Children's Screen Time, Preoccupation with Technology, Social Media Use, and Playing Video Games as Possible Predictors of GPA – a Longitudinal Study

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Abstract. *Prior research has frequently linked digital technology use to academic outcomes, often highlighting small but negative associations between screen time and students' grade point averages (GPA). The goal of this study is to examine the unique contribution of screen time, preoccupation with technology, playing video games, and social media use in predicting changes in students' GPA among elementary school children. A total of 970 mother-child dyads from Croatia completed questionnaires in 2021 and 2023 as part of the CHILD-WELL project funded by the Croatian Science Foundation. At baseline, children were on average 11.04 years old (SD = 1.15), and 53.2% were female. A hierarchical regression analysis revealed that screen time was a small, negative, while preoccupation with digital technology was a small, positive predictor of changes in GPA measured two years later. Age was negatively associated with GPA and female students had slightly higher GPA. Overall, predictors explained a very low amount of variance above the control variables, and no convincing evidence was found that various digital technology use measures were related to academic performance.*

Keywords. screen time, social media, video games, GPA, academic achievement

1 Introduction

Digital technology, particularly smartphones and social media platforms, has become an integral part of students' daily lives. As digital engagement has increased, so too has scholarly interest in its potential impact on academic outcomes. A growing body of research suggests that digital technology, especially social media and screen time is often negatively associated with academic performance, as measured by grade point average (GPA) and other achievement indicators. For instance, a recent study conducted with early adolescents in North America found that the frequency of social media use, including platforms such as Facebook, Twitter, and Instagram, was associated with lower academic achievement (Gordon & Ohannessian, 2024). Similarly, a meta-analysis by Huang (2018) identified a small but statistically significant negative correlation between social media use and academic achievement. Interestingly, this analysis also noted that Facebook use alone showed no significant relationship with academic outcomes. Liu et al. (2017) reached similar conclusions, reporting a negative association between social media use and GPA, with stronger effects observed among female and college-aged students. Beyond social media, screen time has also been related to academic outcomes. For example, studies have shown negative associations between GPA and smartphone screen time (Sapci et al., 2021), general screen exposure (Cerniglia et al., 2021), and video game use (Weaver et al., 2013). In a longitudinal study by Cerniglia et al. (2021), screen time at age four was positively linked with emotional dysregulation and negatively associated with mathematics and literacy achievement by age eight, underscoring potential long-term effects. Paulich et al. (2021) also reported a moderate-size negative effect of increased screen time on academic performance of 9- and 10-year-old children. However, not all findings point in the same direction. Kućar et al. (2023) reported that while Instagram screen time negatively predicted GPA, the frequency of Facebook checking was a positive predictor, suggesting that platform-specific usage patterns may matter.

Similarly, Ventura et al. (2012) found no overall GPA differences based on general video game use. However, they did observe that students who engaged

in moderate levels (11–50 hours per week) of playing their favorite video game performed better academically than low-usage peers, emphasizing the importance of qualitative factors such as gameplay motivation and engagement.

Some authors argue that other measures and concepts, beyond the time spent on a specific app, frequency of checking a device, or general screen time should be involved in digital technology research. In other words, questions such as 'how much' and 'how often' are not sufficient in this rapidly evolving research area. Some researchers began to ask 'why', 'in what way', or 'for what purpose'. For example, Marty-Dugas et al. (2018) focused on absent-minded smartphone use, Bischof-Kastner et al. (2014) on various motivations for using digital technology (e.g., emotional coping vs. for fun/leisure), while Yildirim and Correia (2015) explored nomophobia - the fear of being out of mobile phone contact. Some authors examined a contemporary phenomenon of distracted users of smartphones in public spaces. The term 'smartphone zombie' was coined and gained recognition and attention, one of the reasons being the fact that it can be dangerous to engage in such behavior in traffic and crowded places (Pressey et al., 2024). Although such constructs can be very useful in research on adult population, they cannot be directly translated to a younger population, such as elementary school-aged children. While much research has focused on pathological digital media use, many children engage with digital technology in ways that reflect strong attachment rather than addiction. This non-pathological preoccupation, driven by interest and positive emotions toward devices and applications, may still influence their behavior and well-being. However, the relationship between such engagement and well-being remains underexplored, particularly in children, despite its potential significance through various pathways. Kotrla Topić et al. (2023) proposed a term preoccupation with digital technology, purposefully constructed for younger population in order to grasp their attachment to digital technology. Although the research between this construct and educational outcomes is still exploratory, authors state that a stronger preoccupation with digital technology may lead to less time for other activities, such as homework and studying. As originally defined by Kotrla Topić et al. (2023), preoccupation with digital technology reflects the cognitive and emotional importance that children attribute to digital technologies, rather than the amount of time spent or symptoms of problematic use. The construct is inherently non-pathological and was developed to capture the positive affect, personal relevance, and engagement children may experience in relation to digital tools. While the authors acknowledge that high preoccupation could reduce time for other activities (e.g., studying), they also emphasize that such digital involvement may reflect a normal and adaptive aspect of children's lives. This ambivalence is central to the construct, it may relate to well-being or academic outcomes through both constructive and disruptive pathways, depending on the broader context of use.

The concept of preoccupation with digital technology may be understood in light of emerging discussions around attachment towards digital objects. Preoccupation with digital technology can be understood as a form of emotional and cognitive attachment to digital tools, particularly relevant in contemporary childhood. This aligns with emerging extensions of attachment theory (Bowlby et al. 1992) into digital contexts, where children may form bonds with devices that offer predictability, responsiveness, and gratification (Koles & Nagy, 2021). From this perspective, digital objects can serve as emotional anchors or self-regulation aids, especially in a developmental stage where autonomy and exploration are prominent. Simultaneously, preoccupation with digital technology may reflect a child's familiarity and competence with digital environments, including their ability to navigate, manage, and utilize technology for both social and academic purposes. Research on digital literacy suggests that such skills are increasingly essential for academic performance and self-directed learning (Ng, 2012; Hatlevik et al., 2018). Thus, rather than signifying distraction or dysfunction, higher preoccupation may signal a child's adaptive engagement with digital tools that are increasingly embedded in educational contexts. As highlighted in recent work, this field is still developing, with few studies offering comprehensive frameworks to capture the psychological and behavioral complexities of users' relationships with digital media. Drawing from interdisciplinary perspectives, including psychology, sociology, and consumer behavior, research on digital attachment emphasizes the evolving and often deeply personal connection individuals form with digital objects. This aligns with the notion of preoccupation, which may reflect not just frequent use, but also emotional investment and cognitive engagement (Koles & Nagy, 2021).

Despite the extensive research linking digital technology use with academic outcomes, a notable gap persists: few studies have focused specifically on

children. Much of the current literature centers on adolescents, university students, or adults (e.g., Huang, 2018; Liu et al., 2017; Sapci et al., 2021), leaving open questions about how these findings generalize to younger populations. This underrepresentation limits our understanding of how early digital habits may influence academic trajectories over time.

1.1 Research goals

The goal of this study is to examine the unique contribution of screen time, preoccupation with digital technology, playing video games, and social media use in predicting changes in students' GPA measured two years later, above and beyond the control variables (GPA in previous time point, age, and gender).

2 Method

2.1 Participants

The sample consists of 970 mother-child dyads who completed the questionnaires in both research waves (2021 and 2023). The average age of children at baseline was M_{age}=11.04 (SD=1.15) and 53.2% of the sample was female. At the first time point, children attended third (N=246, 25.2%), fourth (N=264, 27%), fifth (N=250, 25.6%) and sixth (N=217, 22.2%) grade of elementary schools in two counties in Croatia (Osijek-Baranja and Varaždin county).

2.2 Instruments

2.2.1 Preoccupation with Digital Technology

Preoccupation with digital technology was assessed using the Preoccupation with Digital Technology Scale (Kotrla Topić et al., 2023). The scale consists of five items, each rated on a four-point Likert scale, where lower scores indicate lower preoccupation and higher scores indicate greater preoccupation with digital technology. The scale was designed as a brief measure to capture children's affective attachment to digital technology and the importance they attribute to it. Items are intended to reflect a single underlying construct representing the perceived significance of digital technology in the child's life, rather than differentiating between specific devices or activities. The total score is computed as the average of the five items, with higher scores reflecting higher levels of preoccupation. The items include: (1) "How important are devices (smartphone, laptop, tablet, and computer) to you in life?"; (2) "How bothered would you be if you were not allowed to use these devices?"; (3) "How happy does it make you to receive a new device, game, application, or game addition?"; (4) "Do you enjoy spending time with your smartphone, tablet, or computer?"; and (5) "Spending time with my smartphone, tablet, or computer is…" (rated from 1 = Very boring to 4 = Very interesting). Reliability analysis revealed good reliability (Cronbach α = .80).

2.2.2 Screen Time

Screen time was estimated by mothers, who reported the average number of hours their child spent using digital technology on weekdays and weekends separately (open-ended format). Mothers were asked: 'During a typical workday and during the weekend, how much time does your child spend on the following activity (please indicate the average number of hours per day) – using digital devices'. The two values were averaged to create a single screen time estimate. Responses indicating more than 12 hours of screen time per day were considered implausible and excluded from the analysis.

2.2.3 Social Media Use

Children self-reported their social media use by responding to a single item: "How often do you use social media like Facebook, Instagram, Snapchat, TikTok, etc.?" Responses were recorded on a four-point Likert scale (1 = Almost never, 2 = Rarely, 3 = A few times a week, 4 = Almost every day).

2.2.4 Playing Video Games

Children also self-reported the frequency of playing video games using a single item: "How often do you play video games on your laptop, tablet, smartphone, or computer?" Responses were provided on the same four-point Likert scale as above (1 = Almost never, 2 = Rarely, 3 = A few times a week, 4 = Almost every day).

2.2.5 Grade Point Average (GPA)

GPA was defined as the average of final grades across all subjects at the end of the last academic year. This information was obtained from school administrators or class teachers. Grades for each subject are between 1 (failed) to 5 (excellent) and the instruction was to provide a number with two decimal places (e.g., '4.45').

2.3 Procedure

The data used in this study are part of a broader research project called CHILD-WELL, focused on

child well-being in the family context, funded by the Croatian Science Foundation (project number HRZZ-IP-2019-04-6198). Prior to data collection, ethical approval was obtained from the institutional ethics committee and the Croatian Ministry of Science and Education. Written informed consent was obtained from parents of elementary school students across 15 participating schools. In addition, children provided their own consent before completing the questionnaires. The child questionnaire was administered in a group setting during regular class time and took approximately 45 minutes to complete. Mothers received their questionnaire via their children and were instructed to return the completed forms in sealed envelopes back to school. To ensure anonymity while enabling data matching, both children and parents generated a unique, anonymous code at the beginning of the questionnaire.

3 Results

Descriptive statistics (Table 1) show that the average GPA slightly decreased from time 1 (M = 4.78) to time 2 (M = 4.58). Participants reported moderate levels of preoccupation with digital technology, social media use and playing video games. The average reported screen time was 2.85, which in turn translates to 2 hours and 51 minutes. The sample had a mean age of 11.04 years, with a balanced gender distribution.

Table 1. Descriptive statistics

Variable	Min	Max	Mean	SD
GPA t1	2.78	5	4.79	0.35
GPA t2	2.67	5	4.59	0.49
PwDT t1	1	4	2.88	0.57
SM use t1	1	4	1.98	0.83
Screen time t1	0.3	12	2.85	1.51
VG t1	1	4	3.27	0.88
Age	8	14	11.02	1.14
Gender	1 male	2 female		

Note: GPA – grade point average, PwDT – preoccupation with digital technology, SM – social media, VG – video game

The correlation matrix (Table 1 in the Appendix) reveals that GPA at time 2 is strongly associated with GPA at time 1. Higher preoccupation with digital technology was positively correlated with greater social media use, screen time, and video game use, but negatively with gender (indicating higher in boys). GPA in t1 and t2 was negatively associated with screen time, social media use, and age, indicating that older students have lower GPA. GPA t1 showed a small, positive correlation with video games, but not in t2. In both time points, GPA showed a correlation with gender, indicating that female students have somewhat higher GPA.

Regression analysis was conducted in order to examine the unique contribution of each predictor to GPA at time 2, while controlling for the effects of other variables. Regression analysis predicting GPA at time 2 showed that prior GPA was the strongest predictor across all steps, explaining 61% of the variance. In the second step, age and gender were added. Age negatively predicted GPA, while gender had a positive effect, meaning that female students have somewhat higher GPA compared to male. In the final model (third step), preoccupation with digital technology positively predicted GPA, whereas screen time was a negative predictor of GPA. GPA t1, age, and gender remained significant predictors. Social media use and video game use did not significantly contribute to the model in the final step.

Table 2. Regression analysis

	Outcome: GPA t2		
	Step 1	Step 2	Step 3
Predictor	β	β	β
GPA t1	.78**	.76**	.75**
Age		-.08**	-.07**
Gender		.07**	.07**
PwDT t1			.08**
SM Use t1			-.04
Screen Time t1			-.07**
Video games t1			-.03
ΔF	1297.59	10.97	4.22
R^2	.61	.62	.63
ΔR^2		.01	.01

Note: GPA – grade point average, PwDT – preoccupation with digital technology, SM – social media

It is important to note that adding both control (age, gender) and digital technology variables only slightly increased the explained variance of the outcome. More precisely, after controlling for the outcome variable from a previous time point, control variables (age, gender) additionally explained only 1% of the variance, as well as adding four predictors related to digital technology use.

Due to the non-normal distribution of GPA scores, specifically, a large number of participants with a perfect GPA (approximately 50%), additional analyses were conducted using both logistic regression and rank-transformed regression. For the logistic

regression, GPA was dichotomized into "all excellent" vs. "not excellent," while in the rank-transformed regression, GPA scores were converted to ranks, allowing for a nonparametric estimation that reduces the impact of skewed distributions. These alternative models largely replicated the core findings from the original linear regression, though some differences emerged (Appendix, Table 2 and 3). For example, preoccupation with digital technology remained a small but significant positive predictor in the rank transformed model, but not in the logistic regression. Screen time remained a small, negative predictor in both alternative models, while using social media emerged as a small, negative predictor in both models. In all three models, predictors related to digital behavior explained a small amount of variance.

4 Discussion

The present study examined the predictive value of digital technology-related behaviors, specifically, screen time, preoccupation with digital technology, social media use, and video game use on changes in academic achievement (GPA) over a two-year period in a large sample of elementary school children. Importantly, the study addressed a gap in literature by focusing on a younger, understudied population, as most prior research has centered on adolescents and adults.

Consistent with some previous findings (Liu et al., 2017; Huang, 2018), screen time and social media use were negatively correlated with academic achievement. However, in the multivariate model, only screen time remained a significant negative predictor of GPA two years later, suggesting that overall exposure to screens may be more influential than specific digital activities such as social media use or gaming. Higher screen time can also mean less time for other activities such as sports or education, which can lead to negative changes in students' GPA. Faught et al. (2019) reported that adherence to guidelines on limiting excessive screen use is associated with higher academic achievement in a sample of Canadian preadolescents and adolescents. However, the literature on the effects of screen time on cognitive functioning and related outcomes remains limited and has faced growing criticism in recent years. Researchers have pointed out that the reported effect sizes in published studies are often very small, there is potential evidence of publication bias, and overall study quality in this field has been described as relatively low (Ophir et al., 2021; Orben et al., 2020; Wilmer et al., 2017). Therefore, screen time should perhaps be viewed as a rough proxy measure that captures a variety of underlying behaviors and lifestyle factors, rather than a direct causal influence on academic outcomes. Future research should aim to disentangle these complex relationships by using more nuanced and context-specific measures of digital technology use.

Interestingly, preoccupation with digital technology emerged as a small, but significant, positive predictor of later GPA, which is in line with Kotrla Topić et al. (2023), who stated that the preoccupation with digital technology scale was constructed as a counterbalance to constructs focusing solely on addiction or problematic use. Preoccupation with digital technology is not necessarily negative and may reflect a child's positive, meaningful engagement with digital environments. One possible explanation is that preoccupation reflects higher digital literacy. Children who are more engaged with technology may develop stronger skills in navigating digital tools, finding and evaluating information, and solving problems in online environments. These skills have become increasingly essential for completing schoolwork, especially as digital platforms become integrated into classroom and homework routines. Furthermore, preoccupation may reflect a form of attachment to digital objects, where digital devices provide both emotional gratification and a secure base for cognitive exploration. Drawing from attachment theory (Bowlby et al., 1992), if the attachment is not excessive or displacing real-world relationships, it can promote autonomy, self-regulation, and persistence. Children who feel emotionally connected to digital tools may also feel more competent and confident using them for academic tasks, particularly in environments where digital competence is essential. Finally, some aspects of the PwDT scale (e.g., enjoyment when receiving new digital devices) may indirectly capture socioeconomic conditions and which are known to be related to academic success. Children from more resourceful households are more likely to have regular access to such devices. These factors contribute both to higher PwDT scores and to more favorable academic conditions, suggesting that preoccupation with digital technology may, in part, reflect underlying digital capital and socioeconomic advantages. The absence of a significant effect of video game use on later GPA is in line with several mixed findings in the literature (Ventura et al., 2012; Weaver et al., 2013), indicating that the impact of gaming may be highly context-

dependent, influenced by content, duration, and the social or cognitive nature of the activity.

A major strength of this study lies in its longitudinal design and a large sample of mother-child dyads. The study used a multi-informant approach (parent- and child-reported data) and objective GPA records obtained from schools, increasing the reliability of the findings. The inclusion of both general and activity-specific digital technology indicators allowed for a nuanced understanding of how different digital behaviors uniquely relate to academic outcomes. Additionally, a strength of this research is its focus on children in middle childhood/early adolescence. It has been previously identified that studies are typically focused on adolescent/adult population or period of early childhood (Kućar & Šimleša, 2022).

Several limitations must be acknowledged. First, although the longitudinal design enables stronger causal inference than cross-sectional studies, the observational nature of the data precludes the conclusions about causality. Second, some measures relied on single-item self-reports (e.g. video games), which may reduce reliability and fail to capture the complexity of such behaviors. A limitation of this study is the fact that the GPA is strongly skewed towards higher values – around 50% of the children in this study had a GPA of 5.0, meaning they were graded with a maximum grade in all subjects. That is not an odd phenomenon in Croatia (Net.hr, 2024). This grade inflation trend, increasingly common in Croatian primary schools, raises concerns about the validity of GPA as a performance measure, as it may obscure meaningful differences in academic achievement. Moreover, higher-achieving students who are more likely to have supportive, well-functioning family environments are also disproportionately more likely to participate in research and remain engaged in longitudinal studies. This introduces a potential selection bias, whereby the sample may not fully represent the broader population of students, particularly those with lower academic performance or from less advantaged backgrounds. Future studies should include National or State exams as measures of academic achievement. Those types of tests are standardized and equal for all students in a certain country and are therefore more objective. Additionally, while the use of a multi-informant approach is generally a research strength, mothers' estimations of children's screen time are possibly underestimated due to social desirability. Moreover, mothers do not have full insight into all the contexts in which screen use occurs, such as time spent with peers, at school, or in other unsupervised settings. This partial visibility may affect the precision, accuracy and construct validity of the screen time variable and should be considered when interpreting the findings.

Lastly, the explained variance added by digital technology variables was small, highlighting the predominant role of prior academic achievement and suggesting that other contextual or individual factors likely play a more substantial role in academic development. Although two predictors reached statistical significance, effect sizes were small. Specifically, each additional hour of screen time per day at baseline was associated with a 0.07-point decrease in GPA one year later, and a one-point increase on the Preoccupation with digital technology (PwDT) scale predicted a 0.08-point increase in GPA. Age and gender also showed small effects, with older students and males tending to have slightly lower GPA scores. The low explained variance suggests that digital technology usage does not meaningfully account for differences in academic performance. Therefore, even though there is statistical significance, the practical implications about the relationship between digital technologies and GPA are limited.

Future research should investigate potential moderating or mediating mechanisms such as sleep quality, executive functioning, or parental monitoring—that may help explain the complex relationship between digital technology use and academic achievement. Exploring content-specific digital engagement (e.g., educational vs. entertainment use) and the quality of technology interactions would also provide more actionable insights. Ultimately, the findings underscore the importance of balanced digital media use and call for more targeted, developmentally appropriate guidelines for children's engagement with technology.

5 Conclusion

The findings of this study suggest that while certain aspects of digital technology use, such as overall screen time and preoccupation with digital technology, show small associations with academic performance (screen time – negative, preoccupation – positive), their practical impact on GPA appears minimal in elementary school children. Given the low amount of explained variance (1%) above control variables, digital technology use alone may not be a meaningful predictor of academic change during this developmental stage, highlighting the need to consider

broader contextual and individual factors in future research. Each additional hour of screen time at baseline was associated with a 0.07-point decrease in GPA one year later. The findings suggest that not all digital engagement is harmful, and in some cases, preoccupation with digital technology may support academic success. A one-point increase on the Preoccupation with digital technology (PwDT) scale predicted a 0.08-point increase in GPA. For parents and educators, this highlights the importance of monitoring the purpose and context of digital use. Encouraging students to use technology for goal-oriented tasks, information seeking, or organizational support may be more productive than imposing blanket limits. Still, the effect sizes are very modest, and digital behaviors alone should not be overemphasized as drivers of academic outcomes.

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Appendix

Table 1. Correlation matrix

	GPA t1	GPA t2	PwDT t1	SM use t1	ST t1	VG t1	Age	Gender
GPA t1	1							
GPA t2	.79**	1						
PwDT t1	-0.02	-0.004	1					
SM use t1	-.19**	-.18**	.31**	1				
ST t1	-.16**	-.19**	.23**	.16**	1			
VG t1	.07*	.02	.43**	.16**	.11**	1		
Age	-.23**	-.26**	.18**	.15**	.22**	-.01	1	
Gender	.14**	.18**	-.10**	.03	-.08*	-.19**	-.03	1

Note: GPA – grade point average, PwDT – preoccupation with digital technology, SM – social media, VG – video games, ST – screen time

Table 2. Regression analysis with rank-transformed GPA

	Outcome: GPA t2 - rank		
	Step 1	Step 2	Step 3
Predictor	β	β	β
GPA t1 - rank	.74**	.71**	.70**
Age		-.08**	-.08**
Gender		.08**	.08**
PwDT t1			.10**
SM Use t1			-.05*
Screen Time t1			-.06*
Video games t1			-.02
ΔF	1004.47	11.28	4.57
R2	.55	.56	.57
ΔR2		.01	.01

Note: GPA – grade point average, PwDT – preoccupation with digital technology, SM – social media

Table 3. Regression analysis with GPA as a dichotomous variable ("all excellent" vs. "not excellent")

Predictor	B	Sig.	Exp(B)
GPA t1 (dichotomous)	2.24	.00	9.37
Age	-0.18	.03	0.84
Gender	0.55	.00	1.73
PwDT t1	0.30	.09	1.35
SM Use t1	-0.27	.02	0.77
ST t1	-0.20	.00	0.82
VG t1	0.08	.45	1.08
Constant	0.64	.49	1.90
Model Chi-square (df)		240.99 (7), p < .001	
Nagelkerke R^2		.32	
Cox & Snell R^2		.23	
Hosmer-Lemeshow Test (p)		.19	
Overall Classification Accuracy		73.8%	

Note: GPA – grade point average, PwDT – preoccupation with digital technology, SM – social media, ST – screen time