.28

Note. N = 5192. The questionnaire was introduced as follows: „Below you will find statements describing the use of digital devices and the ways it makes the user feel. How often do these situations apply to you?" The seven points scale was: *Never-1, rarely-2, somewhat rarely-3, so-so-4, often-5, somewhat often-6, very often-7.*

STUDENTS' RATINGS OF DIGITAL ADDICTION SYMPTOM STATEMENTS BY GRADE AND GENDER

The highest digital addiction symptom ratings (Figure 1) were in grade 8 (*M* = 36.32, *SD* = 11.31) and grade nine (*M* = 36.3, *SD* = 10.57), and the lowest digital addiction symptom ratings were in grade 6 (*M* = 33.01, *SD* = 11.4). We carried out an univariate analysis of variance. Differences between grades in digital addiction symptom ratings were statistically significant, *F (3, 5188)* =24.395, $p < .001$. Levine's test showed that error variance of dependent variables was not equal across groups, and the Games-Howell post hoc test multiple comparisons showed that ratings at 6th and 7th grades were statistically significantly different from other grades ($p < .001$). There was no statistically significant difference between 8th and 9th grades ($p < 1.00$) (Figure 1).

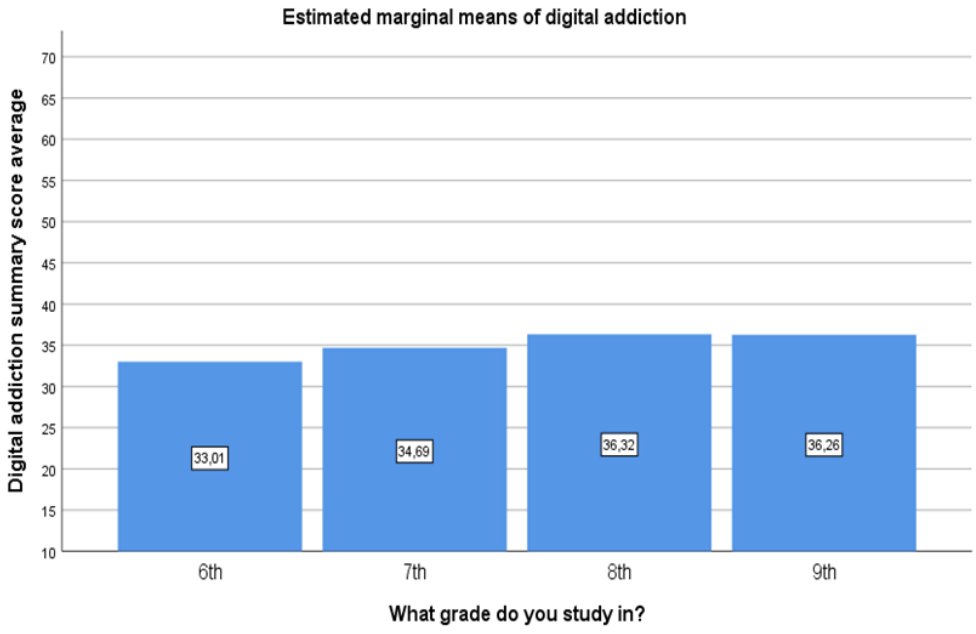

Figure 1. Digital addiction summary score average by grade.

One-Way Anova analysis for a comparison between gender groups (Figure 2) showed that girls ratings of digital addiction (*M* = 37.05, *SD* = 11.84) were statistically significantly higher than boy's ratings (*M* = 32.68, *SD* = 10.13) and higher than the third group who chose „Other/do not want to answer "(M=36.43, SD=11.42), F (2, 5188) = 97.55, p < .001.

Levine's Test indicated that the two groups had not equal variances (p < .001); therefore, the Games-Howell nonparametric test was suitable as a post-hoc test.

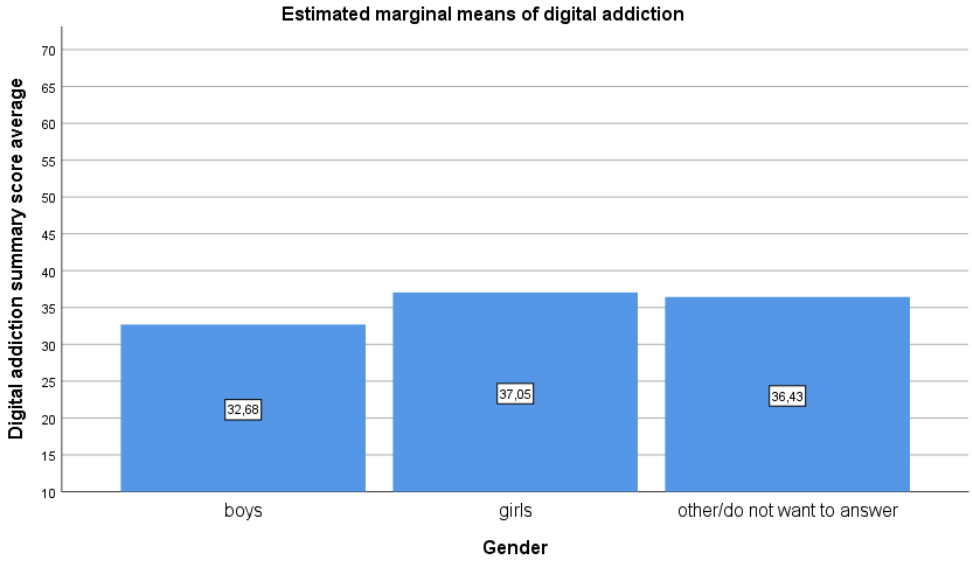

Figure 2. Digital addiction arithmetic mean score by gender.

RELATIONS BETWEEN DIGITAL ADDICTION, SCHOOL BURNOUT, SCREEN TIME AND FEELING RESTED

Students' digital addiction summary scores were moderately positively related to school burnout, screen time during school days, and weekends and weakly negatively related to feeling refreshed in the morning. All correlations were statistically significant. Table 2 presents the correlations between the DAST scores and other measures.

Table 2. Correlations between (DAST) digital addiction symptoms and other characteristics

	Digital addiction	School burnout	Screen time on school days	Screen time on weekends	Feeling refreshed in the morning
Digital addiction	1				
School burnout	.45**	1			
Screen time on school days	.41**	.25**	1		
Screen time on weekends	.40**	.25**	.71**	1	
Feeling refreshed in the morning	-.24**	-.37**	-.18**	-.18**	1

Note: ** Correlation is significant, p < .001.

Discussion

The aim of this study was to examine Estonian primary school students' ratings of digital addiction symptoms and to identify differences between classes and genders. It also aimed to find out the correlations between students' perceived symptoms of digital addiction, screen time, school burnout and perceived feeling of being rested in the morning. The current study is a screening that does not diagnose an individual, but generalises the frequency of occurrence of the phenomenon in one population - Estonian primary school students. Digital addiction at an individual level cannot be defined solely based on digital addiction scale ratings or time of use, but in combination with perceived low satisfaction with life or coping at school, or with the well-being scale[52].

The current study revealed that students constitute a heterogeneous group with significant variation in perceived symptoms of digital addiction as measured by the DAST. On average, Estonian students report experiencing digital addiction symptoms slightly more than the average extent indicated by the scale. Our study confirmed our hypotheses (H1) that the arithmetical mean score of digital addiction is similar or even higher than the result gained with the previous Estonian study at the beginning of Covid crises [52]. The students' mean score at the beginning of 2022 was only a bit higher (M = 35.02, SD = 11.28) than the mean score reflected by the study two years earlier (M = 34.8, SD =11.0) (52).

In the current study, 13% of students' DAST scores showed high symptoms of digital addiction and unhealthy use of digital devices while only a relatively small group of students (15.7%) showed a few symptoms of digital addiction, thus having a healthy pattern of using digital devices. The survey found that students are most likely to use their devices during out-of-school hours, with high ratings for using digital devices to play games or socialise with friends before going to bed. It was also found that digital devices are being used for longer than originally planned.

The results showed that students' ratings of digital addiction symptom statements increase with each grade level, until the 8th grade, partly confirming the hypothesis (H2). The highest digital addiction symptom ratings were found in 8th and 9th grade. Previous studies have shown that excessive use of digital devices and related behavioural addictions increases as students get older. Internet addiction[28,37,54] and gaming addiction[11] prevalence is highest among 15 – 16 years old. This may be due to the fact that the symptoms of digital addiction increase over the years, as the symptoms develop over a longer period of time [1], but it may also be caused by older children's better ability to assess and recognise the symptoms of digital addiction due to their better metacognitive ability to accurately monitor own behaviour[63]. By learning that the problem is becoming more severe in the final years of primary school, it is important that teachers are able to recognise the existence of the problem early and identify at-risk pupils in order to support them with preventive measures. In order to fulfil the fundamental process of educational institutions, i.e. to support the development and learning of the learner to the maximum, school leaders have an important role to play in ensuring that support systems are in place and implemented. In this context, it is also important to educate support specialists, teachers and parents on this issue at national level[14,60].

In addition, it was found that there were differences of digital addiction scores between genders. Girls' ratings of digital addiction symptoms were higher than boys' symptoms, which confirmed the hypothesis (H3) of this study, which suggested that gender differences exist[39]. Some previous studies have shown that girls have higher Internet addiction scores[1,44,48], is also in line with the results of a previous Estonian study that found higher prevalence of digital addiction symptoms in teenage girls[52]. An interesting finding in our study was the fact that the third gender group had also significantly higher scores of digital addiction than boys. Therefore, it is important to further study digital addiction in the third gender group.

The last research question aimed to find out which factors are related to digital addiction symptoms. Screen time, school burnout, and feeling refreshed in the morning were found to be associated with the presence of symptoms of digital addiction, which confirmed hypothesis (H4). Similarly, Seema and colleagues (2022) found that the presence of symptoms of digital addiction was associated with poorer engagement in learning, higher levels of burnout due to learning, and the presence of learning disabilities[52,53]. One of the reasons may be the habitual use of frequent digital devices, which diverts attention away from learning [13]. At the same time, excessive academic challenges can cause students to become stressed, in turn leading them to spend more time online to increase their well-being[9]. Adolescents who experience more stress and poor mental health may use screens to cope with stressors and negative feelings. Better coping behaviours and social support are associated with lower total screen usage[43].

In our current study, we measured only one important and positive sleep quality characteristic - feeling refreshed in the morning[36] and by our knowledge, no other studies have assessed the same sleep quality criteria in relation to students' digital addiction. However, a previous study has found connections between young adults' electronic media use in bed before going to sleep, insomnia symptoms and daytime sleepiness[20]. Honmore (2023) showed that adolescents with high social media addiction suffer from poor sleep quality. Dresp-Langley and Hutt (2022) even provided a conceptual basis for understanding digital addiction as one of the major reasons why adolescents sleep less and less well in the digital age.

Conclusion

In light of the results, it is worth highlighting the suggestion to teachers that young people should be guided to use digital tools purposefully and to monitor the time spent on purposeful activities. Teachers can use the digital addiction scale used in this work, in their humanities or computer science classes to shape the development of digital competences through self-assessment of students[60]. Knowing that the symptoms of digital addiction are associated with self-regulation problems because of habit formation and in part due to self-control problems[2], it is important to propose that teachers could teach self-regulation skills to young people and increase students' self-awareness and procedural knowledge for preserving their health in a digitally rich environment[52].

However, knowing that digital technology plays a major role in today's society and that devices are an important part of young people's lives, agreements need to be put in place in schools to ensure effective learning. One suggestion is to consider the creation of smart-free school breaks, as implementing 45-minute school classes leave little time to ensure deep learning, as time spent on social media platforms during a break can take a sufficient amount of time before a student can switch to learning activities[60]. When creating a technology-free shift, it is important to provide students with substitute activities that allow them to develop creativity, playfulness and be active, so that students' desire to spend time on digital devices is reduced[42]. In addition, students could be given the opportunity to have, for example, an outdoor lesson. This would require finding the necessary resources at school level and ensuring that the necessary arrangements are in place[60].

Developing proper digital addiction literacy through educational initiatives is critical to preventing and detecting digital addiction. A proactive approach could help individuals understand and manage their digital device usage before it escalates to a level requiring intervention[17]. In a digitally rich environment, it is important to draw young people's attention to the need to monitor the purpose of their use of digital tools and the time resources available to them, so that time spent on digital tools does not come at the expense of other important activities and interest in other activities is not lost.

In conclusion, it is important for education leaders to be aware of the issue, by shaping the school

culture and involving the network. It is important to raise the awareness of adults around teenagers, especially teachers and parents, of the dangers of excessive use and to provide the knowledge necessary for prevention in order to create the best possible environment for development and learning. A further suggestion for policy makers is to develop possible prevention measures or programmes[60]. A literature review by Ding and Li, (2023) have suggested at least five different types of digital addiction prevention interventions, which could be implemented and studied with teenagers. Those are cognitive-behavioural therapies (CBT) and CBT-based intervention, family therapy, digital-based intervention, and other interventions.

Limitations and future research directions

In the light of the results of this work, it is important to bear in mind the following limitations. Firstly, the student survey 2022 was carried out during the corona period, when many children were in distance learning, so the result on the time spent by students using digital devices may be higher due to this. Secondly, there is the potential subjectivity of the results, as they are students' estimates of their own use habits and time, which may affect the reliability of the results. However, the students did not know that the questionnaire was a questionnaire of measuring their digital addiction symptoms, but mapping of usage behaviour, as the DAST scale has two names and purposes, and therefore the responses can be considered more reliable. Adolescents frequently engage in multitasking on screens, making it challenging to assess total screen time, which may lead to either underestimation or overestimation[47].

Another limitation is that the extensive questionnaire of the Student Survey is time-consuming to fill in and many children may not have responded with full seriousness, so many responses had to be deleted due to their unreliability. A previous study also found that students with learning difficulties may find answering a long questionnaire difficult, therefore there may be students with learning difficulties whose answers were left out of analysis. Students with learning difficulties may need some extra attention and help with filling in any long questionnaire[53].

This study used a cross-sectional survey approach; future investigations could enhance understanding by employing a longitudinal research perspective. Future research could also focus on primary and secondary school pupils, using qualitative research methods and research designs that could explain cause and effect. Future studies could assess more students' sleep quality indicators in relation to digital addiction, screen time and school burnout. In addition, different school and classroom practices and interventions could be explored in terms of how agreements on the use of pupils' personal digital devices have been made, both during lessons and in class, and how this has changed pupils' behaviour and attitudes.

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The authors declare no conflicts of interest.

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Conceptualization, R.S., J.V., P.O, methodology R.S and P.O, resources and data collection P.O, analysis R.S., J.V., P.O, writing R.S., J.V., reviewing and editing P.O. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement:

The study was conducted according to the guidelines of the Tallinn University Code of Conduct for Research Integrity. We used data from the Student Survey 2022 conducted by the University Center for Innovation in Education (CIE) of Tallinn University. The study did not apply for any research ethics' committee approval. All Estonian schools were invited to participate in the survey, and participation of schools was voluntary, but paid by the school. Registration information was available on the HIK website https://www.tlu.ee/kooliuuring.

Data Availability Statement:

The data is unavailable because of privacy restrictions and because this is an ongoing project.

Informed Consent Statement:

The students' participation in the study was voluntary, the answers remained anonymous and the data are confidential. An oral consent process was used, where researcher and participant have a conversation to give information and obtain consent. There was no paper form to sign. The survey environment Qualtrics was used to conduct the survey. The study was a screening, not diagnosing, at primary schools over the Estonia, and the study was anonymous. The schools get no feedback about any students' private results.

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